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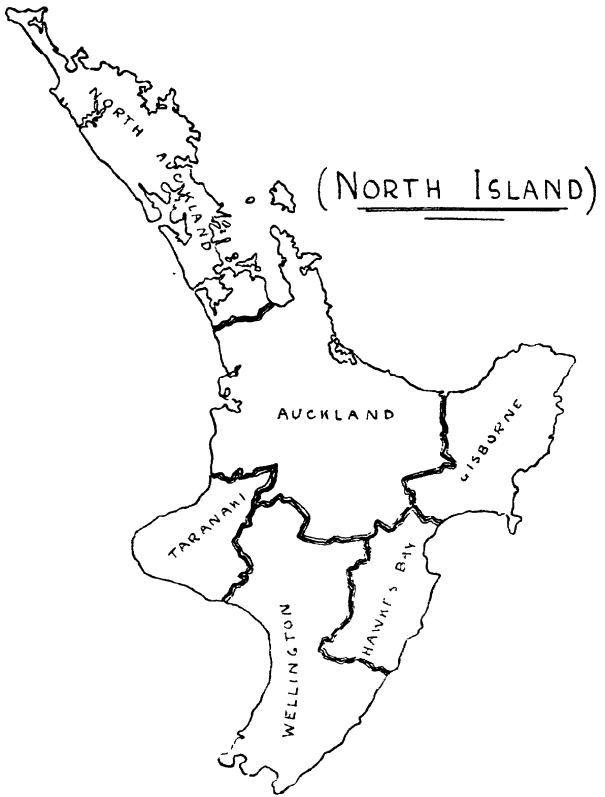
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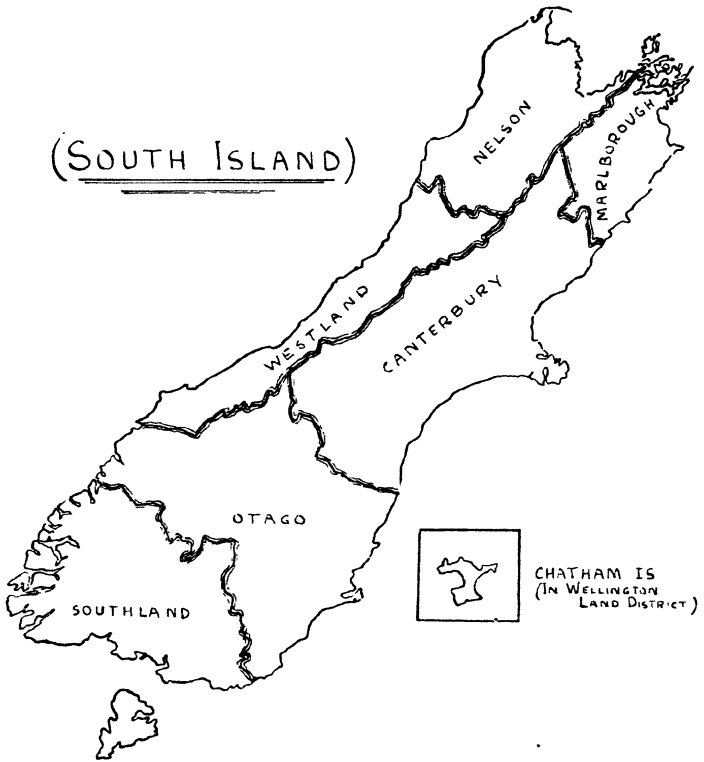
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AGRICULTURAL ORGANIZATION IN NEW ZEALAND

LAND DISTRICTS OF NEW ZEALAND



Map 1



Map 2

AGRICULTURAL ORGANIZATION *in* NEW ZEALAND

A SURVEY OF LAND UTILIZATION, FARM ORGANIZATION FINANCE AND MARKETING

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PREFACE

THIS book is one of a number of surveys into land utilization in various Pacific countries authorized by the Research Committee of the Institute of Pacific Relations. The present project was authorized by the Research Committee of the Institute at the Kyoto Conference held in October and November, 1929, the Auckland University College being made Trustee.

So far as I am aware, the book is unique for New Zealand in at least two respects. It represents the first comprehensive survey of Agricultural organization and land utilization in New Zealand; and it has brought together a larger number of specialists than have ever before co-operated in one investigation in this country. From this point of view alone, the investigation has been worth while. In addition, I believe it possesses some value, because it furnishes a comprehensive record of land utilization and agricultural organization in New Zealand, which will provide a useful book of reference and a starting point for many further enquiries into farming problems.

In planning the book, a broad view of the problem of land utilization has been adopted. The technique of land utilization is conditioned by a wide variety of factors such as land tenure, transport, markets, price movements, organizations, associations and institutions, as well as by conditions of soil, climate, topography and the stage of development of the agricultural arts. Because of their bearing on land utilization, the above and other problems, which may be grouped broadly under the general heading of organization, have been dealt with as adequately as possible.

For a variety of reasons it was found impossible to commence the investigation until the year 1931, when Mr. F. B. Stephens was appointed as Research Assistant. The circumstances under which the work has been undertaken have created many serious difficulties. Farming industries have felt the full force of the depression and have been subjected to rapid and profound changes. As the result of the depression, the many contributors to this work have been required to undertake additional duties and responsibilities which have hampered the progress of the investigation. It was hoped to publish the book early in 1934, but publication was delayed owing to my appointment to a Commission of Enquiry set up by the Government early in the year. Work on this Commission continued right up to the eve of my taking up official work which prevented me from continuing the direction of the project. It became necessary to hand over the work of final editing and preparation for publication to Mr. D. O. Williams, who has been closely connected with the investigation at every stage in its progress. As Director of the project, I would express my

appreciation of his willingness to see the book through its final stages and of his able advice, criticism and co-operation from the time when the investigation was first planned. I know of no one who is more suited by training and experience to undertake the final direction and editing of a publication of this kind.

As Director of the project, I would express my thanks to the many contributors to this volume who have given ungrudgingly of their time and knowledge. Especial thanks are due to Mr. E. J. Fawcett and Mr. H. R. Rodwell who assisted in the work of editing, Mr. D. O. Williams who acted as joint editor and took on the work of directing the project in October, 1934; to Mr. F. B. Stephens, Research Assistant, who gave valuable help in planning and carrying out the project; and to Mr. F. M. Price and Mr. A. Beasley, who assisted in the preparation of diagrams.

Amongst the large number who have assisted in various ways, special mention must be made of Professor G. S. Peren, Principal of Massey Agricultural College, and Professor W. Riddet, Director of the Dairy Research Institute, who, by way of advice, criticism and encouragement as well as by written contributions, have greatly assisted the progress of the work. I would also especially thank Dr. E. Marsden, Secretary, Department of Scientific and Industrial Research, who has always been ready with advice and assistance; Dr. C. J. Reakes, Director-General of Agriculture, who granted permission to his officers to co-operate and who placed the facilities of his Department at our disposal; Mr. G. H. Holford, Agricultural Advisory Officer to Imperial Chemical Industries of Australia and New Zealand, for his assistance in planning the project; and Dr. J. B. Condliffe, sometime Research Secretary to the Institute of Pacific Relations, and Mr. W. E. Holland, who succeeded him to that position, whose sympathetic help has smoothed over many difficulties.

Thanks are due also to the editors of the *International Labour Review* and the *Economic Record* for permission to publish articles which have appeared in those journals.

The finance necessary for the project has been generously provided by a grant from the Institute of Pacific Relations, which also made a grant for publication. Grants towards publication were also made by the Department of Scientific and Industrial Research, Auckland University College and Massey Agricultural College. Without this support, publication would have been impossible.

Responsibility for the views expressed rests with each author in respect of his contribution. Neither the New Zealand Council of the Institute, nor the Institute as a whole assumes responsibility for statements made.

AUCKLAND UNIVERSITY COLLEGE,
AUGUST, 1935.

H. BELSHAW.

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PART I

INTRODUCTORY

CHAPTER I

TRENDS OF DEVELOPMENT

BY H. BELSHAW

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I. GENERAL

A. EARLY SETTLEMENT

1. *The Wakefield Plan*

THE first organized attempt to colonize New Zealand occurred in 1826 when the first New Zealand Company was formed and sent an unsuccessful expedition to Hokianga. The Company was thereafter dissolved. Ten years later, Edward Gibbon Wakefield, disappointed with the results of his efforts to promote systematic colonization in South Australia, turned his eyes towards New Zealand and was the dominant force behind the New Zealand Association, established in 1837.[1] As the result of political opposition this Association was disestablished and gave place to the New Zealand Colonization Company. This was constituted in 1839 and in the same year despatched a body of emigrants to Port Nicholson (Wellington), where they landed in January, 1840. Later, the New Zealand Company or its offshoots established settlements at New Plymouth, Wanganui, Nelson, Canterbury and Otago.

The early settlements embodied, in greater or less degree, definite principles of colonization, but, as so often happens in human affairs, a well-rounded system dissolved before the logic of hard experiences.

It is scarcely necessary in this study to discuss the Wakefield experiments at any length, since such results as they achieved have been so overlain with subsequent events as to leave but few marks on the economic pattern of agriculture. They are, however, of sufficient intrinsic interest to warrant brief mention. The Wakefield theory of colonization embodied a few simple principles which were new in colonial policy:—The proper development of land required the application of adequate labour and capital. The practice of giving free grants of land defeated its object by discouraging capital, since labourers became landowners too readily and capitalists would be deterred from emigrating because of an insuffi-

1. Cf. Marais: *The Colonization of New Zealand*, Chs. I and II

ciency of labour. Labour and capital should be encouraged in right proportions by fixing a definite price for land, sufficiently high to prevent labourers from becoming landowners too readily, but not high enough to discourage settlement. The proceeds from the sale of land were to form an Emigration Fund which should be applied to encouraging the migration of carefully selected labourers.[2]

2. *Failure of the Wakefield Plan*

The Directors of the Company were men of ability and influence. Capitalists were not found wanting to invest in the enterprise, carefully considered principles of selection were strictly applied in the choice of emigrants, land was purchased, and pioneer settlements enthusiastically established, yet the scheme did not work according to plan. There were several causes of failure. The first difficulty was in the purchase of land. Within a few months Colonel Wakefield, the Company's agent, believed that he had acquired 20 million acres, but he had counted without the Native and the Queen's Commissioner sent out to adjudicate upon lands within the Company's district. He was soon harassed by a multitude of native claimants who, encouraged by the Commissioner's sympathetic attitude to their claims, demanded compensation. Depredations and massacre by the natives, and retaliation by the whites arose directly out of the disagreement which ensued. Cultivation was impeded and an exodus took place from some settlements.

These difficulties were not, however, the primary cause of failure. A large number of the investors in the Company were absentees. Consequently the labourers had few employers, so that they were both unemployed and landless. The Company was quite unable to fulfil its promise and find them work. The only solution was to settle them gradually on the land. Further, the Wakefield plan would only work in agriculture, producing for sale. Because of topographical and climatic conditions, difficulties of internal transport, and of the distance from large markets, the dominant farming industry rapidly became pastoral. Agriculture was mainly subsistence farming and '. . . remained the occupation of the small settler who, with his family, supplied most of the labour that his holding required.'[3]

When once the suitability of the country to pastoral pursuits had been clearly demonstrated, Australian run-holders quickly appropriated large tracts. Squatting, grid-ironing and other evils threatened to become serious; but the reduction in the price of land after 1853 and the regulation of settlement by the Provincial Legislatures set up in 1852, averted

2. Cf. Marais: *The Colonization of New Zealand*, pp. 4-5.
3. Marais, op. cit., p. 143.

the danger, though the large landed proprietor was still to remain.[4] Even in Canterbury where the principle of the sufficient price was most completely tried out, the same results eventually followed. Canterbury, like other provinces, 'resolutely determined to be pastoralist.'

In 1850 the New Zealand Company surrendered its Charter. In 1852 the Otago Association failed, and was followed by the Canterbury Association in 1853.

In the same year Grey reduced the price of land from £3 to 10/- or even 5/- per acre.[5]

B. The Rise of Pastoral Farming

New Zealand was now set on the path of evolution which she was to follow. The suitability of the country to pastoral farming was already demonstrated and sheep farming rapidly gained a pre-eminence which was not seriously challenged until the phenomenal growth of dairying during the present century.

The cheap land policy of Grey, though it permitted land aggregation which later necessitated corrective measures, made it possible for small men to acquire holdings. For some twenty years, the evils of land aggregation were not fully realized by Parliament, but thereafter the policy of successive governments was directed in the main to the encouragement of closer settlement and the discouragement of aggregation.[6] In 1853, the European population was just under 28,000. There were already 300,000 sheep and 35,000 head of cattle. Some 40,000 acres of land has been fenced, of which 15,000 acres was under crop, the rest being mainly under native grasses. In addition, a considerable area of unfenced land was grazed by sheep and cattle. Exports of wool were already valued at £67,000; grain £19,000; timber £93,000 and Kauri gum £16,000.[7]

C. Influence of Gold Discoveries

The discovery of gold in Australia in the early 'fifties gave a temporary impetus to the production of grain, exports of which reached a total of 150,000 bushels, valued at £82,000, in 1855.[8] Thereafter exports dropped considerably, but the connection between the Australian colonies was firmly established. Meanwhile internal communications were being steadily extended and improved, and by 1857 steam transport was established in the Pacific, connecting the New Zealand ports with each other and with Australia.[9]

4. Marais, op. cit., p. 154.
5. Cf. Scholefield: *New Zealand in Evolution*, p. 177.
6. Cf. Scholefield, op. cit., p. 177 *et seq.* It was Grey's intention to prevent aggregation by means of a land tax.
7. Cf. Fawcett: 'Land Utilization in New Zealand.' Paper read before the Wellington Group Institute of Pacific Relations, 1930.
8. Cf. Condliffe: *External Trade of New Zealand.* N.Z. Official Year Book, 1915, p. 901.
9. Marais, op. cit., p. 156.

Between 1857 and 1867, gold was discovered in Nelson, Otago, Westland and Auckland Provinces and gave a great impetus to settlement and land utilization. By 1861 the population had increased to 99,000; by 1871 to 256,000; and by 1881 to 490,000. The effects were two-fold. Naturally, increasing population and an increase in the media of circulation, led to high prices for foodstuffs and stimulated wheat production. The average annual area under wheat for the period 1860-1869 was 47,000 acres. In the following decade it had increased to 159,000 acres. Equally naturally, the decline in alluvial gold production after 1870 increased the supply of labour available for other industries, and much of this turned to agriculture. During the next decade, agriculture expanded more rapidly than pastoral farming, though the value of wheat exports never approached those of wool.

D. Effects of a Limited Market

Special difficulties facing the pastoral industries during the period reacted to the advantage of agriculture. In beef, mutton, butter and cheese there was a hopeless glut since the market was almost entirely local. The number of sheep had increased to nearly 13,000,000 by 1881 and there were just under 700,000 cattle. Wool, hides and tallow were the only marketable commodities, and the carcasses were almost valueless by-products. Thousands of old sheep were sold at a nominal price of sixpence per head and converted into manure. A difference of a penny per pound in the price of wool meant a fluctuation of a quarter of a million pounds to the sheep farmers, and for this there was no offset. Many of the holdings were too large and were heavily mortgaged.[10] Sheep farming, though profitable as long as prices kept up, was a highly speculative and risky form of enterprise.

The prospects for dairying were much worse. The export of butter and cheese was insignificant until the 'eighties and showed enormous fluctuations.[11]

'Before the days of refrigeration,' writes Scholefield, 'every farmer made butter on his own premises and according to his own ideas. In 1870, when the population was only a quarter of a million, the dairies on New Zealand farms were turning out five million pounds of butter and half as much cheese per year. Butter was of wretched quality compared with the standard of to-day: variable and liable to develop all

10. Cf. Scholefield, op. cit., Ch X

11. Exports were:

	Butter		Cheese	
Year	Cwts.	Value (£)	Cwts.	Value (£)
1853	1,039	7,507	808	4,092
1860	1,026	6,623	810	3,535
1870	3,435	12,995	2,735	9,327
1880	2,717	8,350	717	1,983

After Condliffe: *External Trade of New Zealand*, pp. 901-2.

manner of obnoxious flavours during the short voyage across the Tasman Sea. It was out of the question in those days to carry butter farther than Australia. As often as not, too, the Australians themselves produced all they required. Cheese, of course, could stand with advantage the journey of three months to England, and it achieved an early reputation on the market there.'[12] Even the cheese was variable in quality and deteriorated in transport. Difficulties of transport limited the market for butter to '. . . the not very discriminating neighbouring towns' and to outgoing vessels which required to replenish their larders.

E. Price Movements and Public Works

From the early 'fifties to the early 'seventies, world prices were rising, and this was a factor encouraging settlement through its influence on export values. Thereafter, until about 1895, world prices showed a falling trend. The dampening effects were for a time postponed owing to the heavy expenditure of loan money in opening up the country. In 1870, Sir Julius Vogel initiated a borrowing policy to subsidize immigration and carry out extensive public works—a young country with a population of 300,000 borrowed ten million pounds in ten years.[13] The result was reckless private speculation and a serious boom in land. When the boom collapsed, the long depression pressed on the country with especial severity and the evil effects of falling prices to a debtor community became only too apparent. As the depression proceeded the commercial banks were taught a cardinal lesson in banking policy—the necessity for avoiding undue commitments on the basis of non-liquid securities. Directly or indirectly, the banks had made considerable advances on the security of mortgages over land, which were depreciating and non-realizable assets. As a consequence the Bank of New Zealand was only saved from failure by an appeal to the Government for assistance.[14]

F. Refrigeration and Technical Improvements in Processing

In 1882 the first shipment of frozen meat and dairy produce to London marked the beginnings of a new era. The depressing effects of falling prices continued for more than a decade, but new and profitable prospects were revealed. Meat was converted from an almost useless by-product into a valuable joint product and the dairying industry expanded steadily and with great rapidity.

By 1885, forty-four freezing works had already been established, and an efficient system of handling freezing and steam transport was steadily

12. Op. cit., p. 143.
13. See Condliffe, op. cit., and *New Zealand in the Making*, p. 32 *et seq.*
14. Cf. Condliffe: *New Zealand in the Making*, pp. 319-327.

developed. A parallel development of factory methods took place in dairying. In 1881, while refrigeration was still in its experimental stage, the Government offered a prize of £500 for the first 50 tons of butter or cheese produced on the factory or co-operative system; but attempts to encourage the establishment of a factory system would have failed but for a fortunate coincidence of events. The successful experiment of 1882 opened up a prodigious market which could only be adequately exploited by a product of high and uniform quality. The impossibility of producing such a product on a large number of scattered farms emphasized the technical superiority of factory methods while the extension of the market warranted capital expenditure in well-equipped establishments. The application of the principle of centrifugal force to the separation of cream in 1879 by the invention of the cream separator ensured greater uniformity in the quality of cream than was possible under the old method of setting by specific gravity. The factory system, based on the co-operative efforts of farmers, has extended rapidly and improved steadily in technique and organization until, at the present time, it may claim to compare favourably with that of almost any other country. The combined effects of these conditions, operating in conjunction with favourable conditions of soil and climate, revolutionized land utilization and gave a new impetus to pastoral farming.

The summary Tables Ia and Ib serve to indicate the rapid development of New Zealand farming since 1881 and afford an interesting commentary on the trend of development towards pastoral farming.

During the period 1901-1929 the value of farm production increased from about £18 million to £82 million. Even allowing for increased prices in the meantime, this represents a phenomenal growth. During the same period the area of land under occupation increased from 35 million acres to about 43·5 million acres, the area under cultivation from under 13 million acres to over 19 million acres, and the number of holdings from about 63,000 to 85,600.

During the period 1881-1929 the increase in live stock has also been very great; total cattle have shown a five-fold increase (700,000 to over 3,400,000) and sheep and pigs have increased about two and a half times (sheep 12,000,000 to 29,000,000; pigs 200,000 to 557,000). The number of dairy cattle increased about four-fold from 1901 to 1929 (370,000 to 1,390,000). Moreover, there has been a marked improvement in the quality of live stock.

From 1881 to 1929 exports increased from £6 million to £55·6 million and an increasing proportion was represented by farm products.

The tables serve to emphasize the growing absolute and relative importance of dairying. At the beginning of the present century, 62 per cent.

TABLE IA

Showing Value of Farm Production, Area Cultivated, and Live Stock Population in the Years 1881, 1901, 1911, 1921, 1929 and 1931

Year	Value of Farm Production (00,000 omitted)				Area Cultivated (Acres) (00,000 omitted)		Grain (Acres) (0,000 omitted)		Livestock (0,000 omitted)			
	Total (£)	Agricultural (£)	Pastoral (£)	Dairying, Bees, and Poultry (£)	Grass	Other	Wheat for Threshing	Oats for Threshing	Total Cattle	Dairy Cows	Pigs	Sheep
1880–81 ..	—	—	—	—	—	—	32	22	76	—	20	1,219
1900–1 ..	179	41	110	28	111	15	21	45	126	37	25	2,023
1910–11 ..	306	40	202	64	142*	17*	32	30	202	63	35	2,400
1920–21 ..	622	90	300	262	161	23	35	17	314	100	35	2,329
1928–29 ..	821	94	423	304	169	22	25	7	345	209	56	2,905
1930–31 ..	571	88	246	237	173	17	25	9	408	252	48	2,979

*These figures are for 1910.

TABLE IB

Exports from New Zealand in the Years 1881, 1891, 1901, 1911, 1921, 1929 and 1931
(0,000 omitted)

Year	Wool		Frozen Meat		Tallow		Butter		Cheese		Grain	
	Quantity (lbs.)	Value (£)	Quantity (cwts.)	Value (£)	Quantity (cwts.)	Value (£)	Quantity (cwts.)	Value (£)	Quantity (cwts.)	Value (£)	Quantity (Bushels)	Value (£)
1881 ..	5,942	291	—	—	8	12	(2,426)	(8,496)	(3,056)	(6,112)*	582	99
1891 ..	10,619	413	100	119	18	17	4	15	4	9	588	68
1901 ..	14,682	370	186	225	34	35	20	88	10	24	1,337	129
1911 ..	16,942	649	225	350	41	61	30	158	44	119	176	33
1921 ..	15,871	522	432	1,116	55	87	90	1,117	137	820	—	—
1929 ..	23,496	1,536	334	988	42	69	165	1,323	178	702	—	—
1931 ..	21,172	552	474	890	47	41	199	1,065	164	446	—	—

*Figures in parentheses are actual figures.

of the total value of farm production was represented by pastoral farming (mainly sheep farming), 22 per cent. by agriculture and 16 per cent. by dairying, poultry and bees. In 1928-29, pastoral farming accounted for 51·5 per cent. of the total value of farm production, agriculture 11·5 per cent. and dairying 37 per cent. In 1901 dairying provided about 9 per cent. of the total value of exports, as against about 39 per cent in 1929. In both periods the bulk of the remaining exports consisted of pastoral products other than dairying, the percentage from pastoral exports tending to decline.

II. TRENDS FROM THE TERMINATION OF THE WORLD WAR TO THE BEGINNING OF THE WORLD CRISIS

A. The 'Aggregate Prosperity' of Farming Industries

1. *Export Prices and Costs*

During the war, farming conditions were complicated by the withdrawal of many farm producers for service overseas, and the commandeering of farm products at fixed prices. Export prices rose steadily and were some 45 per cent. higher in 1918 than in 1914. On the other hand, the index number of farm expenditure, which is a rough measure of farm costs, rose by 62 per cent. in the same period. The volume of farm production increased very little, if at all, and if the purchasing power of net farm profits is taken into account, the position of the farming community was no better at the end of the war than at the beginning.

Events since the war are capable of more detailed statistical treatment than those of any previous period, but statistics are still not sufficiently accurate to permit of more than general and tentative conclusions in regard to the prosperity of farming industries.

During the calendar year 1928, exports from New Zealand reached the record total of £56·2 millions. Of this amount, £52·2 millions, or 96 per cent., consisted of farm products. The average total value of farm production for the seasons 1927-28 and 1928-29 was £75·5 millions, so that approximately two-thirds of the total value of farm production was exported. Except in the case of wheat (the yield of which was valued at £2·7 millions in 1928-29), which is protected by a sliding scale tariff, and of minor products which do not enter into the export trade, the price of farm products moves in close sympathy with export prices, and these offer the best available index of farm prices. Fluctuations in export values and changes in the physical volume of production are the dominant factors influencing the gross value of farm production. The following table compares the index number of export prices (pastoral and dairy produce) with the index number of farm expenditure:—

TABLE II

Index Number of Export Prices (Pastoral and Dairy Produce) and of Farm Expenditure, together with Ratio Export Prices: Farm Expenditure (Base average, 1914 = 1000)

Year	Export Prices	Farm Expenditure	Export Prices / Farm Expenditure
1914	1000	1000	100
1915	1138	1187	96
1916	1340	1380	97
1917	1518	1574	96
1918	1545	1623	95
1919	1630	1671	98
1920	1657	1645	101
1921	1572	1523	103
1922	1251	1543	81
1923	1479	1593	93
1924	1649	1586	104
1925	1748	1582	110
1926	1407	1555	90
1927	1396	1574	89
1928	1553	1642	95
1929	1492	1636	92
1930	1168	1628	72
1931	881	1490	59
1932	795	1250	64
1933	792	1150	69

(Note: The main items included in the index number of farm expenditure are: Interest 33.3%; wages 25%; materials 26%. For a detailed discussion of the index, see N.Z. Official Year Book, 1932, pp. 686-687.)

During the years 1919-21, the post-war boom occasioned a marked rise in export prices. In 1922, prices fell sharply, but recovered rapidly so that prices for 1925 were higher than ever before in the history of New Zealand. In 1926 and 1927 export prices fell, and were 20 per cent. lower in 1927 than in 1925; in 1928 there was a substantial recovery, to be followed by a downward movement which rapidly gathered way until in 1933, despite assistance from a 10 per cent. depreciation in exchange on London, export prices were 21 per cent. lower than in 1914, and 49 per cent. lower than in 1928.

In estimating changes in the profitableness of farming, some account must be taken of changes in farm costs. The index number of farm expenditure is not an accurate index of farm costs, because it assumes a constant weighting of the different items of expenditure, and because it takes no account of the relationship between 'input' and 'output' as it is affected by changes in management, or changes in the number of units of 'input' per unit of area. Nevertheless, a truer perspective is obtained if the index numbers of farm expenditure and of export prices are considered together than if the latter is considered separately. This has been done by expressing the index number of export prices as a percentage of the index number of farm expenditure. The relationship between the

two was favourable to the farmer in 1920 and 1921, and again in 1924 and 1925 because in these years export prices rose relative to the index of expenditure. The relationship became less favourable in 1926, improved moderately in 1928, and rapidly became worse thereafter.

In order to obtain a more satisfactory measure of changes in the 'aggregate' prosperity of farming industries, it would be necessary to correct for changes in volume of output. The following table gives a three-year moving average of the physical volume of farm production.

TABLE III

Index Number of Physical Volume of Farm Production (Three-Year Moving Average)

(Base Average, 1919-20 to 1923-4 = 100)

Year	Index	Year	Index
1916–17	91	1923–24	103
1917–18	88	1924–25	102
1918–19	89	1925–26	105
1919–20	90	1926–27	116
1920–21	94	1927–28	123
1921–22	102	1928–29	130
1922–23	105	1929–30	132
		1930–31	134

It will be noted that the index shows a steady rise throughout the period, especially from round about the year 1925-26.

The assumption underlying the ratio Export Prices: Farm Expenditure is only completely valid if production obeys constant money returns; i.e., if the index number of prices and farm expenditure remaining the same, the net money return per unit of output is the same irrespective of the volume of output. In fact, however, there is a strong probability amounting to practical certainty that of recent years, increased production has been accompanied by increasing returns in the true sense; i.e., in terms of physical units of input and output; while at the same time, overhead in the form of mortgage interest has been spread over a larger number of units of output. Hence prior to the crisis increased production was most probably accompanied by increasing money returns.

The apparent decline in farming prosperity since 1925 as indicated by the ratio Export Prices: Farm Expenditure was wholly or partially offset by expanding production associated with increasing returns. It is doubtful if the position of farming industries was any less prosperous in 1929 than in 1925. Thereafter the position rapidly deteriorated as export prices fell.[15]

15. An attempt was made to express the change in aggregate prosperity by means of an index number, but there were so many statistical pitfalls that the index was abandoned.

B. Trends

1. *Total Production and Exports*

The increase in the total volume of farm production and the true volume of exports is shown in the following table:—

TABLE IV

Volume of Farm Production and Exports

Three-Year Moving Average of Index Numbers of Farm Production and True Volume of Exports, 1919-31

(Base Average, Farm Production, 1919-20 to 1923-24; Exports, 1919-23 = 100)

Year	Farm Production	Year	Exports (Moving Average)
1919–20	90	1919	—
1920–21	94	1920	92
1921–22	102	1921	95
1922–23	105	1922	102
1923–24	103	1923	106
1924–25	102	1924	102
1925–26	105	1925	102
1926–27	116	1926	104
1927–28	123	1927	108
1928–29	130	1928	113
1929–30	132	1929	117
1930–31	134	1930	120

The moving average of farm production shows an increase of 34 per cent. about the season 1930-31 over the average of the period 1919-20-1923-24, the corresponding increase for the true volume of exports being 20 per cent. This latter figure slightly understates the position, since the percentage of agricultural and pastoral to total exports rose from 92·7 per cent. to 94·5 per cent. The increases were due mainly to greater intensity of production, since the total area occupied remained practically stable during the period, while the total area under cultivation was less than 6 per cent. greater in 1930-31 than in 1919-20.

2. *Relative Increases in the Main Products*

During the period 1919-20 to 1929-30, the total occupied area was very stable, but the occupied unimproved land declined from 25,468,000 acres to 24,213,000 acres. During the same period the cultivated area increased from 18,005,000 acres to 19,156,000 acres. During the season 1929-30 to 1931-32, the occupied area declined from 43,369,000 acres to 42,729,000 acres—a reduction of 630,000 acres. Holdings of unimproved land declined by 334,000 acres and of cultivated land by 307,000 acres.

(a) *Number and Average Size of Holdings.*—The above changes have been associated with changes in the number of holdings and in the average area per holding occupied.

TABLE V

Number of Holdings and Average Area Per Holding, as at January 31, 1919 to 1933, Inclusive, Exclusive of Holdings in Boroughs

Year	Number of Holdings	Average Area Per Holding
1919	80,468	539
1920	81,592	533
1921	84,076	518
1922	84,899	513
1923	85,519	510
1924	86,139	506
1925	85,977	507
1926	85,734	509
1927	85,628	509
1928	85,716	507
1929	85,602	508
1930	85,167	509
1931	83,816	516
1932	82,968	515
1933	83,780	509

The number of holdings increased from the end of the war until 1924 and the average area declined. Thereafter the average area remained comparatively stable but there was a decline in the number of holdings after 1930.

(b) *Area Under Main Crops.*—The following table gives the area under the main crops for the years 1918-19 to 1932-33, inclusive. The area under grain and pulse crops shows considerable annual variations, but a fairly stable trend. The yield of grain crops also shows marked annual movements but no very definite trend. There has been a gradual increase in the area under permanent pasture, in grasses and clovers, green, root, and other crops, and in total area cultivated. It should be noted that nearly 60 per cent. of the unimproved occupied land is pasture land covered with tussock and other native grasses.[16]

(c) *Relative Changes in Production.*—Changes in the relative importance of different farm products have been more significant than changes in the area devoted to different crops. These changes are summarized in the following tables. Table VII shows the weight of wool produced and number of carcasses of stock slaughtered. There was some decline in the quantity of wool shorn during the seasons 1918-19 to 1921-22, largely owing to the encroachment of dairying during the post-war boom. Thereafter the quantity of wool showed a marked increase from 247 million lbs.

16. Unimproved occupied land was classified as follows in 1918-19 and 1932-33:

Area Under	Acres (000 omitted) 1918-19	1932-33
Phormium tenax (Native Flax)	56	64
Tussock and Other Native Grasses	15,625	14,137
Fern, Scrub and Second Growth	3,394	4,000
Standing Virgin Bush	4,499	3,419
Barren Unproductive Land	2,155	2,019
Total Unimproved Occupied Land	25,729	23,640

in 1924-25 to 288 million lbs. in 1932-33. Cattle slaughtered increased very substantially until 1924-25 and thereafter declined heavily owing to depressed prices and the encroachment of dairying. Substantial increases have occurred in the slaughterings of sheep and pigs since 1924-25, but the most important increase has taken place in the case of lambs. The number of sheep declined from 25,829,000 in 1919 to 22,222,000 in 1922,

TABLE VI

Acreage Under Main Crops—1918-19 to 1932-33

(Acres, 000 omitted)

Year	Grain and Pulse Crops	Grasses and Clovers, Green, Root, and Other Crops*		Sown Grasses; Permanent Pastures	Total Area Cultivated	Unimproved Land	Total Area Occupied
1918–19	713	—	—	—	—	—	—
1919–20	883	936†	—	16,125	18,005	25,468	43,473
1920–21	954	1,027	—	15,912	18,160	25,387	43,547
1921–22	814	1,021	—	16,113	18,381	25,147	43,528
1922–23	660	1,038	—	16,259	18,417	25,236	43,653
1923–24	659	1,022	752‡	16,447	18,453	25,120	43,573
1924–25	699	1,068	796	16,450	18,511	25,122	43,632
1925–26	577	1,068	764	16,616	18,583	25,024	43,607
1926–27	671	1,098	722	16,680	18,830	24,757	43,588
1927–28	630	1,058	713	16,871	19,017	24,438	43,455
1928–29	592	1,153	757	16,855	19,090	24,432	43,522
1929–30	567	1,196	716	16,873	19,156	24,213	43,369
1930–31	686§	1,350	717§	16,722	19,006	24,233	43,240
1931–32	701§	1,258	721§	16,495	18,849	23,879	42,729
1932–33	793§	1,398	700	16,422	19,033	23,640	42,673

*Grasses and clovers are mainly cut for hay or ensilage.
†Total.
‡Area in green, root and other crops, included in the total.
§Including areas also sown with grasses and clovers.

TABLE VII

Wool Production and Slaughterings of Stock

Year	Estimated Wool Production* In Millions of "greasy" lbs.	Stock Slaughtered† in thousands of carcasses				
		Mutton	Lamb	Beef	Veal	Pigs
1924–25 ..	247	3,906	4,968	501	—	359
1925–26 ..	236	3,570	5,206	469	—	406
1926–27 ..	256	3,811	5,545	413	106	444
1927–28 ..	262	3,703	5,981	470	166	498
1928–29 ..	272	3,508	6,197	409	397	518
1929–30 ..	273	3,992	6,652	367	444	530
1930–31 ..	271	4,263	8,198	335	559	502
1931–32 ..	283	5,234	8,828	330	608	482
1932–33 ..	288	4,356	9,854	405	614	591

*Includes shorn, scoured, washed and slipe wool and wool on skins. Scoured, slipe and washed wool converted to greasy basis on the assumption of an average loss of 33⅓ per cent; wool on skins averaged at 4 lbs. greasy wool per skin. See N.Z.O.Y.B., 1934, p. 337.

†Includes slaughterings at abattoirs and slaughter-houses during twelve months ended March 31, and slaughterings on farms during twelve months ended January 31.

and thereafter showed a substantial upward trend to 28,649,000 in 1934. The number of cattle has increased progressively from 3,035,000 to 4,301,000 during the same period, almost all the increase being due to the growth in the number of dairy cows. The number of pigs increased rapidly from 235,000 in 1919 to 660,000 in 1934.

TABLE VIII

Numbers of Live Stock

1919 to 1934

Year	Total Sheep (as at 30th April) (000 omitted)	Cattle (as at 31st January) (000 omitted)				Pigs (as at 31st Jan.) (000 omitted)
		Breeding Bulls	2-Years Old and Over for Dairying	Other Cattle (including Calves)	Total Cattle	
1919 ..	25,829	57*	826	2,153	3,035	235
1920 ..	23,915	58*	893	2,150	3,002	267
1921 ..	23,285	59*	1,005	2,075	3,139	350
1922 ..	22,222	59*	1,137	2,127	3,323	384
1923 ..	23,081	60†	1,249	2,172	3,481	401
1924 ..	23,776	59†	1,313	2,192	3,563	414
1925 ..	24,548	59†	1,323	2,120	3,504	440
1926 ..	24,905	59†	1,304	2,090	3,452	473
1927 ..	25,649	59†	1,303	1,896	3,258	520
1928 ..	27,134	59†	1,352	1,862	3,274	587
1929 ..	29,052	62†	1,371	2,013	3,446	557
1930 ..	30,841	65†	1,441	2,263	3,770	488
1931 ..	29,793	68†	1,602	2,411	4,081	476
1932 ..	28,692	74†	1,702	2,297	4,072	513
1933 ..	27,756	76†	1,846	2,270	4,192	592
1934 ..	28,649	76†	1,933	2,293	4,301	660

*Of all ages.
†Two years old and over.

3. *Expansion of Dairying*

The most marked expansion has been in dairying. Except for a temporary recession in the 1925-26 season, the production of butterfat has increased annually since 1920-21:—

TABLE IX

Estimated Butterfat Produced, 1920-21 to 1933-34[17]

(lbs., 000,000 omitted)

Season	Amount Produced	Season	Amount Produced
1920–21	155	1927–28	264
1921–22	199	1928–29	289
1922–23	226	1929–30	314
1923–24	229	1930–31	322
1924–25	241	1931–32	340
1925–26	234	1932–33	397
1926–27	259	1933–34	427

17. See Dairy Industry Commission Report, 1934, p. 163.

(a) *Changes in Use of Butterfat.*—The following table shows that the increase has been associated with a marked change in the relative importance of different uses to which milk is put:—

TABLE X

Utilization of Total Estimated Butterfat Produced,[18] *1920-21 and 1933-34*
(Estimated for all Butterfat in Milk as at the Pail)
(00,000 omitted)

Butterfat in	Season 1920–21 (lbs.)	Per Cent. of Total	Season 1933–34 (lbs.)	Per Cent. of Total
Butter	863	55·7	3,080	72·2
Cheese (including whey butter)	500	32·3	934	21·9
Milk consumed ..	107	6·9	132	3·0
Cream consumed ..	13	0·8	16	0·4
Other dairy products ..	36	2·3	20	0·5
Milk fed to calves, and wastages	31	2·0	85	2·0
Total	1,550	100·0	4,267	100·0

(b) *Relative Increase in Value of Dairy Production.*—The increase in the value of dairy produce is, of course, less marked than the increase in volume, but the following table shows that dairying has tended to increase in relative importance, even though the price decline in dairy produce has been greater than in the other products compared:—

TABLE XI

Value of Farm Production

Average Value of Agricultural, Pastoral and Dairying Products (together with Poultry and Bees), and of Total Farm Production, in the Seasons 1919-20 to 1921-22 and 1929-30 to 1931-32

	(£0,000 omitted)		(£0,000 omitted)	
	Average for Seasons 1919–20, 1920–21 and 1921–22	Per Cent. of Total	Average for Seasons 1929–30, 1930–31 and 1931–32	Per Cent. of Total
Agricultural Products	9,03	14·3	8,63	14·2
Pastoral Products ..	32,07	50·8	26,67	43·9
Dairy, Poultry and Bees	22,00	34·9	25,47	41·9
Total Farm Products ..	63,10	100·0	60,77	100·0

18. See Dairy Industry Commission Report, 1934, p. 164.

(c) *Dairying as an Avenue for Employment.*—The great importance of the increase in dairying as a means of providing employment is shown by the following figures for the years 1919-20 and 1928-29:—

TABLE XII

Workers on Farms

Number of Persons Engaged in Farming on Holdings Used Principally for Agricultural, Dairying and Pastoral (and other) Purposes, Seasons 1919-20 and 1928-29

	Year, 1919–20			Year, 1928–29		
	Male	Female	Total	Male	Female	Total
Agricultural	12,806	3,384	16,190	12,427	1,721	14,148
Dairying	37,263	18,432	55,695	56,825	17,861	74,686
Pastoral	49,616	10,748	60,364	43,633	6,142	49,775
Total	99,685	32,564	132,249	112,885	25,724	138,609

The number of workers, both male and female, has declined on holdings devoted mainly to agricultural and pastoral purposes. The number of females engaged on holdings devoted to dairying has declined slightly, but the number of males has increased from 37,263 to 55,695, or about 50 per cent.

4. *Developments in Subsidiary Products*

At the same time as the above tendencies have been in operation, there has been substantial development in the production of what may be described as subsidiary products such as fruit, vegetables, poultry, eggs and honey. This growth has occurred *pari passu* with the increase in population, but in addition, an export trade has been developed in fruit and honey. From consideration of space, there is no discussion in this work on poultry farming or beekeeping, but fruit farming and market gardening are discussed in Chapter XXV. In addition, there have been new and important developments associated with novel financial methods in the establishment of plantations growing flax, tung oil trees and timber. These are referred to in Chapter IX.

Chapter II

FACTORS AFFECTING LAND UTILIZATION IN NEW ZEALAND

By H. Belshaw

I. Conditions of Soil, Topography and Climate. II. Markets and Price Movements. III. Land Settlement Policy and Public Works. IV. Finance. V. Processing and Marketing. VI. Research and Education. VII. Farmers' Organizations. VIII. Farm Management—A. Increased Use of Artificial Fertilizers—B. Improved Methods of Farm Management—C. Improvements in Stock and Crops—D. Improvements in and Increased Use of Machinery.

I. CONDITIONS OF SOIL, TOPOGRAPHY AND CLIMATE

THE basic factors underlying land utilization in New Zealand are discussed in detail in later chapters. All that can be attempted here is a brief outline statement to provide a general background for what follows.

The principal factors responsible for the rapid expansion of farm production in New Zealand are, of course, the highly favourable conditions of soil and climate and an expanding demand for New Zealand products in the United Kingdom, which is the main market.

The total area of New Zealand is about 66 million acres. Of this, about 43 million acres is occupied, and 19 million acres cultivated. About one-half of the unoccupied area consists of mountains unsuited for settlement. It seems unlikely that there will be any appreciable expansion of the occupied area, and some of the poorer land may go out of occupation. Productive expansion in the future is likely to be based on an expansion of the cultivated area and an intensification of cultivation on the area already cultivated rather than in the occupation of new land. New Zealand soils are, in general, deficient in phosphate, but except in mountainous regions, the volcanic plateau in the centre of the North Island, the gum lands of the North Auckland Province, and certain swampy areas, soil conditions do not prevent the utilization of land for farming. Many areas previously regarded as poor country are showing themselves amenable to research and proper methods of breaking in, while much land outside the margin for farming is now being used for afforestation.

A great part of the 24 million acres of occupied, uncultivated land consists of light hill country, well suited to extensive grazing, or broken country on which cultivation is too difficult. Over a great part of such country the rainfall is low, and it is as much this factor as soil conditions which results in the lightness of the pastures and which necessitates extensive methods of grazing.

On the remaining cultivated area the distribution of crops is determined mainly by rainfall rather than by soil conditions. Over the greater part of the cultivated area rainfall is between 30 inches and 60 inches per year. Most of the Canterbury Plain receives less than 30 inches, but the area receiving less than 25 inches is small and confined to Central Otago and parts of Canterbury. Hence, over the greater part of the cultivated area, conditions of rainfall are well suited to pasture growth, and less suited for grain crops. For this reason, and because conditions of soil are not unfavourable, about 17 million acres out of the total cultivated area of 19 million is in sown grasses. Canterbury, with a rainfall in the main between 25 and 30 inches, is the main arable farming district. Over almost the whole of the cultivated area, the temperature is mild and subject to small seasonal variations, except on high country or in its immediate vicinity. In such circumstances, cattle are seldom housed, and even in mid-winter, pasture usually makes some growth. Pasture demands less labour for cultivation than arable crops, while the absence of the need for housing live stock in winter economizes in labour and capital expenditure for buildings. In the light of these conditions, and bearing in mind that native grasses are the dominant crop on uncultivated areas, the dependence of New Zealand on a pasture economy can be readily understood.

II. MARKETS AND PRICE MOVEMENTS

Since the war, between 72 per cent. and 86 per cent. of the value of all exports has gone to the United Kingdom, and until the imposition of a quota on meat in 1932 and the threats of a quota on butter at the time of writing, the British market has been able to absorb all that New Zealand could send.

As has been shown, the significance of movements in export prices is very great, and the era of rising prices from 1895 to 1921 was important in promoting farming expansion and reinforcing other influences making for closer settlement.

There is a general tendency for costs to lag behind selling prices, so that during a period of rising prices the margin between costs and selling prices tends to expand. This is all the more important in that interest charges, which are the largest single item in outgoings, remain fixed during the period of a mortgage contract and require a smaller expenditure of real purchasing power to meet them. Further, there is a tendency for prices of raw materials of agricultural and pastoral origin to rise more sensitively and to a greater degree than the prices of manufactured goods. This has a two-fold effect. Since New Zealand's exports are comprised mainly of the former class and her imports of the latter, the terms of international interchange tend to become more favourable when prices

are rising and this reacts favourably on general prosperity. It means also that the cost of farm requisites tends to rise more slowly than selling prices, and this applies also to wages. The reactions on public finance are also favourable; at least in so far as the burden of existing debt is concerned, since interest charges remain fixed in terms of money but fall in terms of real purchasing power. Hence the real burden of taxation to cover the service of debt tends to fall. It will be readily appreciated that these conditions were of great significance in promoting closer, and additional settlement and the extension of public works. On the other hand, they were conducive to careless or predatory methods of farming, to uneconomic expenditure in public works, and to inflated land values. During a period of rising prices there is a strong tendency for the market value of land to rise above its real value as a productive agent. Purchasers project into the price they pay, an element to allow for anticipated increases, and it is clear that during the greater part of the period 1895-1920 land values were too high. In consequence of rising values there was a considerable speculative element in farming, and the too frequent transfer of land on small margins of equity reacted prejudicially on farming practice. As long as the rise continued, the injurious effects were not apparent. Rising values encouraged subdivision and the growth of small and medium farms, and the price paid for land was justified by subsequent events; but the situation was fraught with danger when prices began to fall.

The post-war years saw a marked acceleration of these tendencies, consequent partly on the great rise in export prices, partly on the entry of the Government into the market as a purchaser of land for soldier settlement. With the turn of the tide in 1921, the unsoundness of the situation was revealed. Land which had changed hands during the preceding years was greatly over-valued and over-mortgaged, and a large number of farmers were forced to relinquish their holdings.

The pressure of falling prices since the war, more especially after 1925, stimulated improved farming technique, more particularly in the form of top-dressing, rotational grazing, improvement of herds and increased use of machinery. As has been indicated, there was some decline in the area occupied, and in the number of holdings after 1924:—

Year (Jan. 31)	Number of Holdings	Total Area Occupied
1924	86,139	43,572,564
1928	85,716	43,455,454
1933	83,780	42,673,394

Nevertheless, improvement in land and in farm technique led to a rapid increase in the volume of farm production.

Meanwhile, public works, particularly hydro-electric works and improved roading, have proceeded apace, and the rise of the motor has caused a revolution in transport. These developments in transport and power have had important reactions on productivity, but have had some unfavourable repercussions. The competition of motor transport has seriously affected railway revenues, and through them the budget, while the equitable allocation of the cost of improving and maintaining roads between the different local authorities and between them and the central government raises a difficult problem. Another problem giving cause for concern is the increased real burden of the indebtedness occasioned by public works, resulting from the fall in prices.

With the dramatic fall in prices consequent on the world crisis, the disparity between farm costs and farm selling prices became so serious that remedial measures on a national scale became necessary. These are discussed in the concluding chapter of this work.

III. LAND SETTLEMENT POLICY AND PUBLIC WORKS

From the mid-'nineties onwards the State was very active in encouraging land settlement. The dominant idea has been the promotion of closer settlement both within the area of already occupied land and in the area of Crown lands as yet undeveloped. The instruments used to foster this ideal have been compulsive or persuasive or penal. The power to acquire compulsorily large estates suitable for subdivision, though exercised sparingly, expressed clearly enough the land-philosophy of the country. The development of more and more lenient systems of deferred payment, the evolution of Crown leaseholds which were both attractive and secure, the provision of finance to meet special requirements, the construction of a highly efficient Land Transfer System and the energetic programme of public works all directly encouraged land settlement because of the greater accessibility they bestowed. The graduated land tax, continually revised to make it more penal against the large estates, may not have been as decisive an inducement to subdivision as was hoped, but it did reinforce the pressure of such other tendencies as rising prices and increasing land demand.

These programmes were set in a period of rising prices, expanding markets and more intensified forms of farming. In its close identification with land settlement, the State became a large-scale land mortgagee and the direct lessor of about half the occupied land of the Dominion. In both capacities it has proved itself generous when hard times have come in revising the contracts entered into by lessees or purchasers under deferred payments.

A closer examination of State policy would suggest that in many

respects the optimism of the days of expansion over-simplified the problems of land acquisition and disposal. Many were attracted to the land whose personal capital was so small as to destroy the security which was inherent in the tenures themselves; while the ease with which land could be bought and sold on small deposits and under the Transfer System often led to land-gambling instead of land utilization.

The Public Works policy which has been an essential part of land-settlement and land-development schemes was undoubtedly over-ambitious in many respects; but was pressed upon successive governments first by the initial reluctance of private enterprise to do the work itself and later by the expansionist spirit which was dominant in the Dominion.

The recent repeal of the graduated land tax and its replacement by an income tax was a recognition of the exceptional nature of the present depression and its particularly severe impact on net farming incomes. It is, therefore, to be understood more as a question of economic expediency than of economic recantation. The ideal of closer settlement has in no way been impaired. On the contrary, the belief that unemployment might at least be mitigated through more land settlement led to new legislation which strengthened the powers of compulsory land purchase (or lease) for the purpose of establishing small holdings. In the meantime, however, narrowing markets and the threat of additional quota restrictions have checked the development of this policy.

IV. FINANCE

Except of recent years, the supply of credit has been adequate and not difficult to obtain, and the system of financial organization, though loosely integrated and possessing serious weaknesses, worked reasonably well during the buoyant years from the middle 'nineties to about 1920. The rungs of the agricultural ladder were not difficult to climb. In the earlier years of the colony especially, the stock and station agents and the banks played an important part in financing agriculture. As has been indicated, the banks were so closely involved in the fortune of farming that they were faced with a serious crisis in the early 'nineties. In consequence of the prolonged depression, lack of confidence in farming as a field for investment and the difficulties of the banks, finance was expensive and difficult to obtain. Largely as the result, the Advances to Settlers' Office was established in 1894, and provided a useful, though limited and conservative, source of long-term credit until the onslaught of the world crisis.

With the turn of the tide after 1895, credit became easier, and was obtained readily from the banks, stock and station agents, and private individuals. The banks confined themselves mainly to satisfying short

term and intermediate credit needs—mainly the former—long term credit being provided mainly by private individuals, the Advances to Settlers Office and the Public Trust Office. Stock and station agents remained an important source of short term and intermediate credit.

Falling prices after 1920 turned the attention of farmers towards the improvement of credit facilities, and strong pressure was brought to bear on the Government. As a result, a Rural Advances branch of the State Advances Office was established in 1926, and a Rural Intermediate Credit Board in 1927. These had already demonstrated their usefulness when the world crisis developed. In addition, dairy companies have developed separate financial activities of recent years. These are concerned mainly with satisfying short term and intermediate credit needs.

V. PROCESSING AND MARKETING

Practically eighty per cent. of the butter and cheese is processed by co-operative dairy factories. In some cases the co-operative concern owns several factories, although the majority administer one factory. Proprietary factories in general operate only one factory. The two major problems on the processing side of the dairy industry are:

(1) The economic waste caused by the overlapping of the area of operation of the various factories, and

(2) The defects in the quality of cheese.

The first problem appears insoluble apart from a thorough rationalization of the industry. The second problem is the subject of much scientific investigation in many quarters, which has already shown useful results.

Practically all the dairy produce exported is sent forward for sale on the English market through English brokers. There is some buying in New Zealand by English houses, but the amount is small compared with the volume sent on consignment. Wool is sold as a rule at auction sales held in various centres throughout New Zealand. At these sales representatives of local milling interests and foreign buyers compete with one another. A small proportion of the wool is sent to England for sale on the English market on behalf of the farmer. Frozen meat is usually shipped on behalf of the freezing company or one of the stock agents operating throughout New Zealand, for sale on the English market. A small quantity is shipped on behalf of farmer consignors.

Although there has been some attempt to control the actual sale of New Zealand primary produce,[1] wool, dairy produce, and frozen meat are in general sold through ordinary commercial channels. There is little co-operative effort in the actual sale.

1. See chapter XXXV.

However, the control boards in the dairy, frozen meat, and fruit industries have organized for the country as a whole the transport and insurance of their respective products. In these cases collective bargaining has taken the place of individual effort, with undoubted gain to the primary producer. The control boards have also done something to smooth out the seasonal fluctuations by regulation of shipment. They have also been prominent in advertising the New Zealand product on the English market.

VI. RESEARCH AND EDUCATION

Research work in New Zealand is concerned almost exclusively with the land and land products. Its scope in this field has been considerably widened in recent years, and now relates, in various technical aspects, to production, processing and marketing problems. In this work the biologist, chemist, geologist, mycologist, botanist and bacteriologist have so far played a more important part than the economist, mainly because the earlier period of rising prices and expanding markets could satisfactorily care for the profit-side of farming. In more recent years, increasing importance has been attached to research directed to quality improvement and to management problems. The economic side of land utilization research is more obtrusive than formerly, but as yet is inadequately organized and financed.

The sources of finance for conducting various research projects have been partly Government grants, partly subsidies from farmers' organizations, partly Empire Marketing Board Grants, and to a small extent private endowment. In many cases a given project is financed by contributions from several sources. Apart from such research work as University teachers are able to undertake in addition to their ordinary duties, research is to a major extent co-ordinated under the Department of Scientific and Industrial Research.

The depression has greatly hampered much work, and has brought some of it to an end. In several cases where continuity was an essential condition, the material and intellectual capital involved has been lost through the sudden drying up of funds. In other cases, the diversion of workers and funds from one project to another has had the same effect. To an extent not met with so noticeably in larger countries, research workers are often made conscious of the part which policy and expediency can play in influencing their activities. Particularly is this so in the case of fundamental work the practical applications of which are not self-evident. Nevertheless, in spite of these difficulties, many genuine contributions to human knowledge and to progress have been made by a relatively small body of men.

The effectiveness of agricultural research and adult agricultural education is undoubtedly impaired through lack of proper co-ordination between the two. There are research workers in agricultural colleges who have little institutional contact with workers in other institutions, and teachers (who may also be research workers) who have little or no opportunity for contact with the field workers of the Departments. Teaching and research, as well as the advisory work of departmental officers, suffer in consequence. A very clear case exists for some economic rationalization in intellectual activities.

VII. FARMERS' ORGANIZATIONS

Farming opinion is fairly well organized in the Dominion, and farmers' organizations are able to bring considerable pressure to bear on political policies. The most representative organization is the Farmers' Union, which aims at expressing the farmers' view on political and general economic questions. It is organized on the basis of local branches affiliated to sub-provincial and provincial districts, and headed by a New Zealand Conference.

In addition to this general organization there are, in most branches of the primary industries, organizations such as the Sheepowners' Federation, or the National Beekeepers' Association, which keep a watch on any legislation or regulations affecting or likely to affect their own industry. Most of these latter institutions are also concerned with vocational matters, and form channels through which much technical information is disseminated. The dairy industry as such is not organized to any degree; but because of the fact that the principal dairying areas, the Waikato and Taranaki, tend to be almost exclusively dairying, the Farmers' Unions in these areas really voice the opinion of dairy farmers.

On the vocational side very much is being done. In sheep, cattle and pigs, breed societies have done much to educate the farmer in the value of good stock. As a consequence the standard of stock tends to be higher each year. The agricultural and pastoral shows, which are held in most districts at least once a year, are a very valuable educative influence.

The herd-testing movement is worthy of special mention. Practically 20 per cent. of the dairy cows in the Dominion are tested for butterfat production monthly during the milking season. The information thus gained is essential if a herd of high-producing animals is desired.

The Control Boards in their respective industries have, to some extent, become a focus of farming opinion. Elections of producers' representatives are usually contested in the interests of some particular policy, and the Control Boards are in effect the industrial Parliaments of their respective industries.

VIII. FARM MANAGEMENT

Attention has already been drawn to the fact that the increase in farm production has been associated with and partly dependent upon the conversion of unimproved into cultivated land. In the main, the improvement has taken the form of the establishment of permanent pasture of good quality. Whether or not the expenditure in improvements has been financially remunerative is sometimes open to question, but there can be no doubt of its effects on the physical volume of production. Among the remaining factors making for increased production, the increased use of fertilizers, changes in farm methods, improvements in stock and crops, and the increased use of power and machinery and improvements in the types of machines, are the most important.

A. Increased Use of Artificial Fertilizers

One of the most outstanding changes since the war has been the marked increase in the use of artificial fertilizers. The nature of the increase, the types of fertilizer used, and the methods of use are discussed in Chapter XIX. The figures available are not complete over a long period, but the following figures serve to give a rough indication of the extent of the increase in the practice of top-dressing grass lands of recent years.

Table XIII

Area Top-dressed

Year Ended Jan. 31	Artificial Fertilizers (Acres)	Lime (Acres)	Total
1927	1,414,264	106,995	1,521,259
1928	1,834,366	118,124	1,952,490
1929	2,531,530	223,373	2,534,496
1930	—	—	2,650,748*
1931	2,432,438	438,878	2,871,316*
1932	2,067,672	386,649	2,454,321*
1933	1,741,035	102,952	2,438,114*
1934	—	—	2,249,170*

(*The figures marked with an asterisk allow for areas top-dressed twice, or with two or more fertilizers.)

The figures show a very considerable increase in the use of fertilizers, especially if allowance is made for duplication in the earlier years. This increase has had important reactions on the growth of pastures, and this, in turn, has influenced farm management.

B. Improved Methods of Farm Management

Improved methods of farm management would have proceeded in any case, but they have been much hastened, and the direction they have

taken has been largely determined by the increased productivity due to the increased use of fertilizers. The most outstanding developments have been in dairying. Among the changes which have taken place on dairy farms, the following is of special interest: There has been a strongly marked tendency to rely less on root crop and supplementary fodder crops and more on hay and ensilage. This change is due in part to the desire to economize in the use of labour, but in part also to the increasing yield of grass crops which provided an increased source of supplementary feed. Another tendency has been a steady movement towards the subdivision of fields. This enables a more effective utilization of prolific grass growth on fully-improved farms, and has been found to improve pastures on partially-developed land. At the same time improved implements have enabled the more effective cultivation of the green sward and the spreading of animal droppings. Much progress has also been made in the proper balancing of stock to grass, winter carrying capacity being increased by the extended use of hay and ensilage from surplus grass in the flush season. The more effective utilization of pastures is also facilitated by so-called "rotational grazing," milking cows being followed in a field by dry and young stock or ewes.

A discussion of changes in farm management in other types of farming will be found elsewhere in this work. The above account is intended merely to illustrate the types of change in farm management which have promoted increased productivity of recent years.

C. Improvements in Stock and Crops

Improvements in the yield and quality of crops and in livestock have operated in the same direction. The most striking examples in regard to livestock are also to be found in dairying.

As the result of herd testing, greater attention to culling and breeding and improved farm management, the average butterfat yield per cow increased from 154·25 lbs. per annum in 1920-21 to 218·80 lbs. per annum in 1929-30. Much valuable work is also being done to improve the quality and yield of seed, pastures, flax, and wool, at Lincoln and Massey Agricultural Colleges, and at the Plant Research Station at Palmerston North.

D. Improvements in and Increased Use of Machinery

Associated with these improvements there has been a marked increase in the use of machinery and power.

The following table gives a sufficient picture of the change which has taken place without the need for detailed discussion:—

TABLE XIV

Farm Machinery

	1922		1934	
	Number	Horsepower	Number	Horsepower
Electric Motors ..	778	2,541	29,164	39,613
Steam Engines ..	740	3,500	398	1,771 (1930)
Internal Combustion Engines	17,557	57,004	21,758	68,141
Portable or Traction Engines	1,065	6,198	817	5,076 (1930)
Agricultural Tractors	412	6,949	5,062	79,884
Milking Machines ..	12,468	--	25,178	—
Capacity*	45,819*	—	88,273	—
Cows on Holdings using Milking Machines	533,345	—	1,324,063	—
Cream Separators ..	38,861	—	55,625	—
Shearing Machines : Plants	5,468	—	7,894	—
Shearing Machines : Stands	17,788	--	22,482	—
Wool Presses ..	8,253	—	9,906 (1930)	—

*Cows capable of being milked simultaneously.

The above references are not exhaustive, and are intended simply to illustrate the types of change which have occurred. All the more important features are more fully discussed in subsequent sections of this work.

Chapter III

GENERAL CHARACTERISTICS OF NEW ZEALAND RURAL ECONOMY

By D. O. Williams

I. General. II. Tenure. III. Size of Holdings. IV. Land Transfer. V. Family Farming and Labour. VI. Co-operation. VII. Provision of Finance. VIII. Taxation and Rates. IX. Markets.

I. GENERAL

IT has been indicated that, of the 43 million acres of occupied land, about 24 million acres are 'unimproved,' and are under native grasses, phormium, fern, scrub and virgin bush. Of the remaining 19 million acres, by far the largest portion (16 million acres) is in sown grasses or clovers. Field crops, including grasses and clovers cut for hay, seed or ensilage, represent somewhat less than 5 per cent. of the total land in occupation.

Sheep farming covers about 30 million acres or close on 70 per cent. of the occupied land. Nearly 3½ million acres are given over to dairy farm holdings, while mixed farming of various kinds—mixed agriculture and sheep farming, mixed dairying and sheep farming, and general mixed farming—account for the remaining occupied land with the exception of comparatively small areas devoted to market gardening, fruit growing, poultry farming, nurseries, etc.

Although the area devoted to sheep farming is more than eight times as extensive as that used for dairying, there are twice as many dairy farm holdings as sheep farm holdings and the population living on dairy farms is twice that on sheep farms. Of the total rural population engaged in farm work, over 40 per cent. are dairy farmers, about 26 per cent. sheep farmers, and about 20 per cent. are engaged in the various types of mixed farming.

II. TENURE

About half the occupied land is owned as freehold and about half is farmed under various Crown leases. Private leases are comparatively unimportant as yet, although there is evidence of growth in this type of tenure. The land held and farmed as freehold is in general the best land in the Dominion and was amongst the first to be taken into occupation. There is very little high-grade land left in the direct ownership of the Crown so that new settlers seeking this type of country must either purchase or lease it from private owners; except where the State elects to exercise its powers (under the Land for Settlements Act and the Small

Holdings (Relief of Unemployment) Act) of compulsory acquisition for subdivision.

The tenurial policy has, in the last few decades, been consciously directed towards freeholding. The evolution of a highly efficient State Land Transfer System has materially helped the process of purchase and sale of farming lands since it has almost entirely removed risk from titles; while the tradition of purchase on small deposits and the growth of land-mortgage finance, both State and private, have operated in the same direction. In addition, the State, in its land laws, has aimed at making every important Crown lease convertible, at the option of the lessee, into freehold.

The Crown leases vary considerably in detail, but most of them conform to certain general principles: maximum areas are prescribed, conditions of occupation and improvement are stipulated, the leases are for relatively long periods and can be renewed at a revaluation, and retiring lessees are protected in their improvements. At their best, under the modern Renewable Leases, they give almost complete security of tenure. In this respect they are better than many freeholds which have been precariously financed on minimum deposits and maximum mortgages. They have left the tenants' capital free for investment in improvements, they have encouraged such investment and they have, by firmly established precedents, assured him of financial alleviation should farming depression place him in difficulties. The Crown tenant has shown his appreciation of these advantages by preferring, for the most part, to retain his lease rather than acquire the freehold. To a certain extent the right to obtain the freehold has been as satisfactory as actually exercising the right; but to a larger extent the best of the State leases are realized to be better than precarious freeholds over the same class of country. Even in the case of high-quality land which has been purchased by the State from private owners and subdivided for closer settlement, most holdings are held on Crown leases. Hence, in spite of very positive encouragement, there has been surprisingly little increase in freeholding in this century; and the bulk of land transfers affect land already in private ownership.

A distinction between holdings which are freehold and holdings which are leasehold would not present a true picture of tenurial conditions; for many holdings are partly freehold, partly leasehold. Mixed tenures of this kind are most common with sheep farming and become less common the more intensive the type of farming. Again, the more intensive the type of farming the more common is the holding which is entirely freehold, and the more extensive the type of farming, the more common is the holding which is entirely leasehold.

III. SIZE OF HOLDINGS

The variation in the size of holding ranges from the very large 'Pastoral Runs' (Crown leases) which average about 15,000 acres and are frequently as large as 50,000 acres, to small market gardens and orchards. The 'Pastoral Runs' are the poorest of occupied land, and are found mainly in the South Island. In total area they represent about half the total Crown leases and more than one-fifth of the total occupied land of the Dominion. 'Small Grazing Runs,' also Crown leases and comparatively poor country, average over 3,000 acres and represent about 14 per cent. of all leases. The remaining Crown leases all average under 300 acres and are often land of good quality.

The average size of leaseholds is considerably greater than the average size of freeholds; but an analysis of these tenures under types of farming shows that the difference is marked only in extensive farming. The size and number of pastoral runs and small grazing runs substantially increase the leasehold average; but as these holdings are entirely devoted to extensive farming, and as the more intensive types of farming—dairying, general mixed farming, etc.—are occupied more on freehold than on leasehold, general averages are of little use. Thus, while leaseholds are larger as a rule than freeholds in the case of sheep farming, freeholds are larger as a rule than leaseholds in the case of dairying. Broadly, it can be said that where leaseholds predominate (in extensive farming) they are larger in average area than freeholds; and that where freeholds predominate (in intensive farming) they are larger in average area than leaseholds. In all cases, however, holdings which are partly freehold and partly leasehold—irrespective of the type of farming—are larger in average area than holdings which are either entirely leasehold or entirely freehold.

The approximate average size of holdings according to tenure is as follows:—

Type	Acres
Crown Leases	750
Other Leases	270
Mixed Freehold and Leasehold	1,500
Freehold	300

The average size of holdings according to type of farming is as follows:—

Type	Acres
Sheep and Cattle Grazing	1,750
Mixed Agriculture and Grazing	425
Mixed Dairying and Grazing	400
General Mixed Agriculture	140
Dairying	105

It is difficult to measure accurately the changes that have occurred over a period in the size of holdings. Some reduction in average size has

been brought about in the last two decades but it probably does not exceed 5 per cent. The operating forces have been the State's closer settlement policy which has affected Crown leases mainly, and the process of subdivision and sale of privately-owned lands. Such evidence as exists suggests that normal buying and selling of land has been equally as important as State policy in bringing about this result.

IV. LAND TRANSFER

Up to the present the transfer of freehold farming lands has been one of our major activities. The registration of titles under the Land Transfer System removes practically all legal obstacles to the purchase and sale of land. Titles are as secure as it is possible to make them, and can be searched without delay or expense.

The extent to which farm lands have been traded in has been affected also by the facts that private ownership is not to any appreciable degree combined with and complicated by tenant farming; that the population is exceptionally mobile; that traditional family locations are still exceptional; that young properties of high quality land were keenly demanded when prices were rising, new industries developing and markets expanding; and that State policies of taxation, public works and agrarian finance both reinforced the demand for land and helped to provide the means for buying and farming it.

V. FAMILY FARMING AND LABOUR

About 90 per cent. of the freehold land is farmed by the owners, either with family or hired labour. The typical nature of the family farm is shown by the fact that occupiers and their families actually engaged in farm work comprise about 75 per cent. of the total working rural population other than seasonal workers. Apart from special seasonal labour requirements, New Zealand farming is therefore conducted on the basis of three-fourths family, one-fourth employee labour.

Different types of farming differ in their labour equipment. In the case of dairying the family farm is predominant and there is little hired labour. In other classes of farming, mixed and pastoral, hired permanent labour is normally more important. The 1926 census showed that for every 100 'employers, workers on own account and relatives assisting but not in receipt of wages' there were about 36 paid workers in dairying, 68 in mixed farming, 84 in 'agriculture' and 130 in sheep farming.

Seasonal labour is needed mainly for harvesting and shearing and is met partly by casual labour and partly by migratory labour working individually or in gangs. The seasonal requirements for making hay and

ensilage on dairy farms are sometimes met by co-operation among the farmers and sometimes by mobile gangs of organized labour.

Female labour is not of much importance numerically. In 1928-29 only 12 per cent. of the females living on farm holdings were engaged in farm work apart from domestic duties; while hired female employees represent only 1 per cent. of the total of females on farms. By far the largest number of female workers are employed in dairying but in recent years their numbers have noticeably declined owing mainly to the increased use of the milking machine. Share farming is common only in dairying although even here it is unimportant compared with the owner-farmer type of holding. In many instances, share farming is regarded as a step towards occupying ownership but in recent years there has been a tendency for a permanent share farming class to develop in some districts.

VI. CO-OPERATION

Although there is a limited amount of co-operation among farmers in such things as harvesting, and shearing, the main co-operative developments have not concerned the activities on the farm. The most important sphere of co-operation has been that of processing farm products. To an overwhelming extent such co-operative processing has been confined to the dairying industry, although it is found to a minor extent in meat freezing and preserving works. In dairying the evolution of co-operation has in a very real sense made the factory a specialized continuation of the farm; but it has not yet succeeded in producing a national co-operative system. Co-operation for marketing has taken the form of Export Boards which have succeeded in organizing the transport and insurance of their respective products; while co-operation for credit has not yet become important in practice. Co-operation is to be found in some form or at some stage in almost every type of farming; but it is often unimportant. Thus the amount of wool sold through co-operative brokerage houses is small compared with that sold through private concerns. Sheep farmers as a whole have had little interest in co-operation, which has made its greatest appeal and been of greatest application to dairying.

VII. PROVISION OF FINANCE

The credit requirements of farming industries are heavy. The equity of the new settler is frequently very small, and there are very few farms which are not substantially mortgaged. This has serious reactions in times of falling prices, since it makes for considerable rigidity in farm outgoings. In many cases the seller of the farm will leave part of the purchase price by way of mortgage, the remaining financial requirements for land pur-

chase and establishment of farms being obtained mainly from private individuals, the State Advances Office and the Public Trust.

New Zealand farmers borrow freely to meet working expenses or purchase stock and equipment, while the hire-purchase system is common in the purchase of implements. Commercial banks and stock and station agents are the most important sources of short-term credit. Intermediate credit is obtained mainly from commercial banks, the Rural Intermediate Credit Board and stock and station agents.

VIII. TAXATION AND RATES

The graduated land tax has now been abolished and been replaced by a graduated income tax. The only tax on farming lands is a flat tax of 1d. in the pound on the unimproved value of the land, this tax being subject to certain exemptions. For the majority of farmers, the graduated land tax had been no burden owing to the system of mortgage and other exemptions and it is certain that they would have paid a great deal more under an income tax. The real burden, however, has been, and still is, the charges for local body rates. The aggregate of rates was about four times as great as the graduated land tax payable just prior to its abolition, and being for the most part ungraduated, fell with disproportionate severity on the small holder.

IX. MARKETS

Our main farming production is for overseas markets. The local market absorbs a negligible amount of wool, lamb and cheese and about 20 per cent. of the butter produced. In beef and pig products, the local market is the larger, but these products are so much less important than those first mentioned that our dependence on the overseas market is not materially lessened. The overseas market is virtually limited to the United Kingdom in all cases except wool which has important additional outlets chiefly in Europe. The organization of overseas marketing under the various Export Boards is essentially partial since no effective control over the producing and processing phases exists; while distribution to the local market is almost entirely in the hands of competing private enterprise.

CHAPTER IV

THE PLACE OF PRIMARY INDUSTRIES IN THE ECONOMIC LIFE OF NEW ZEALAND

BY D. O. WILLIAMS

I. General. II. Value of Production. III. External Trade. IV. Farm Products and Factory Production. V. Occupational Distribution. VI. Other Indices. VII. Instability of Economic Structure.

I. GENERAL

NEW ZEALAND'S economic structure is based predominantly on primary industries. In common with most other countries, conscious endeavours have been made to promote the development of secondary industries mainly through tariff protection and sometimes (as in the case of pig-iron) through State subsidies. But the results have not been spectacular. The predominance of farming as the chief source of our national income has never been even remotely challenged and, apart from possible changes in public policy, farming is unlikely to lose its premier position.

II. VALUE OF PRODUCTION

There are no individually satisfactory methods of comparing the relative importance of one industry with another since all are directly or indirectly interdependent; but there are several contributory methods which help to define the situation. The first relates to measurements of the value of production as compiled by the Government Statistician:—[1]

TABLE XV

Estimate of Value of Production

(£ millions)

Classes	1927–28	1928–29	1929–30	1930–31	1931–32	1932–33
I. Agricultural products	9·3	9·4	8·9	8·8	8·0	8·9
*II. Pastoral products	39·3	42·3	33·7	24·6	19·3	20·4
†III. Dairying, Poultry, and Bees	28·3	30·4	29·7	23·7	23·1	21·2
IV. Mining products	3·5	3·5	3·6	3·6	3·7	3·5
V. Fishery products	0·5	0·5	0·6	0·5	0·4	0·4
VI. Forest products	3·2	3·1	3·3	2·7	1·7	1·7
‡VII. Factory products	22·6	23·7	25·0	23·1	18·6	17·7
VIII. Builders, Labourers, and Industrial Workers	13·1	12·4	13·4	11·0	10·0	10·0
Total production	119·8	125·3	118·2	98·0	84·8	83·8

*Includes gross output of freezing works.
†Includes gross output of butter, cheese and preserved milk factories.
‡Added value.

1. See current number N.Z.O.Y.B. under 'Value of Production.'

If the first six groups are added together as representing the whole of the primary production, they normally constitute approximately 70 per cent. of the total value of production as assessed in this table. This proportion has remained remarkably constant since the beginning of the century:—

TABLE XVI

Percentage Proportions of Total Value of Production

Group	1900–1	1910–11	1920–21	1927–28	1928–29	1929–30	1930–31	1931–32	1932–33
Primary	71	73	72	70	71	68	65	66	67
Other	29	27	28	30	29	32	35	34	33
Total ..	100	100	100	100	100	100	100	100	100

The effect of falling external prices in reducing the proportion attributable to primary production in 1930-31 and 1931-32 is marked; but the effects of the depression on factory products (Group VII) and on building construction, etc. (Group VIII), is now becoming more noticeable. The price disparity, however, still remains biased against primary products, and it is doubtful whether the pre-crisis proportions will be re-established.

In its Report the Economic Committee (1932) estimated that the National Income was, in prosperous years, about 20 per cent. in excess of the estimated value of production.[2] On this basis it can be said that farming industries (Groups I, II and III) normally contribute 50 per cent.; all primary industries (Groups I-VI) 54 per cent.; and other than primary industries (Groups VII and VIII) 26 per cent. to the national income.[3] Rough as such calculations necessarily are if expressed in absolute terms, they are a working approximation to the facts and leave no doubt as to the exceptional position occupied by farming in our national economy.

III. EXTERNAL TRADE

The comparatively specialized character of our production is reflected in the high per capita value of our external trade. In recent years we have consumed locally not more than 20 per cent. of the total value of our major farming products—wool, dairy produce and meat.[4] The large surpluses of these products available for export together with other minor pastoral exports, constitute about 94 per cent. of our total outward trade. On the other hand, the comparative unimportance of our secondary industries necessitates the importation of large quantities (per capita) of manufactured goods from overseas.

2. See page 14 of Report, Section 16.
3. The balance, 20 per cent., is an allowance for goods not included in the groups, and for services.
4. Wool and cheese about 5 per cent.; lamb 8 per cent.; butter 25 per cent.; mutton 45 per cent.

The size of our per capita external trade is usually a matter of considerable gratification to New Zealanders who are happy to find some economic instance in which they can surpass most other countries, and who consider that it is a mark of high national efficiency. In this we are not entirely unjustified for, with the resources at our disposal, our achievement is that of a very energetic people. But it is evident that our per capita external trade might have been smaller had our resources been sufficiently diversified to permit the growth of important secondary industries. In some measure our large per capita external trade is due to weakness in our natural resources.[5] So far as it is possible to judge these difficult matters, our country appears to be deficient in the raw materials of industrialism or, more precisely, other countries enjoy a relative advantage either in the extent and nature of their resources, or in their geographical position. The reverse is the case in farming. The result has been that time has confirmed the dominance of our pastoral activities.

IV. FARM PRODUCTS AND FACTORY PRODUCTION

The extent to which farm products enter as raw material into our factory production cannot be precisely determined; but a conservative approximation can be made. At the outset it is necessary to note that with a few exceptions a factory here is any 'establishment engaged in the manufacture, repair, or preparation of articles for wholesale or retail trade or for export, which employs at least two hands or uses machine power.' The total of factory production, therefore, is an aggregate from many sources and in many cases the origin of the raw material used is not classified in official statistics.

In the following estimate some only of the factories erected on an agricultural and pastoral basis have been considered.[6] They were selected either because of their importance or because the calculation of the value of New Zealand primary raw material was not too uncertain. Over a period of eight years up to 1931, these factories have used approximately £270 millions of local farm products as raw material for their operations, an amount which equals about 65 per cent. of the value of all raw materials used in all factories. Many of the factories excluded from the list use important amounts of primary material other than farm products and some use an undefinable amount of farm produce. To say that 65 per cent. of the raw material used in our factories comes from farms in New Zealand understates the situation to some extent. A figure of 70 per cent. is probably not wide of the mark.

5. Marshall: *Money, Commerce and Credit*, pp. 110 fg.

6. Meat freezing, butter, cheese, condensed milk, etc.; ham and bacon curing; grain mills; soap and candle works; breweries; wool scouring; boot and shoe factories; wool mills; rope and twine works; flax works.

The extent to which farming thus provides the direct basis of our factory organization indicates that to a major degree factories here are simply a specialized continuation of our primary activities. Factories engaged in directly processing farm products are of outstanding importance. The processing of meat and dairy produce alone has accounted, in the period covered, for over 40 per cent. of all factory production and for 55 per cent. of all the materials used in factories. When an adequate analysis of our factory statistics has been made and the purely processing industries as well as the public utility services separated from the total, the remaining factories may, for want of a better term, be called 'secondary industries.' These secondary industries, although they include a mass of heterogeneous activities, produce goods and use materials of considerably less value than the two primary processing industries mentioned—meat and dairy produce.[7]

V. OCCUPATIONAL DISTRIBUTION

In the census statistics (1926), primary production includes 'agricultural and pastoral farming, market gardening, poultry and bee farming, fruit growing, fishing and trapping, mining and quarrying, bush sawmilling, scrub-cutting and gum digging.' On this comprehensive definition (which, however, excludes all processing of raw materials) primary production occupied in 1926 about 142,000 people, or about one-fourth of the total breadwinners in the Dominion. From the point of view of numbers engaged, dairy farming is the most important industry in New Zealand, with sheep farming next. There are no other industries at all comparable in this respect.

VI. OTHER INDICES

The pervasiveness of farming in our national life is reflected in other ways not capable of numerical statement. The chief financial institutions of the country are concerned largely, often predominantly, with farming finance. Thus the banks in this country, though known as commercial banks, undertake important investment functions in connection with farming while the stock and station companies are very important specialists in farming finance. On the political side, farmers usually dominate the House numerically, which in consequence has always been strongly 'grass-conscious.' The bulk of the major legislation of the country has been directed either to the encouragement of land settlement or to the preservation of the farmer on the land. In New Zealand 'Key industry' invariably means 'farming,' and despite the concessions that from time to time have been made to the aspirations of local manufacturers, national policy has seldom run the risk of subordinating the interests of farmers.

7. For analysis see recent Official Year Books under 'Factory Production.'

Humanitarian legislation, and legislation generally of the wider social sort, as well as the elaborate State ventures which have suffered so much recent criticism and curtailment, have usually followed in the wake of farming opulence. In education the influence of farming has been less marked, mainly because the need of agricultural education was not at all apparent in the long run of prosperity from the 'nineties. In recent years there has been a comparatively large development both in agricultural teaching and research. The research activities devoted to other than farming problems are few. In the field of local body government, by far the greater number of authorities are rural in organization and objectives. State services directly concerned with farming and farming problems are amongst the largest in the country, and the same can be said of many private services whose organization is directly related to the handling and financing of farm produce and farm requisites.

VII. INSTABILITY OF ECONOMIC STRUCTURE

The organization of New Zealand on a specialized farming basis, producing a limited range of major products to be marketed mainly overseas and dependent on large importations for its secondary requirements and on large borrowings for its capital needs, is the explanation of many of our most pressing problems. Our main exports are remarkably few in number, although of great importance to us. In the past our purchasing power overseas has depended directly on the successful sale of a limited range of products and on borrowing. Borrowing as a normal source of national income has now been cut off. It has, therefore, become more than ever true that with our present economy, our prosperity is dependent to an exceptional extent on external prices. The size of our per capita exports and their nature and their fewness render us highly sensitive to world influences. The impact of rising or falling prices for any one of the half-dozen major exports is felt immediately in the rural districts, and soon spreads by repercussion to the cities. The inherent inelasticity of farming production makes it impossible to adjust output rapidly to changes in demand. Even though the prices of any or all of his products fall catastrophically, as they have, the farmer has felt that he has no option but to continue producing. Moreover, his external costs, as well as import prices, are much more rigid than his receipts from overseas selling, so that his economic position is always affected by variations in his receipts to an earlier and greater extent than by adjustments in his costs. This exceptional dependence on external factors is an undoubted source of weakness and instability to the country; but in itself this fact does not necessarily establish the proposition that greater security would

result if we deliberately fostered larger local markets through State-aided secondary developments.

A greater diversification of our exports would do much to diminish present instability; but this development is most unlikely to occur in the field of secondary exports. Our deficiency in natural resources is associated with an unfavourable geographical position. We are remote from the dense centres of population. We lie in the centre of the water hemisphere. Like England before the Great Discoveries we are essentially a terminal country 'at the end of the world and on the road to nowhere.' Such markets as might be reached by us are more accessible to other countries. Even in these days of cheap long-distance transport, remoteness remains an obstacle, particularly to a small country which would attempt to pioneer an export industrialism. The obstacle of distance can be offset only by superior natural advantages which we possess only in the case of primary production.

More urgent, perhaps, than encouraging a greater diversification of our exports, is the need to secure additional markets. To a dangerous extent our exports are concentrated in one market. With the exception of wool, our exports have no important or reliable market outside the United Kingdom. Normally, over 80 per cent. of our exported butter, practically all our exported cheese, mutton and lamb, about 80 per cent. of our exported beef, and 50 per cent. of our exported wool are taken by the United Kingdom. These few commodities make up over four-fifths of our total exports, and in recent years our markets outside the United Kingdom have become negligible. It is apparent that unless we can erect some defence in the form of exchange control, or find other markets over which to spread our risks, we are completely exposed to every English price crisis. The risk we run in thus concentrating our exports in one chief market is accentuated by the fact that England herself is such an important farming country. In the case of several products which vitally concern us, the English farmer is an important supplier of his own market, and is able, through quota or tariff arrangements, to limit the competition we offer him. The possession of other markets would not, of course, eliminate either of these risks, but it would offer some insurance against the full force of depression, for even though economic prosperity and depression are of international range, all countries are not necessarily affected to the same degree nor at precisely the same time. It is one of our contemporary perplexities that a clearer recognition of our need for additional markets should coincide with the contraction or closure of markets which a few years ago seemed so promising.

PART II

GENERAL FACTORS AFFECTING LAND UTILIZATION IN NEW ZEALAND

Chapter V

GEOLOGICAL STRUCTURE AND TOPOGRAPHY

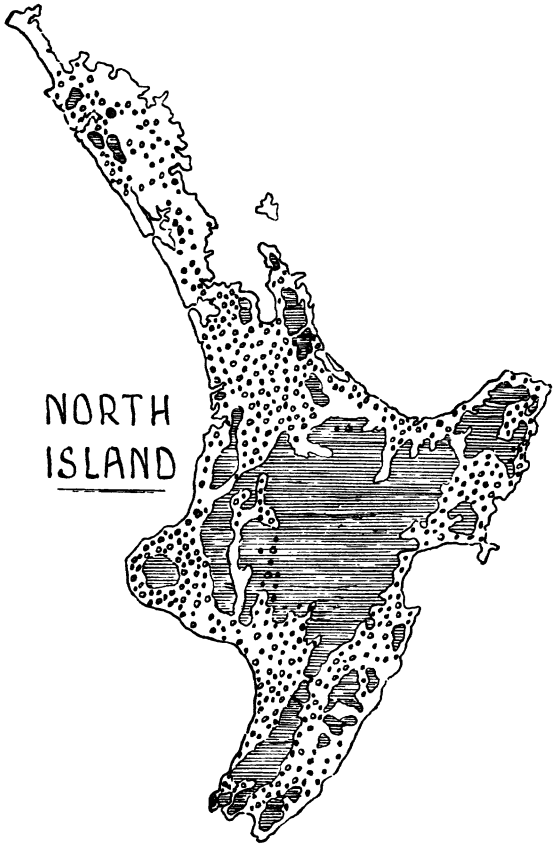
By W. N. Benson

I. General. II. Geographical Districts—A. North Island: 1. North Auckland; 2. Auckland Rural District; 3. Lower Waikato and Piako; 4. Cape Colville Peninsula; 5. Bay of Plenty; 6. Central Region; 7. Gisborne District; 8. Hawke's Bay and East Wellington; 9. Wellington Rural District; 10. Horowhenua and Manawatu; 11. Rangitikei and Wanganui; 12. Upper Wanganui; 13. Taranaki; 14. West Coast. —B. South Island: 1. Waimea; 2. Marlborough and North West Canterbury; 3. Christchurch Rural District; 4. Banks Peninsula; 5. South-East Canterbury and Waitaki; 6. Eastern Otago; 7. Southland; 8. Central Otago; 9. Mackenzie Country; 10. Fiordland; 11. Westland; 12. West Nelson and the Grey Valley.

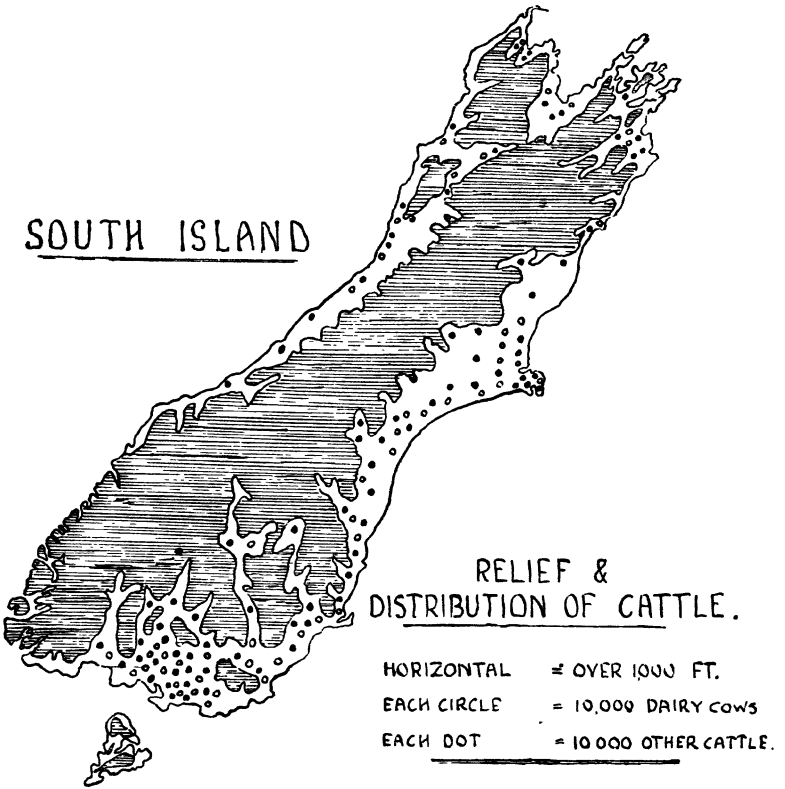
I. GENERAL

THE geological structure of New Zealand can be expressed in a few sentences. The basement consists essentially of ancient highly folded sediments, argillites and greywackes chiefly. On these rest a series of younger sediments, sandstones (with some coal), clay or mudstone, and less often limestone. This series was considerably folded and partially worn away before the eruption of basaltic lavas in the north and west of the North Island, and in the east of the South Island, and of siliceous lavas and pumice in the centre of the North Island. Further earth movements resulted in the irregular elevation and depression of blocks of the earth's crust and produced the main features of the present topography. Subsequent erosion partially removed the younger sediments from the higher ranges, cut deep valleys, and spread out the material derived therefrom in extensive sheets of silt or gravel in the main river valleys, structural depressions, and coastal plains. The detritus in the valleys of the Waikato and Piako and of the streams entering the Bay of Plenty derived from the volcanic rocks of the central plateau is largely composed of pumice. Most of the younger sediments have been removed from the basement formations in the South Island, and are now almost confined to a narrow foothill zone, but in the north-west and east of the North Island these formations still remain over most of the area.

The maps showing the distribution of cattle and sheep indicate at a glance the major geographic factors controlling this distribution. In the case of cattle the factor is topographic. The cattle are found in the lowland areas in plains and river-flats, and are not abundant above an elevation of a thousand feet above the sea, save along the succession of swampy upland valleys traversed by the Main Trunk railway near the centre of the North Island. In those regions where the area of well-watered lowland is most extensive, dairying predominates over the raising


NORTH
ISLAND

Map 3


SOUTH ISLAND
RELIEF &
DISTRIBUTION OF CATTLE.
HORIZONTAL = OVER 1000 FT.
EACH CIRCLE = 10,000 DAIRY COWS
EACH DOT = 10 000 OTHER CATTLE.

Map 4

of cattle for beef. Cheese-making predominates over butter-making in the South Island, the reverse in the North Island, except in Taranaki. The principal geographical control is the necessity, in the case of cheese-making, of the proximity of the sources of supplies and the adequacy of the roading, permitting the daily delivery to the factories of the whole milk-yield from the farms.[1]

In the South Island the distribution of sheep is determined principally by climate. The sheep which are dominantly of cross-bred types are almost confined to the regions with rainfall less than 45 inches per year, and lying at an elevation of not more than 4,000 feet above the sea. Most of the sheep are pastured at elevations below 2,000 feet and where the rainfall is less than 30 inches per year. In the higher country Merinos are more abundant, with Corriedales in intermediate situations, and Romneys in the moister Southland district. In the North Island the Romney breed of sheep predominates, and extends over the region receiving up to 60 inches of rain per year, with the exception of the area of infertile and 'bush-sick' siliceous volcanic rocks in the centre of the island.

II. GEOGRAPHICAL DISTRICTS

These general comments may be supplemented by more detailed account of the separate districts of New Zealand. For purposes of discussion areas are chosen which are fairly uniform in regard to their geographical features, so that they may be considered almost as 'natural regions.' They do not coincide with the official provincial boundaries.

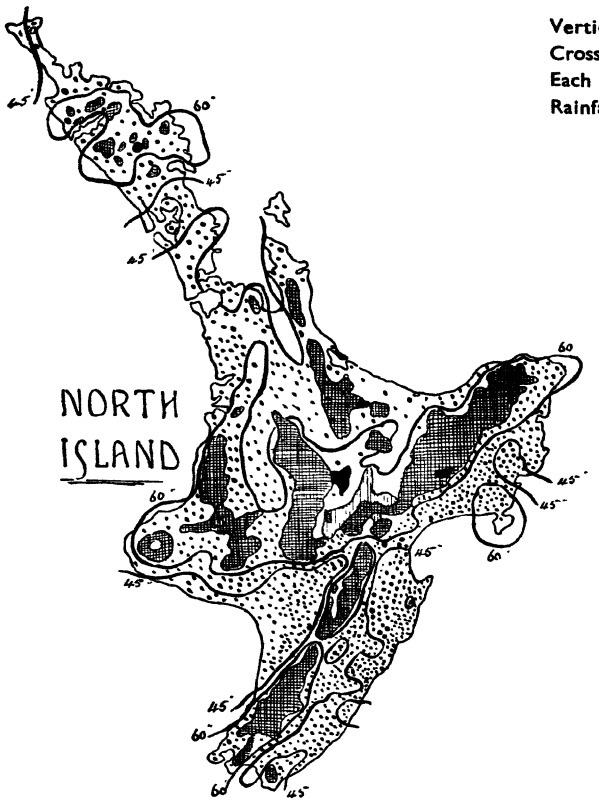
A.—North Island

1. *The North Auckland District* extends as a long peninsula, two hundred miles to the north-west of Auckland. It contains the earliest white settlements in New Zealand, but still possesses a large proportion (25%) of Maoris in the population. The warm and humid climate is conducive to the rapid weathering of rocks to friable soil, and luxuriant plant growth in fertile areas. These were originally covered by forests, of which only a small residue still exists, including the last of the exploitable Kauri pine. With the clearing of the ground, however, the loose soil is readily washed away, leaving a comparatively infertile clay. The topography and fertility are closely connected with the nature of the underlying geological formations. It is in the main an upland region of moderate relief, rising to fairly even summit levels about 600 feet in height, and intricately dissected by wide valleys. In the broader portion several irregular blocks composed of resistant formations rise to heights

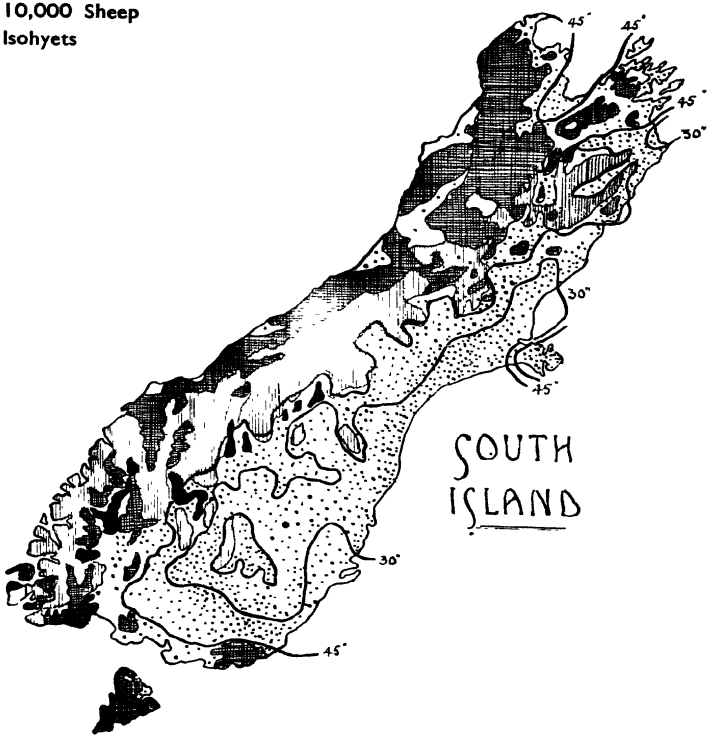
1. R. O. Buchanan: *The Pastoral Industries of New Zealand*, Institute of British Geographers, Publication No. 2.

DISTRIBUTION OF FORESTS, HIGHLAND, RAINFALL, AND SHEEP

Vertical Lines - Over 4,000 ft.
Cross-hatched - Forests
Each Dot - 10,000 Sheep
Rainfall - Isohyets



Map 5



Map 6

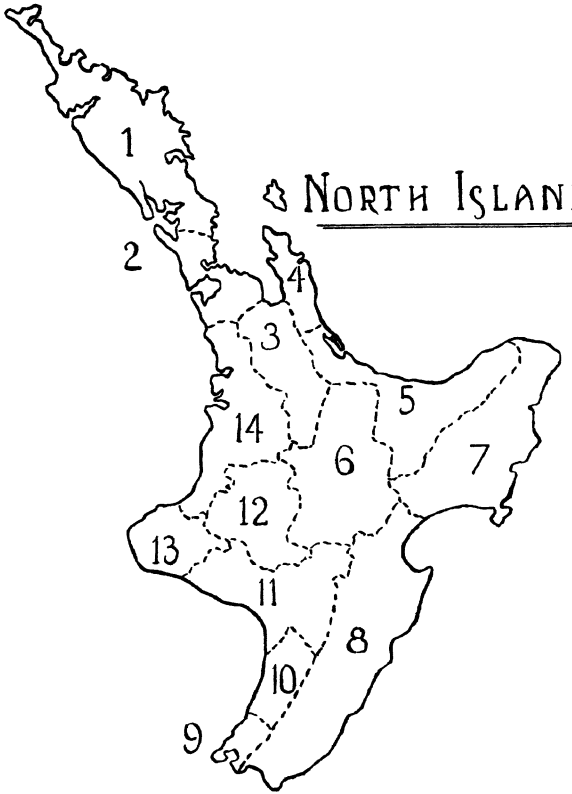
of 1,500 to over 2,000 feet. The whole region has been submerged to the extent of several hundred feet in geologically recent times, and valleys have become a series of tidal inlets affording harbours for small craft.

The principal settlements are in the valleys leading to such estuaries. The basement rocks are hard ancient sediments which have been exposed in the more elevated blocks, yielding a thin gritty soil on the summits, and rather better soil on the slopes. The younger formations make up most of the area, and are more varied. They consist of sandstones (containing locally exploitable coal), limestone and claystone. The sandstone yields a fair soil, becoming much more fertile where the underlying rock is rather calcareous. The claystones yield an infertile soil, covered usually with a scrub vegetation. They are imperfectly drained by sluggish swampy streams. Most of this region, however, was once forested, and the search for the resin of the former trees ('Kauri gum') has given livelihood to a diminishing number of men.

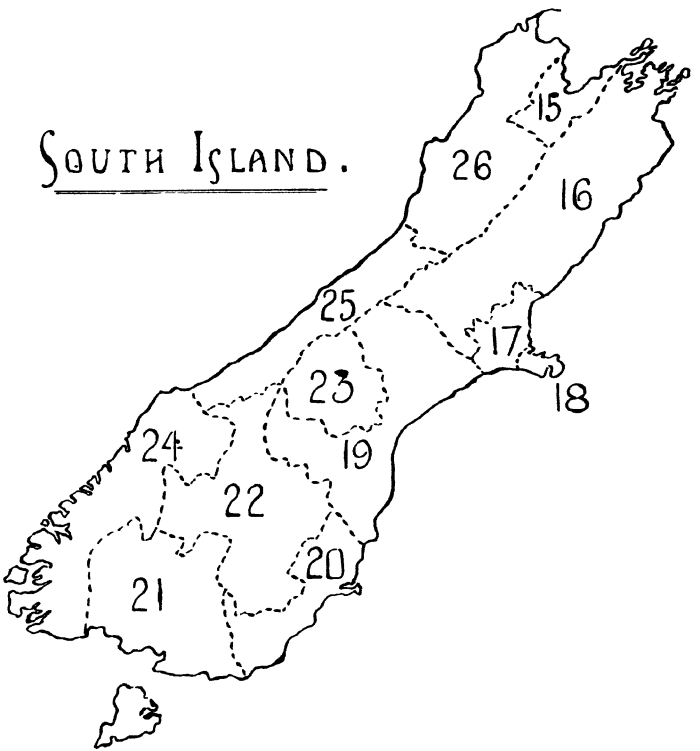
The wide extent of this type of land, and the difficulty of constructing good roads across it, has been the chief obstacle to the development of this district. Where limestone is associated in large amount with claystone, conditions are favourable for cement making, and a large output is produced by a works near Whangarei. Volcanic rocks which are rich in silica cover a small area and form rugged hills with infertile soil. Those poor in silica form the widespread basaltic flows yielding a very rich soil. Sand dunes rising to heights of 600 feet form the long spit joining the North Cape to the Mainland and extend along the west coast. The western side of these often maintains a scanty pasture, but the eastern slopes are more often bare. Between the dunes are swampy areas which have yielded Kauri gum. The alluvial flats along rivers are thus derived from a variety of sources, but are usually capable of intense cultivation, their variation in productivity depending chiefly on their situation in regard to water channels. Transport in the region has recently been facilitated by the construction of the railway throughout the length of the peninsula, lessening the importance of marine transport. Formerly the shipping on Kaipara Harbour, the southern end of which was connected to Auckland by rail, carried most of the trade in the southern half of the peninsula, access being made possible by the widely extending arms of the inlet. Direct trade to Auckland from Whangarei, Bay of Islands, Whangaroa and Hokianga, and a number of minor inlets accounted for the remainder of the trade.

The harbours of the west coast are rendered difficult by the presence of shifting sand bars. At present the ports are used more to receive supplies of fertilizers, oils and foodstuffs from Auckland than as outlets for the products of the district, though there is a fair export of butter and timber

BOUNDARIES OF REGIONS (GEOLOGICAL)



Map 7



Map 8

from Hokianga, butter and meat from Russell, and butter and cement from Whangarei.

2. *The Auckland Rural District* as here considered lies within a circle of about 30 miles from the city. Here the only formations are the younger sediments, the comparatively fertile sandstones, and infertile claystones rising to a general level of about 400 feet, and deeply dissected by wide, largely-drowned valleys. There is a wide extent of basaltic flows yielding a fertile soil surmounted at many spots by volcanic cones of basaltic ash. In the south-east the basement rocks rise to form the hills along the western side of the Firth of Thames, on which forestry reserves have been proclaimed. The size of the individual holdings is much smaller than in North Auckland, and dairying industries form a larger part of the general occupation. There is also a noteworthy amount of orcharding. The submergence of the district has been such that the eastern and western coast is near Auckland separated by only a mile of lowland. Manakau Harbour on the west is a wide, shallow inlet, with a narrow entrance obstructed by a bar and shoals. The port of Onehunga, however, is the source of supplies for much of the West Coast region. The commodious harbour of Auckland may be entered by vessels drawing up to 30 feet of water, and possesses a berthing space of 18,000 feet, nearly half of which has railway services. The port has an overseas trade of nearly a million tons per annum.

3. *The Lower Waikato and Piako District* extends south-eastwards from Auckland for nearly 80 miles. It is centred about the town of Hamilton, and is occupied by the wide alluvial plains and swamps bordering these rivers, together with the Waipa Valley. The flats are divided by low, rounded ridges of younger sediments and a few higher hills of the basement formations. The plains are made up of gravel and pumice silt which is not naturally fertile, but is capable of very great improvement by artificial manures. A larger proportion of the total occupied area is under fodder crops than in any other region of New Zealand. As a result of this and of the favourable topographic conditions the region has become the northern centre of the dairying industry, and is even more intensely stocked than the Taranaki district. The bulk of the produce is in butter, other milk-products being subordinate. The abundant clover also supports many apiaries. The plains also carry large areas of swamp suitable for flax-growing, and are easily drained. The outlet of the district is by rail to Auckland, or by boat from Thames. River-borne traffic on the Waikato and Waipa is now relatively small.

4. *The Cape Colville Peninsula,* with which Great Barrier Island may be included, consists chiefly of more or less siliceous volcanic rocks. Formerly it was a very productive gold mining and timber producing

region, and as both these industries have declined, grazing has become more prominent. The soil is, however, rather poor. A certain amount of timber-milling is still in progress. The outlet of the region is by rail or by the ports of Thames, Coromandel and Whitianga, which are available for small shallow-draft vessels only.

5. *The occupied regions of the Bay of Plenty* form only a small proportion of the total area. They fall into two classes, a narrow strip of lowland running east from Tauranga to join a wide alluvial plain extending far inland along the Rangataiki valley, which drains from the central plateau. The soil is composed of the detritus of siliceous volcanic rocks and of pumice, and is not very fertile. Inland the volcanic hills extending towards Rotorua carry some merchantable forest. In the south-eastern portion of this region is the most primitive of the remaining Maori communities in a wide area of sparsely cultivated Native Reserve. The outlet for this region is by rail and also from the ports of Tauranga, taking small steamers, and from Whakatane, which may be used by small craft only. From Whakatane, goods are conveyed by lighter to vessels moored in the open roadstead. Direct shipping from the local freezing works into oversea vessels is thus possible. The eastern portion of the region consists of valleys draining the spurs of the Raukumara range, which is composed of the ancient sediments. Here sheep raising predominates. Cattle raising is subordinate. The outlet of the district is by coastal steamers from Opotiki.

6. *The Central Region* is largely occupied by forest, both natural and planted, and a comparatively small proportion is occupied for agriculture; indeed, much of the region is almost useless. The region is chiefly plateau rising to the south and bearing many volcanic peaks. The soil is derived almost solely from siliceous volcanic rocks and pumice, and is generally of poor quality, the stock thereon being subject to 'bush sickness.' On the east rises the high Kaiwaka Range of ancient sediments. The holdings are large, but the pastoral productivity is small. The outlet is by rail to Auckland. Maoris form 30% of the small population.

7. *The Gisborne District* is one of great productivity, separated from the Bay of Plenty by the thickly forested Raukumara range. It comprises the well-watered eastern slopes of the latter, consisting of younger sediments, chiefly clay- and mud-stones forming well-dissected hills with only a small area of lowland. The region is divided into large holdings and roads are rather scanty and poor, for little material suitable for their construction is available. The relief of the country favours the rearing of cattle for meat rather than for dairying. The outlet of the region is by the coastal ports at Hicks Bay, Tokomaru, Tologa Bay, Waikokopu and Wairoa, and by the main port at Gisborne, towards which several wide

valleys converge. Except in regard to the last, shipping facilities are poor, and goods are taken by lighters to and from vessels in open roadsteads. Freezing works exist at Hicks Bay, Tokomaru and Waikokopu, and a butter factory near Tokomaru. Similar loading conditions for oversea cargo vessels are necessary at Gisborne, where the roadstead is very exposed to easterly and southerly winds, but the coastal vessels may berth in a harbour constructed in the mouth of the Turanganui River, which, however, constantly varies in depth and requires much dredging.

8. *Hawke's Bay and East Wellington* is the district containing the greatest number of sheep and nearly the greatest proportion of improved land, and highest carrying capacity for stock. The topography is varied. The western margin consists of the Kainanawa and Ruahine ranges of ancient sediments, on the eastern slopes of which lie a vast series of younger sediments that pass beneath the wide gravel and silt plains along the central strip of the region and rise to form the hilly country along the east. The greater portion of the area lies in the rain-shadow of the ranges and receives less than 45 inches of rain per year. The central portion, lying east of the Manawatu gap in the range, receives nearly 60 inches. The wide alluvial plains near Napier have a supply of artesian water. On this plain are a number of orchards and apiaries. The region is well roaded and a railway extends throughout the central depression. Excepting for a small amount of goods delivered into coastal steamers from the coastal port of Wairoa, and at other points along the coast of Hawke's Bay, Napier, Wellington, and perhaps Wanganui, form the outlets for the district, and goods from the most southern portion must be hauled over the Rimutaka range to Wellington. Napier has a breakwater port with 1,800 feet of wharf, at which vessels drawing 25 feet could berth before the recent earthquake. An inner harbour (Port Ahuriri), entered by a channel of varying depth, was utilized by lighters and steamers drawing less than 14 feet. The large oversea vessels anchored in the roadstead, which was safe in southerly and westerly weather, but subject to a heavy swell. The earthquake of February, 1931, which caused an uplift of the coast by about six feet at Napier, diminished the depths of these ports.

9. *The Wellington Rural District* includes the southern portions of the Rimutaka and Tararua Ranges, composed of ancient sediments, and the intervening gravel-filled Hutt Valley. Wellington Harbour has the greatest trade of any New Zealand port, though that of Auckland is almost as great. Direct services by mail steamers with Sydney run almost weekly, and with San Francisco every three weeks. Regular cargo services to other Australian ports and by Panama to the Eastern American ports and Great Britain run at frequent intervals. The Cape Horn route is now followed to a comparatively small extent. The port is landlocked,

possesses a deep, clear entrance, and within is an area of 30 square miles, from 6 to 14 fathoms deep, providing good anchorage. Wharfage space is adequate. Of the 12,000 feet of wharves, 5,000 feet provided with railway facilities are available for berthing vessels drawing 30 feet.

10. *The Horowhenua and Manawatu Region* consists of the forested Tararua Range of which the western slopes have been cleared for grazing, the Horowhenua coastal plain margined by dunes, and the gravel terraces and swamp lands near the Manawatu River. It is very productive dairying and sheep country, and has a large area occupied in flax growing. Over five per cent. of the area is under fodder crop.

11. *The Rangitikei and Wanganui District* is made up entirely of younger sediments, usually sandy mud-stones issuing from the dune-covered silts between the mouths of the Manawatu and Rangitikei, or the low coastal cliffs, further west, and sloping up towards the central plateau. It is deeply trenched by the upper tributaries of the Rangitikei, Turakina, Mangawhero, Wanganui, Waititara and Patea Rivers, between which there extend broad gently undulating uplands. These form the most productive sheep-raising country in New Zealand, and also carry a large number of cattle, predominantly for beef. About 6 per cent. of the area is under fodder crops. A large amount of honey is also produced. Palmerston North, Feilding, Marton and Wanganui are the main towns in this region. The outlet of the district is from Wanganui. At the entrance of the river is the Castlecliff Wharf, adjacent to refrigerating works, and available to vessels drawing 18 feet, while the town wharf, four miles up the river, is accessible only to small craft. Large overseas vessels are worked at the anchorage two miles off shore, which is entirely without shelter from the south and west. The Wanganui River is navigable by river steamers to Pipiriki for 60 miles, and these carry a fair amount of goods. At the eastern and western end of the district are the two small ports of Foxton and Patea, which are available for small craft only.

12. *The Upper Wanganui District* is that area comprising the southern and western margins of the central plateau. To the north and east it is overlapped by the volcanic ash and the great cones of Ruapehu and its neighbours. These rise from a swampy plateau over 3,000 feet in height, whence the stream valleys descend into gorges cut through soft younger sediments to join the valleys of the Rangitikei, Wangaehu and Wanganui Valleys. The area comprising the volcanic cones and the land surrounding these, and forming the north-eastern part of this region, have been proclaimed a National Park. The development of this region has followed the completion of the Main Trunk Railway, and is still in progress. Sawmilling accompanies the clearing of forest land. The roading facilities

are poor, and transport depends upon the Main Trunk Railway and on that running south-westwards to Taranaki, and to some extent on the Wanganui River, the head of navigation for launches being Taumaranui, at an elevation of 490 feet above the sea and 145 miles from Wanganui.

13. *The Taranaki Region* consists of young sediments upon which stands the great cone of Mt. Egmont. Round the base of the mountain, fertile, volcanic soil has been widely spread. The abundant rainfall and fertility of the soil make this region the second greatest centre for dairying. The bulk of the produce is, however, cheese rather than butter. The region is served by excellent roads, railways extend along three sides of the region, and its outlet (apart from the bar harbours of Patea and Waitara) is from New Plymouth. 'From its geographical position and its growing importance with overseas shipping this is at present the natural ocean gateway for the West Coast of the North Island. The approach to the harbour is safe, easily navigable, and has no bar.' At present accommodation is provided for overseas vessels up to 530 feet in length and to a draft of 26 feet, which is the depth of the approach to the wharves, but large bays 650 and 1,200 feet long alongside the wharves have been dredged to 32 and 33 feet depth respectively. The wharves are connected with the railway service.

14. *The West Coast Region* is made up chiefly of younger sediments, mostly clays, mudstones and sandstone, but comprising also the largest area of massive limestone in the Dominion. These sediments slope gently down from the central plateau, and terminate in sea cliffs. A certain amount of pumice lies over these rocks on the eastern margin of the district, and here and there the older sediments of the basement have been elevated and are exposed, notably in the Herangi and Hakarimata Ranges. Several large basaltic cones, about 1,000 to 2,000 feet in height, notably Mts. Pirongia and Kariori, rise above the general surface. The younger sediments have been much dissected; the streams flow in entrenched meanders over a hundred feet deep, and in places have flood plains of some width. The extent of erosion of a series of sloping sediments of varying character has given rise to innumerable sandstone cliffs, and landslips, resulting generally in a rather uneven topography. The transport facilities are small. Three main meridianal roads traversing respectively the coastal, central and eastern portions of the district, are crossed diagonally or transversely by several other highways. The rarity of good road-making material in the southern portion of area is a great disadvantage. The railway passes through the eastern margin of the area only. The coastal harbours of Kawhia, Aotea and Raglan are all much hampered by the possession of shallow bars, but goods from here are taken in small vessels to Onehunga. The mouths of the Awakino, Mokau

and Tongaporutu Rivers can be entered in fine weather and at high tide by vessels of 100 tons burden, and launches can travel 25 miles up the Mokau River. Sand bars are formed in front of these rivers by the dominant north-westerly swell, and are cleared out during flood time. The hills support abundant sheep and cattle, which fatten in the valleys. A certain amount of timber still remains, but the lack of means of transport accounts for a great deal of destruction of timber during clearing operations. A minor amount of flax-milling is carried on.

B.—South Island

1. *Waimea Country* forms a very distinct geographic unit. It is an area of low hills open to the sheltered waters of Tasman Bay, and enclosed on three sides by high ranges. The climate is mild and equable, with a good rainfall. The hills are composed of gravel and silt, and to the east and west lie the alluvial plains of the Waimea and Motueka Valleys. The former has long been devoted to orchards and hop-growing. The development of orchards in the latter region has been a feature of the past two decades. The area is well roaded. The eastern valley has railway connection with the port of Nelson, while the products of the western area are shipped by coasting vessels from Motueka and other points on Tasman Bay. The approach to the harbour of Nelson is an easy one, though the roadstead is open to north-westerly gales. The harbour, which is protected by a natural breakwater, 'The Boulder Bank,' affords 480 feet of berthing space for vessels drawing up to 22 feet of water, but only small vessels can enter at any state of the tide.

2. *Marlborough and North-west Canterbury* is a very mountainous region, consisting of a number of ranges rising above 5,000 ft. in height. Between these are the intricate deepwater sounds of Marlborough or great valleys which, in the case of the Wairau and Awatere, Waiau and Hurunui Rivers, contain wide stretches of younger sediments and alluvium. In the two latter these sediments are spread out in extensive intermontane basins. Apart from these areas, and from a narrow coastal and foothill zone of younger sediments and alluvium, the area is almost wholly built up of the older (basement) sediments, argillites and greywackes forming the high ranges. In this region, half the district is divided into holdings of more than 4,000 acres. The region is almost entirely devoted to sheep raising, though some dairying and mixed farming occur in the lower and marginal regions. In these regions, and particularly in North Canterbury, much grain is raised. Parts of the intermontane basins are being afforested. Transport is difficult, but the portion from the Awatere northwards has good rail and road service to Picton, where large overseas vessels may berth at the single 600 ft. wharf,

which is within fifty miles' sail of Wellington. There is a small coastal export of hay and fruit, in small steamers from the mouth of Wairau. South from here the mountains come down to the sea, leaving a narrow coastal strip by the Kaikoura Peninsula devoted to dairying, and exporting from the small harbour north of this promontory. The southern portions of the region are connected by rail to Lyttleton.

3. *The Christchurch Rural District* is made up entirely of the gravelly Canterbury Plains, with a narrow foothill fringe of younger sediments. They are crossed by the valleys of the Ashley and especially the Waimakariri Rivers, to which their deposition was due. Near Christchurch, and extending thence to the latter river, there is an abundant supply of artesian water. The region lies within the rain-shadow of the Southern Alps and has a moderate rainfall, and is rather subject to frosts. Besides sheep and cattle, wheat, oats, orchards and apiaries provide the chief industries of this fertile district. Transport facilities are excellent, and export is direct from Lyttleton.

4. *Banks Peninsula* consists of dissected and basaltic hills, which have been partially submerged, and hence are deeply embayed and joined to the mainland by the outward growth of the Canterbury Plains. The volcanic rocks at various spots are covered by a loessic soil, composed of dust derived from the ancient sediments and blown from the Waimakariri Valley. Noteworthy in this area is the growing of grass for seed, chiefly near Akaroa. The principal outlet of the area, and that of all North Canterbury, is the port of Lyttleton, seven miles from Christchurch, and 175 miles by sea from Wellington. This harbour is easy of access except in south-westerly gales. There is a channel dredged to 29 feet deep (low water) leading to the inner harbour (100 acres in area), which is enclosed by a breakwater and dredged to 31 feet. 7,500 feet of well-equipped berthing space is available for vessels drawing 34 feet. Transport from the eastern half of the Peninsula to Lyttleton is over hilly country, but there is little trade in Akaroa Harbour by coasting vessels.

5. *South-east Canterbury and Waitaki* comprises the area between the Rakaia River and the southern limits of the Waitaki Valley. The county boundaries in this region run athwart the natural divisions, so that the region is very heterogeneous. Three distinct units are present—(a) The gently sloping gravelly plains which narrow southwards to Timaru, and thence broaden into the delta of the Waitaki River. This is chiefly occupied in pasturage, though a considerable area is devoted to the raising of grass seed, especially about Ashburton. (b) The downland or low foothill country composed of younger sediments, associated near Timaru and Oamaru with basalts, in part covered by loessic soils. These younger sediments are especially widespread near Timaru and Waimate, and on

them, and more especially on the gravels of the Canterbury Plains, is grown the bulk of the New Zealand wheat. (c) The ranges of the older sediments, which extend back into the main chain of the Southern Alps, and rise above the limits of country suitable for pasturage. The deep, relatively narrow valley of the Rangitata carries the pasture land far into the main range, while the more open and broader Waitaki Valley extends back into a large intermontane basin. The outlet of this region is either by rail to Lyttleton or Oamaru, but chiefly from Timaru. This is a breakwater harbour enclosing a space of 50 acres, most of which is dredged to a depth of 30 feet, and nearly 3,000 feet of well-equipped berthing space is available. The breakwater harbour of Oamaru has a much smaller capacity, and is available only to vessels with a draft of 20 feet, for which there is 1,400 feet of wharfing space.

6. *Eastern Otago* consists of a seaward sloping region, of which the basement rocks consist of highly altered ancient sediments or schist, with a coastal zone of younger sediments capped here and there by basalt. A special element in this region is, however, the presence of two extensive areas of recent silts filling the Lower Taieri, Tokomairo, and Clutha Valleys, on which dairying is concentrated, while the rolling down-like hills of ancient sediments in the Clutha Valley carry more stock than is usual for this formation. The raising of grain, chiefly oats and rye, is important. Grass seed is, however, a subsidiary feature of the cultivation of this region. The outlet of this region is from Otago Harbour, containing two ports. The entrance is by a sinuous channel over 30 feet deep, leading to Port Chalmers, where there is 5,000 feet of berthing space, having depths between 19 and 30 feet. A dredged channel, seven miles in length, permits vessels drawing 23 feet to continue to Dunedin, where 6,000 feet of wharves are available.

7. *Southland* shows in the main, wide plains of gravel and silt, and ranges of moderate elevation composed of older sediments in the south, and schists in the north, well-watered, and with a productive capacity above the average for such formations. In the north-west, it rises into uninhabited Alpine regions. The plains form the chief centre of dairying in the South Island, and a variety of milk products are manufactured. They are also the chief area for growing oats for threshing and for raising grass seed. In the south-eastern portion a certain amount of timber is cut, and there is some afforestation in the northern portion. Roading throughout is good save in the south-east. The outlet is by Bluff Harbour, which, though possessing a narrow entrance, is unencumbered by a bar, and well protected from the dominant westerly winds. There is 3,400 feet of wharfing space for vessels drawing 30 feet. The nearest Australian port, Melbourne, is 1,180 miles distant.

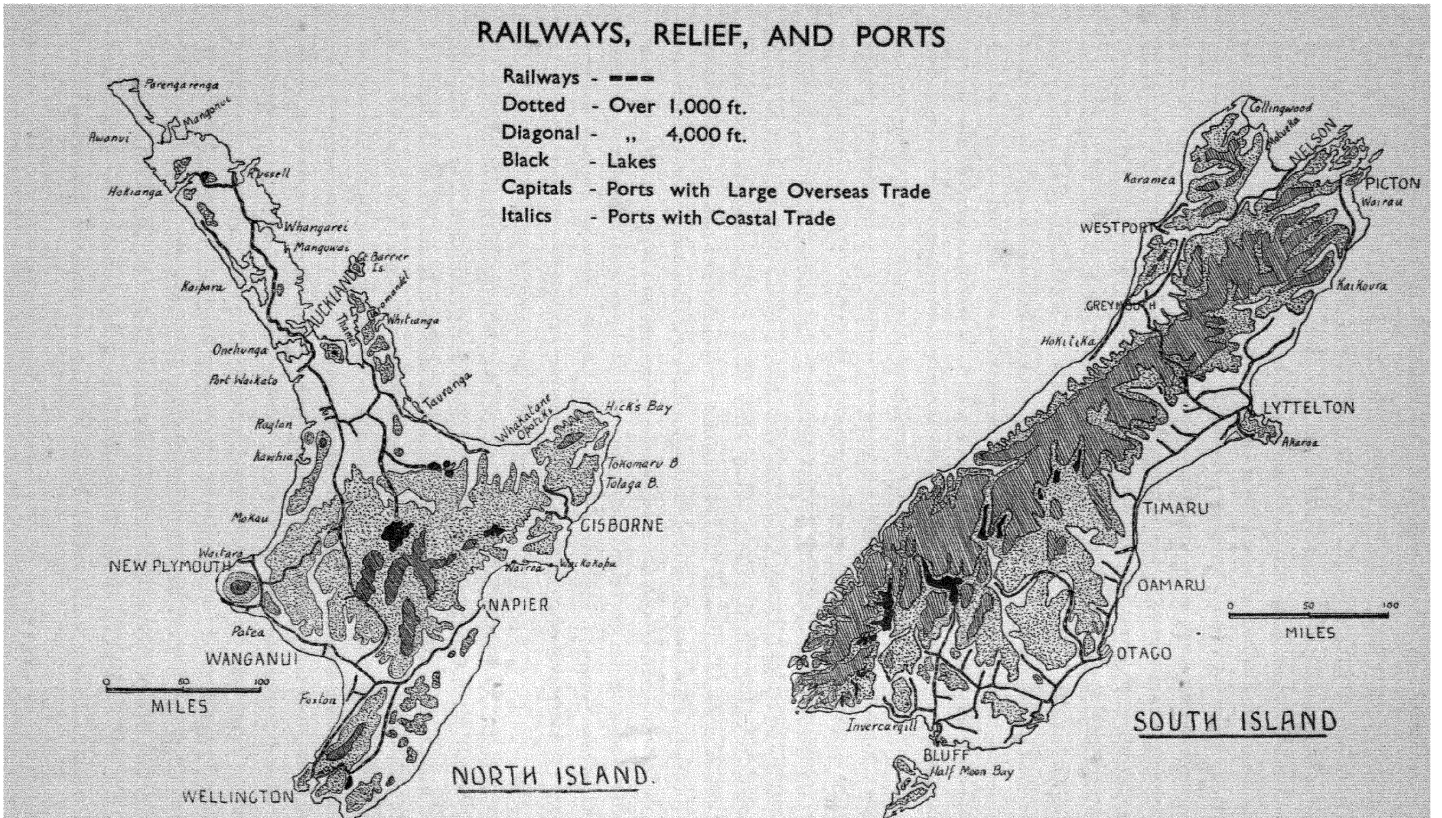
8. *Central Otago* consists of a series of gravel-filled basins lying between schist ranges in the rain-shadow of the Southern Alps. Except on the marginal ridges the rainfall is less than 30 inches annually, and for the lower portions it is less than 20 inches. In this region, therefore, irrigation has been developed, and pastures and orchards have been thus treated. The region is, however, devoted almost wholly to sheep raising, and typical properties comprise extensive areas of 'high country,' extending up to 4,000 feet elevation, with lowland paddocks for winter feeding. The sparse rainfall and sandy soil give low average fertility, and the normal holding is of large area. The outlet of this region is chiefly by rail to Dunedin or the Bluff.

9. *The Mackenzie Country* in the south-west of Canterbury has similar features to Central Otago. It is essentially a region in which high ranges of ancient sediments surround a broad gravel-floored basin where the rainfall is low. The average holding is even larger than those in Central Otago, and its capacity for carrying stock is no better. This region has an outlet eastwards through a low pass (Burke's) to Fairlie and thence by rail to Timaru, or south-eastwards by the Waitaki Valley to Oamaru.

10. *Fiordland,* comprising Fiord County and the western portions of Wallace Lake and Vincent Counties, are uninhabited alpine regions without immediate agricultural value. They have large areas of forest, of which but little is merchantable. The presence of limestone, and the possibility of development of a large amount of hydro-electric power, has caused the manufacture of nitrate fertilizers to be considered. A motor road is now under construction through this region from Lake Te Anau to the head of Milford Sound.

11. *Westland* is a narrow zone comprising the forested western slopes of the Southern Alps and a coastal strip covered by silt, gravel and moraine, and crossed by many rivers. Though rather deficient in lime, a good deal of this may ultimately be utilised for grazing and flax growing, but little of the land is improved as yet, and the amount of stock carried is small. The sheep are mostly in the northern portion near Ross. Cattle are widespread. Transport facilities are poor. A road extends for about 60 miles northwards to Ross, whence there is rail connection with Hokitika and Greymouth. Hokitika has a small harbour with a very variable bar that can usually be crossed by vessels with less than 9 feet draft. The outlet from the southern end is from the mouth of the Haast River by small craft, which also call at intervening points.

12. *West Nelson and the Grey Valley* is a very mountainous region, composed of ancient sediments and granites, and of younger strata containing the chief coal-deposits in the Dominion, and a considerable amount of limestone. In the valleys are broad or narrow strips of gravel terraces,


RAILWAYS, RELIEF, AND PORTS
Railways - ▬▬
Dotted - Over 1,000 ft.
Diagonal - ,, 4,000 ft.
Black - Lakes
Capitals - Ports with Large Overseas Trade
Italics - Ports with Coastal Trade
Parengarenga
Mangonui
Awanui
Hokianga
Russell
Whangarei
Mangawai
Barrier Is.
Kaipara
AUCKLAND
Thames
Coromandel
Whitianga
Onehunga
Port Waikato
Tauranga
Raglan
Kawhia
Whakatane
Opotiki
Hick's Bay
Tokomaru B.
Tolaga B.
GISBORNE
Mokau
Waitara
NEW PLYMOUTH
Wairoa
Hastings
Napier
Patea
WANGANUI
0 50 100
MILES
Foxton
WELLINGTON
NORTH ISLAND.
Collingwood
Motueka
NELSON
Karamea
PICTON
Wairau
WESTPORT
Kaikoura
GREYMOUTH
Hokitika
LYTTELTON
Akaroa
TIMARU
OAMARU
0 50 100
MILES
OTAGO
Invercargill
BLUFF
Half Moon Bay
SOUTH ISLAND

Map 9

Map 10

moraines and alluvial flats. Less than a quarter of the occupied land has been improved, and the carrying capacity is low. Much of the terrace land consists of 'pakihi'—barren treeless moorland with an undrained, sour, peaty soil, deficient in lime and phosphates, and resting on hard ferruginous gravel. Cattle raising and dairying is carried on to some extent in the coastal districts and the Inangahua Valley. Sheep are depastured in the Buller and tributary valleys about Murchison, but these do not suffice for the local demand for foodstuffs. Timber milling occurs in a number of places, and, in addition to the local mining and building requirements, there is a surplus of timber for export. Facilities for transport are not very good. The main road outlet from Westport is through Murchison to Nelson, but the railway connection has not been made, nor is the connection with Greymouth via the Inangahua Valley yet made. On the other hand, Reefton and Hokitika are joined by rail to Greymouth and thence via the Otira Gorge to Christchurch. The chief ports for coal export are Greymouth and Westport, which are improved river mouths with shifting bars with depths of 13 feet or more at low water. As the range of tide is 9 feet, fair-sized vessels cross at high tide. Smaller vessels work the coastal ports of Karamea, Westhaven, and Collingwood (daily to Nelson) at high tide, and Takaka. A good road connects the last two townships with Motueka.

Chapter VI

SOILS OF NEW ZEALAND

By B. C. Aston (assisted by R. E. R. Grimmett and F. J. A. Brogan) and T. Rigg

I. Introduction. II. Profile Classification of New Zealand Soils. III. Influence of Geology on Soil Properties. IV. Volcanic Soils of Central North Island Territory. V. North Auckland Soils. VI. Bay of Plenty Soils. VII. Poverty Bay Soils. VIII. Hawke's Bay Soils. IX. Wairarapa Soils. X. Manawatu Soils. XI. Nelson and Takaka Soils. XII. South Island West Coast Soils. XIII. Marlborough Soils. XIV. Canterbury Plains Soils. XV. South Canterbury Soils. XVI. Central Otago Soils. XVII. Southland Plain Soils. XVIII. Littoral and Estuarial Soils. XIX. Mineral Deficiency Areas.

I. INTRODUCTION

In recent years much attention has been directed to the classification of soils based on a study of the soil 'profile.'[1] Glinka and other Russian workers have shown the great value of this method of soil classification for Continental countries possessing great variation of climatic conditions in different regions. Marbut and his colleagues have adopted the broad principle of soil classification based on a study of the 'profile' for U.S.A. More recently Prescott has shown that the same method of soil classification can be successfully used in Australia, and as a result of his studies has been able to classify Australian soils into ten groups which possess very distinctive features.

II. PROFILE CLASSIFICATION OF NEW ZEALAND SOILS

In New Zealand, although the importance of soil 'profile' study has been recognised, opportunity has not permitted a detailed examination of soil profiles in different parts of the country. The mountainous character of many parts of New Zealand, with its constant erosion of hill-land and the deposition of fresh material on the flood plains prevents the development of mature soil profiles in many districts. Owing to the comparatively small size of New Zealand and the uniformity of climatic conditions which prevail over large areas, it can hardly be expected that a study of New Zealand soils based on the 'profile' will reveal so many distinct groups as has been noted by workers in Continental countries.

With the exception of certain areas in Marlborough, in Central Otago, and possibly in Canterbury, the high rainfall experienced in other parts of New Zealand suggests that the majority of New Zealand soils have been leached of water soluble salts of sodium, potassium, calcium and magnesium, and in the majority of cases leaching has removed also from the topsoil and subsoil carbonates of calcium and magnesium. While under conditions of high rainfall, e.g., West Coast of the South Island,

1. 'Profile'—a vertical section of soil showing characteristic appearance due to soil-forming processes.

typical podsols[2] have developed showing a well-marked grey horizon[3] A^0, a bleached horizon, A^1, and a pan formation of iron and humus compounds (Horizon B), podsolization in other parts of New Zealand where the rainfall is not so high is not so well developed, except in North Auckland, where typical podsols are to be found in many of the 'Gumlands.'

The following averages for lime and magnesia extracted by strong hydrochloric acid from a wide range of New Zealand soils show to some extent the degree of leaching which has taken place under different rainfall conditions:—

TABLE XVII

Lime and Magnesia Soluble in Strong Hydrochloric Acid[4]

Inches Rainfall Per Annum	No. Samples Averaged	Lime (CaO)	Magnesia (MgO)
Below 20	6	0·59	0·72
20–30	63	0·48	0·48
30–45	89	0·34	0·31
45–60	62	0·36	0·29
Over 60	30	0·18	0·16

It is well known that many New Zealand soils are acid in reaction. The following figures for lime-requirement determined by Hutchinson and McLennan's method show the averages for a considerable number of soil samples collected in different parts of New Zealand:—

TABLE XVIII

Lime Requirements[5] *of New Zealand Soils. Hutchinson and McLennan's Method*

No. Samples (Averaged)	District	Lime-Requirement Figure (average) Per Cent. $CaCO_3$
3	Central Otago	0·02
51	Canterbury	0·11
10	Marlborough	0·08
45	Southland	0·16
24 (Types)	Nelson	0·18
24	Wellington	0·18
8	Hawke's Bay	0·20
6	Taranaki	0·23
70	Auckland	0·38
21	West Coast, South Island	0·38

The lime-requirement figures increase for all districts of high rainfall. The lowest figures occur in Central Otago, Marlborough, and Canterbury, where the rainfall is under 30 inches per annum.

2. Soils, usually of a sandy texture found in cool, temperate, moist climates, characterized by an acid reaction in all layers, of which there are three principal ones; an upper ('A') grey and impoverished of bases by leaching; a middle ('B') brown, due to deposition of humus and hydrated oxides of iron and alumina from 'A'; and a lower ('C') of partially disintegrated rock.

3. A layer in the soil profile.

4. Aston: *N.Z. Journal of Agriculture*, 1916, pp. 48-55.

5. An empirical figure, obtained by the Hutchinson and McLennan method in which the percentage of carbonate of lime absorbed by the soil from a solution of calcium bicarbonate is determined.

The low rainfall of Central Otago and the scanty vegetation have resulted in soils low in organic matter and high in soluble salts. The prevailing colours of the soils are grey and yellow-brown. These soils belong to a distinct group which is in marked contrast to the many New Zealand soils showing podsolized characteristics.

The black colour and high content of organic matter found in certain Marlborough soils under a rainfall of 20 to 30 inches suggests the possibility of the presence of typical 'Chernozem' or 'Black Earth.'[6] A study of the profile of these soils, however, has not been made.

Many soils covering mountainous country consist largely of fragments of partly weathered rock. In other localities eruption of volcanic material in recent times has covered the country with comparatively unweathered rock fragments. In such cases little profile development is visible, and according to the classification of prominent Russian workers, the soils of these areas would all fall into a particular group named 'Skeleton' soils.[7]

On a basis of soil profiles, it is probable, therefore, that New Zealand soils could be classified into four main groups. Investigation will, no doubt, enable suitable subdivisions of podsolized soils to be made, e.g., typical podsols, brown forest soils, etc.[8]

III. INFLUENCE OF GEOLOGY ON SOIL PROPERTIES

Many detailed studies of the soils in particular localities of New Zealand have been made. In certain cases, particularly at Nelson, surprising differences in the characteristic properties of the soils may occur within a restricted area. These differences are attributable to the varied geology of the districts and the fact that erosion and denudation of hill country and the accretions on the flood plains prevent the development of mature soils. Under these circumstances, the composition of the parent rock influences greatly the characteristic properties of the soil.

One striking illustration of the very great effect of geology on soil properties may be cited from the Nelson district. Here ultra-basic rocks, basic igneous rocks, granite and quartzite, limestone, triassic shales and sandstones, Maitai slates, sandstone and greywacke and old gravel formations are exposed.

Very striking differences in textural properties and in the fertility of the soils associated with the different geological formations occur. In several cases not only is there a great difference in the carrying capacity of pastures associated with the soils, but serious stock ailment occurs on at least two of the soil types.

6. A climatic soil type of continental regions with low rainfall, characterized by high humus content lacking recognizable structure to great depths, and by containing large quantities of plant food, and concretions of carbonate of lime.

7. Soils in which the original character of the rock particles has not been completely masked by the soil-forming processes.

8. Soils of the Podsol group formed under moist, cool conditions, but in which the sesqui oxides are distributed throughout the weathered parts instead of all being deposited in the lower horizon.

Not only do soils located on particular geological formations of the Nelson district show marked differences in characteristics, but the alluvial soils of the plains show similar variations dependent largely on the nature of the material brought down by the rivers and deposited on the plains. In certain cases, even the soils in the upper courses of the rivers differ greatly from those deposited near their mouths. The Motueka River soils afford a striking example of great variation. In the upper courses, the soils are largely derived from material brought from the 'Mineral Belt' country (ultra-basic rocks). The soils possess low fertility, and difficulty is experienced in growing the usual crops. In the Riwaka district the Motueka River has formed a large alluvial plain of extremely fertile soils. The parent material deposited in the Riwaka district comes from hornblende gneiss, limestone, granite and weathered gravel formations. It is not surprising, considering the diversity and potential fertility of several geological formations to which the Motueka River and its tributaries have access in their lower courses, that the soils of the Riwaka plain are so fertile.

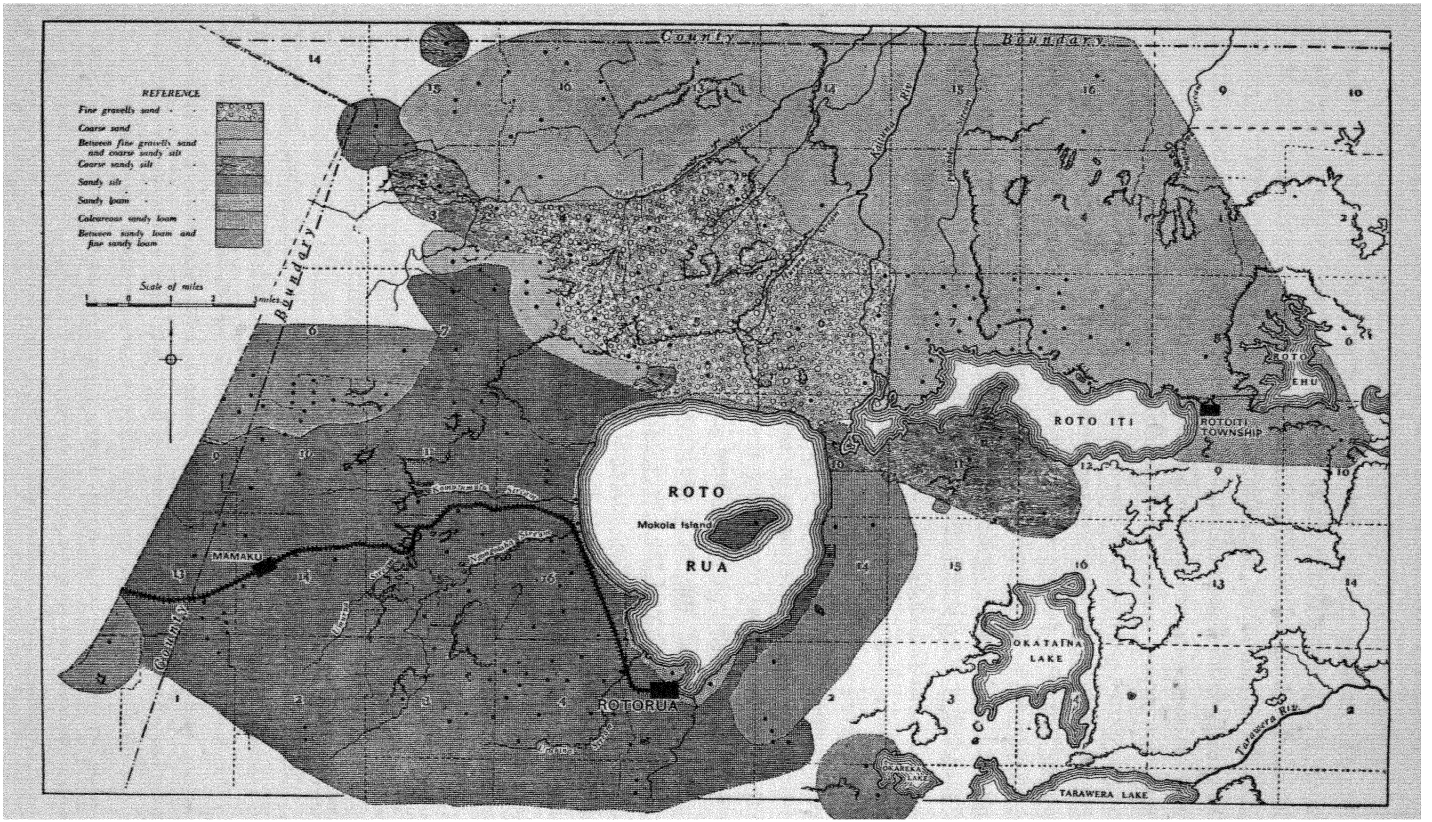
The important part played by geology in determining the characteristic properties of Nelson soils is only one illustration out of many which could be quoted concerning the influence of geology on the nature of soils in different parts of New Zealand. The mica-schist soils of Central Otago and Westland are outstanding in their high content of available phosphate, and the Otago soils owe much of their high fertility when irrigated to the parent material from which they are derived. The climate, however, determines the method of utilization of mica-schist soils. In the wet west coast, cattle farming is predominant, but in the dry central districts sheep are almost alone pastured.

The volcanic soils of the central North Island territory show surprising differences in fertility and in the health of stock grazing the pastures associated with them.

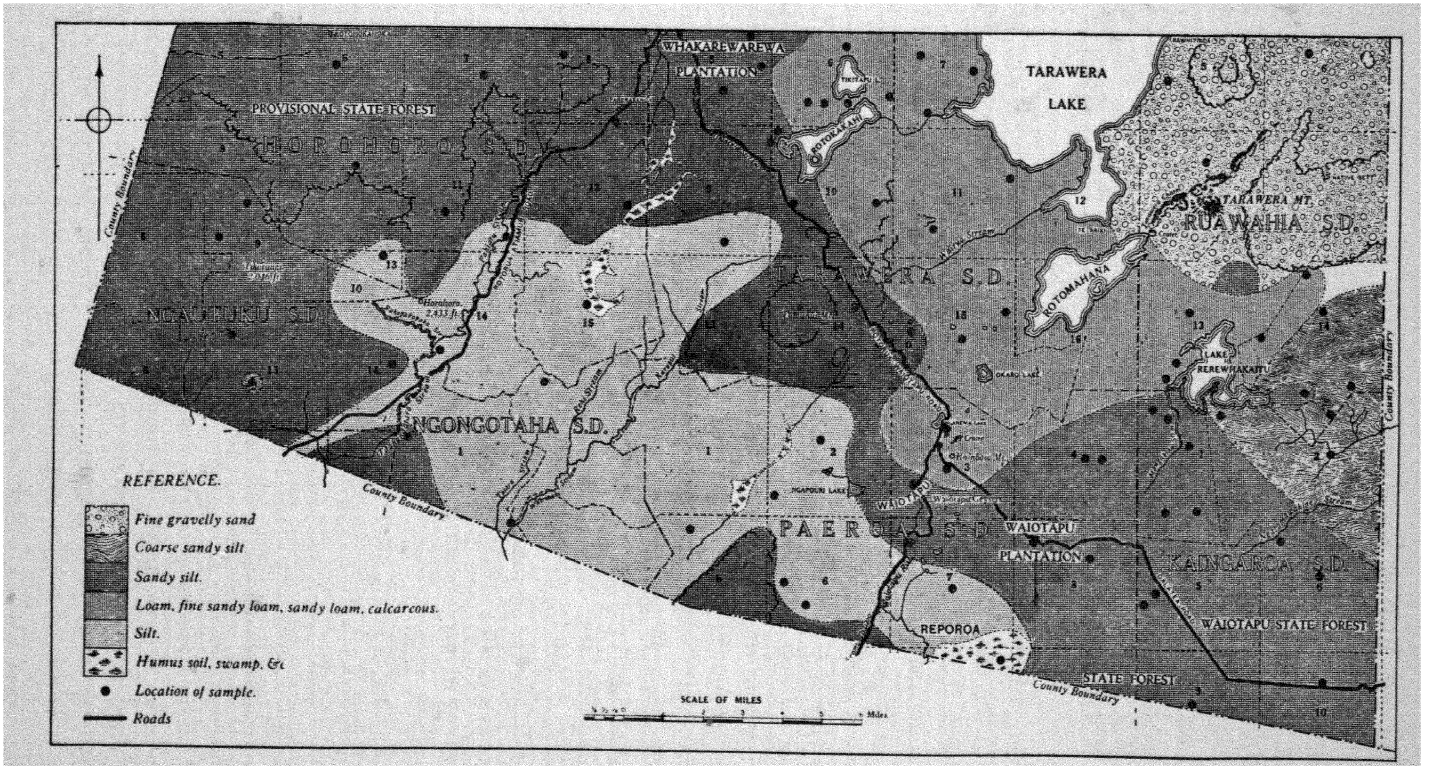
Andesitic volcanic showers usually give rise to fertile soils, but rhyolitic volcanic showers in the central district present difficulties in their utilization for agriculture.

Detailed soil studies of particular areas have been made by Aston and his colleagues in different parts of New Zealand, by Ferrar in Central Otago, by Grange and Taylor in the volcanic districts of the North Island, by Rigg and his assistants in the Nelson Province, and by Wild in Canterbury and Southland. (See Bibliography.)

In all districts where detailed surveys have been made, a considerable number of different soils have been identified and described. Great variation in textural properties and in content of organic matter frequently occur. The following two maps of the first soil survey conducted in New Zealand show these variations clearly:—


REFERENCE
Fine gravelly sand
Coarse sand
Between fine gravelly sand and coarse sandy silt
Coarse sandy silt
Sandy silt
Sandy loam
Calcareous sandy loam
Between sandy loam and fine sandy loam
Scale of miles
County Boundary
ROTO
Mokoia Island
RUA
ROTO ITI
ROTOITI TOWNSHIP
ROTO EHU
MAMAKU
ROTORUA
OKATAINA LAKE
TARAWERA LAKE
Tarawera Rus

Map 11


WHAKAREWAREWA PLANTATION
TARAWERA LAKE
PROVISIONAL STATE FOREST
HOROHORO S.D.
TARAWERA MT.
RUAWAHIA S.D.
TARAWERA S.D.
NGAURUKU S.D.
ROTOMAHANA
LAKE REREWHAKAITU
NGONGOTAHA S.D.
PAEROA S.D.
WAIOTAPU PLANTATION
KAINGAROA S.D.
REPOROA
WAIOTAPU STATE FOREST
STATE FOREST
County Boundary
REFERENCE.
Fine gravelly sand
Coarse sandy silt
Sandy silt.
Loam, fine sandy loam, sandy loam, calcarcous.
Silt.
Humus soil, swamp, &c
Location of sample.
Roads
SCALE OF MILES
Miles

Map 12

Similar but less striking variations in soil reaction[9] and lime status have been found in the soils of particular localities. Not infrequently soils well supplied with available plant food and lime have been found in close proximity to soils highly deficient in both plant food and lime.

In this short article it is, therefore, impossible to describe in detail the different soils which have been identified; it is proposed, however, to comment on some of the more striking features of representative soil types in different parts of New Zealand.

IV. THE VOLCANIC SOILS OF THE CENTRAL NORTH ISLAND TERRITORY

Investigations in New Zealand have shown that a very large area of country in the central districts of the North Island is covered by volcanic ash showers from the eruptions of volcanoes in the Rotorua zone, in the Taupo zone, including Mts. Tongariro and Ngauruhoe, and of Mt. Egmont. These extensive air-distributed deposits were noticed, although frequently not identified or mapped, by the early surveyors, particularly by S. Percy Smith, Surveyor-General, and by geologists, particularly H. Hill, of Hawke's Bay.

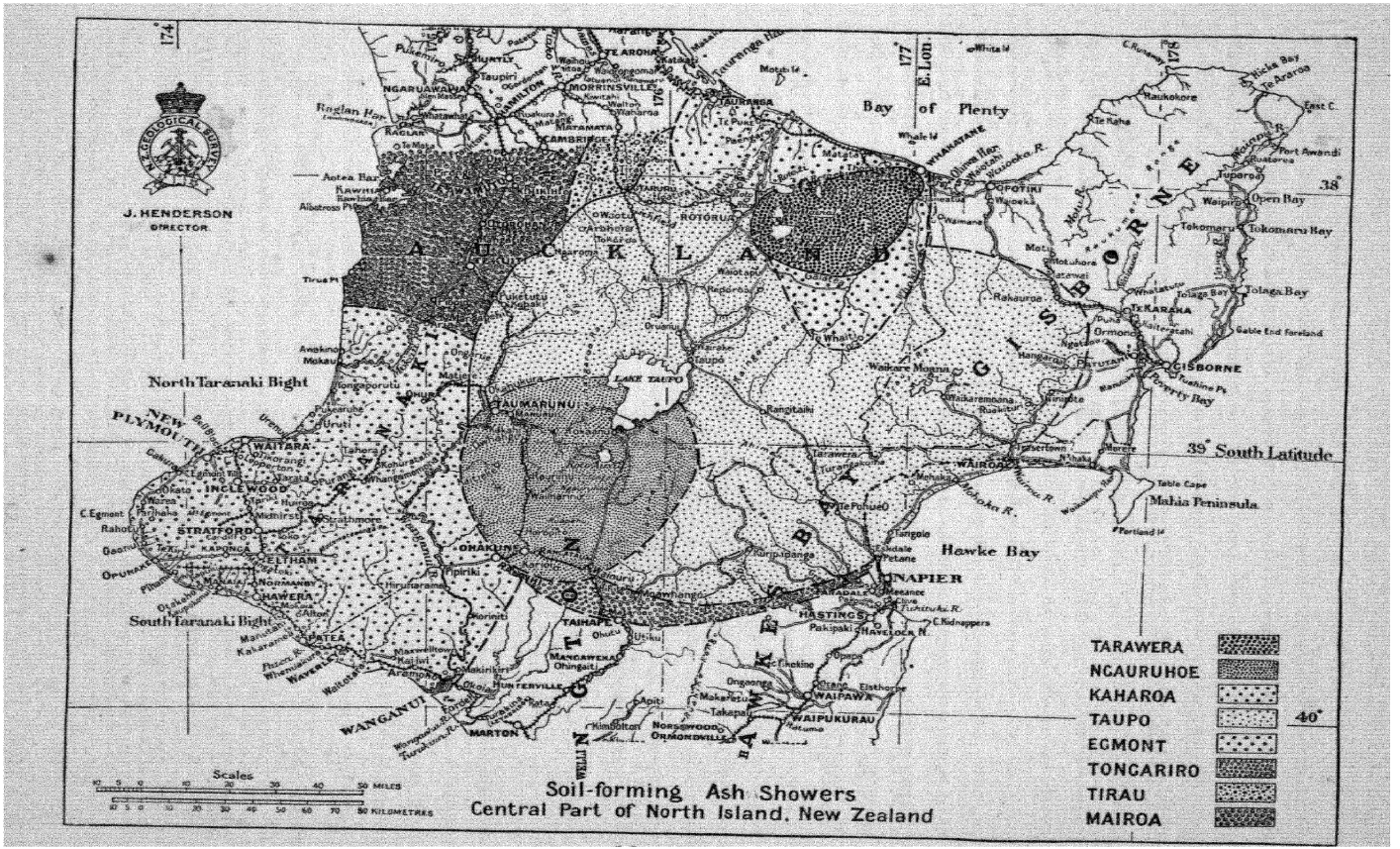
The whole of the country between New Plymouth and Napier and between Wanganui and the Bay of Plenty has been covered by volcanic ash from eruptions in one or more of the zones previously mentioned. Where the country is steep much of the volcanic ash has been removed by slumping and by erosion. Nevertheless the volcanic ash showers have been responsible for the derivation of the major soil types throughout the whole central territory.

The following account taken from Messrs. Grange and Taylor's paper 'The Occurrence of Bush Sickness on the Volcanic Soils of the North Island' gives a brief description of the major soil types which have been delineated:—

'(1) The Mairoa shower, dark brown in colour, occurs in the Te Kuiti, Mairoa (west of Te Kuiti), Te Awamutu and Kawhia districts. It is derived chiefly from eruptions of Mt. Egmont—an andesitic volcano—together with some rhyolite from the Rotorua and Taupo centres. The soil which belongs to the loam category is well leached of lime, magnesia and soda.

'(2) The Egmont showers comprise at least two showers of different epochs which came from Mt. Egmont. The older ash, dark brown in colour and speckled with white crystals of feldspar extends northward to Aria and south-eastward to Wanganui. In the Ohura, Matiere and Ongarue districts it is mixed with a small amount of rhyolitic ash. The soil which

9. The degree of acidity or alkalinity of the soil.


N.Z. GEOLOGICAL SURVEY
J. HENDERSON
DIRECTOR
Soil-forming Ash Showers
Central Part of North Island, New Zealand
Scales
MILES
KILOMETRES
North Taranaki Bight
South Taranaki Bight
Bay of Plenty
Hawke Bay
39° South Latitude
40°
38°
TARAWERA
NGAURUHOE
KAHAROA
TAUPO
EGMONT
TONGARIRO
TIRAU
MAIROA

Map 13

has a loam texture is well leached of the strong bases. The younger ash extends from the mountain eastwards at least as far as Stratford. It is coarse in texture and little weathered.

'(3) The Tirau shower, which forms the soil in the Tirau and Putaruru districts is rhyolitic in composition though the fact that the lime, magnesia and phosphoric acid content is somewhat above that of showers known to consist entirely of rhyolite suggests that it is admixed with a little andesite. It resembles the Mairoa soil in appearance and texture.

'(4) The Tongariro shower, erupted from the andesite volcano of that name, was blown a long distance to the north to near Putaruru and eastwards to near Napier, but in these directions it is covered with Taupo pumice. South-east of Tongariro it forms the soil along a narrow belt extending from Raetihi to Napier. Good sections of it are seen at Kihitahi north of Taihape, where the ash is dark brown in colour and of a loam texture. In composition it resembles unweathered andesite. The strong bases have suffered loss by leaching but not to the same extent as in soils derived from the earlier of the Egmont showers.

'(5) The Taupo shower is the most widespread. It had its origin in Lake Taupo and spread chiefly to the eastward. The ash is rhyolitic in composition, contains a good deal of pumice and is coarse in texture.

'(6) The Kaharoa shower, composed of rhyolite fragments, came from a crater south of Lake Rotoiti and extends north of Tauranga and south of Te Whaiti. It is light-coloured, loosely consolidated and very coarse in texture.

'(7) The Ngauruhoe ash, andesite in composition, occurs within a circular area of about thirty miles radius round Ngauruhoe volcano. The deposit consists mainly of dark fragments of scoriaceous andesite. Ash and scoria from present-day eruptions of Mount Ngauruhoe continue to add to the thickness of the deposit in some localities. Dust from an eruption which took place a few years ago was carried as far as Rangipo Prison Farm, ten miles north-east of the volcano. The texture of the ash is that of a sandy silt.

'(8) The Tarawera shower, occupying a relatively small area, is the product of the Tarawera eruption of 1886. From Tarawera it extends a short distance south-westward reaching nearly to the Rotorua-Waiotapu road; to the north-east it extends to Whakatane. The deposit is made up of two different kinds of ash. East of a line joining lakes Rerewhakaitu (south-east of Lake Tarawera), Tarawera and Okataina, it consists of dark basalt lapilli forming a coarse soil, whereas to the west of these lakes it is grey mud (a loam in texture), composed of rhyolite ash with a small admixture of basalt.'

Over considerable areas of country shown in the map of volcanic soils, resortment of ash from different sources has taken place. Such admixtures of volcanic ash occur on the plains of the Waikato, of the Whakatane and of other rivers. In the case of the Waikato plains rhyolitic fragments form by far the greater part of the parent material from which the soils have been derived.

The volcanic soils, covering as they do such a large area in the North Island, are of great importance in New Zealand agriculture. The valuable dairying industries of the Waikato and Taranaki are both located on soils derived from volcanic ashes. In both cases good results with high production of butter-fat have been secured by farmers in these districts.

In other localities stock ailment associated with particular volcanic soils has retarded agricultural development. Bush-sickness has long been recognised as a serious stock ailment affecting ruminant animals on several localities in the vicinity of Rotorua. More recently bush-sickness has been identified at Kopaki, 35 miles south-east of Te Kuiti, and at Ngaroma, 25 miles south-east of Te Awamutu.

At Mairoa, 15 miles west of Te Kuiti, farmers have suffered considerable loss of sheep from a stock ailment which has certain symptoms similar to bush-sickness. Aston and his colleagues have shown that the soils in this locality are very deficient in lime, and that great improvement both in carrying capacity and in stock health is effected by topdressing with a mixture of lime and superphosphate.

V. NORTH AUCKLAND SOILS

The northernmost peninsula, from Kaipara to the North Cape, shows a variety of soil types, falling into three main groups:

A derived from wind-blown sand.

B derived from soft tertiary sandstones, grits and conglomerates.

C derived from harder more ancient basalts and andesites.

A. The wind-blown sands occupying most of the middle and southern portions of the peninsula comprise four principal types:—

(1) Fore-dunes of the western beaches composed of sand-grains of varied and only partially weathered rocks.

(2) Ancient fixed dunes composed of originally similar materials to (1), but more weathered and partially cemented.

Both these types carry a heath vegetation dominated by low-growing *Leptospermum scoparium*. There is evidence that the ancient fixed dunes were once in part covered with Kauri forest. Plant foods are very deficient in these soils, which are also very acid, but on account of their sandy nature would probably respond well to liming and manuring.

(3) Wandering dunes, requiring sand binding plants to stabilise them before agricultural development is carried out.

(4) Fore-dunes of the eastern beaches, composed of nearly pure silica sand, and hence worthless agriculturally.

B. The soils derived from the soft tertiary sediments occupy areas of hilly country of comparatively low relief north of Parengarenga Harbour. They were originally clothed with Kauri forest, and are fairly typical 'gumlands' soil. Sections show the profile to be a podsol. They have a high clay content, a pH as low as 4·6, and are very deficient in plant foods. The present vegetation is low *Leptospermum scoparium* heath. Agricultural development would be expensive at present.

C. The older and harder basalts and andesites form hills with steep and broken contours. The soils derived from these rocks have an irregular distribution, but are well defined in the extreme north-west portion of the peninsula. The soils in this area are reddish in colour and immature in profile, containing concretions of ironstone as well as fragments of country rock. It is considered that they represent the lower or 'B' horizon of a podsolized soil, the upper or 'A' horizon of which has been partially or wholly (according to the slope) removed by erosion probably following the destruction of the mixed rain forest in pre-European days. The present vegetation is dominated by *Pteridium esculentum*. Although of high clay content, and very deficient in 'available' plant foods, they are somewhat less acid and have greater 'total' plant foods than 'B.' Their more open and gritty nature also makes them more amenable to cultivation, especially for horticulture. At present a company is planting portions of the area with tung-oil trees.

VI. BAY OF PLENTY SOILS

The soils of the Bay of Plenty are mainly derived from volcanic ash. Between Tauranga and Matata sandy soils predominate. These soils consist mainly of rhyolite particles from the Kaharoa shower. They are naturally well-drained and are suited to intense cultivation.

Between Matata and Opotiki dust from the Tarawera eruption has greatly enriched the soils in lime, magnesia and potash. The Rangitaiki and Whakatane Rivers have deposited much silt brought from different sources, but in the case of the Rangitaiki River plain, the enrichment of the soil by basaltic ash brought down by the Tarawera and Rangitaiki Rivers is very pronounced. A considerable area of swamp land occurs in the Rangitaiki basin, but this land when drained gives excellent pastures.

Bay of Plenty soils are generally deficient in phosphate, and pastures require liberal topdressing with phosphatic manures (see *N.Z. Journal of Agriculture*, 1921, Vol. xxii., p 223, 'Some Bay of Plenty Soils,' by B. C. Aston).

VII. POVERTY BAY SOILS

The hill country in the vicinity of Poverty Bay belongs to the Oamaru geological formation. Calcareous mudstones are exposed, and these have contributed much material in the formation of the more recent alluvial flats of the Waipaoa River. After heavy floods much silt and sand is deposited, and analyses have shown that the deposit is rich in lime, available phosphate and potash. These alluvial flats are of high natural fertility, and give excellent results with pasture, maize and other crops.

Older terraces of pumice—probably from the Taupo centre—occur on higher levels. These pumice soils differ widely in properties from the recent alluvial soils of the Waipaoa River. The pumice soils are somewhat coarse in texture and are deficient in available phosphoric acid (see Aston, *N.Z. Journal of Agriculture,* 1918, Vol. xvii., pp. 196-200, 'Notes on Some Poverty Bay Soils').

VIII. HAWKE'S BAY SOIL

Hawke's Bay is fortunate in the possession of a large area of fertile soil which is used for fruit culture, pastures and arable farming. Considerable variation both in texture and in the characteristic properties of the soils is found in different parts of the Province and even in the alluvial soils of the plains. This is not surprising, for the rivers have access to country of widely different parent material. The whole district has in the past been within the zone of volcanic ash deposition, and on gentle slopes remnants of early ash showers can still be found. The rivers rising in the Kaimanawa Mountains must have brought down on to the plains a large quantity of volcanic ash from different eruptions in the Taupo zone. This admixture of material is probably responsible for the high productiveness of many alluvial soils of Hawke's Bay.

IX. SOILS OF THE WAIRARAPA

As might be expected from the topography and geology of the Wairarapa, considerable variation of soils occurs. The soils of the hills are derived from sandstone, limestone, papa, conglomerate and greywacke. The soils of the plains are invariably more fertile than the hills. Considerable variation in the lime status of the soils has been found, which is in keeping with their derivation from different geological formations. The soils are usually low in available phosphoric acid, and pasture analyses have shown that in midsummer and in autumn a deficiency of phosphoric acid is likely to occur in many pastures if drought is experienced. A great range in soil texture is found, but loams, silt loams and sandy loams are most common (see *N.Z. Journal of Science and Technology,* Vol. xii., 1931, pp. 304-320, 'The Wairarapa District,' Aston and others).

X. SOILS OF THE MANAWATU

Three well-defined groups of soil occur on the plains between Palmerston North and Paekakariki. These are:

(1) the blown sands of the coast;
(2) the swamp soils located for the most part behind the sand-dune country; and
(3) the silts and loams of the river flats and terrace lands.

In the case of the swamp soils and of the river-flats, considerable variation both in texture and properties are frequently encountered. This is not surprising, for the Manawatu brings silt and sand from the eastern face of the Tararua Mountains, the Ruahine Mountains, the Pukatoi Hills, and from the Wairarapa Plains, while the Ohau, Otaki and Waikanae Rivers drain country of more restricted geological origin on the western side of the Tararua Mountains. In addition sand blown in from the coast has contributed greatly in a number of cases to the textural qualities of soils both in the swamp-humus and loam categories.

The swamp soils have resulted through the blockage of the outlets of the western rivers by sand drift. They are rich in organic matter, well supplied with available potash, and usually rather low in available phosphoric acid. Despite their acid reaction they contain notable quantities of lime and other bases which can be extracted by hydrochloric acid. The swamp soils have been drained to a great extent, and are being used for dairying pastures and the culture of New Zealand flax (*Phormium tenax*).

At least four distinct textural types have been noted in connection with the alluvial soils and elevated terrace lands of the Manawatu. These types are as follow:—

(1) *Silt Loam.*—Much of the land bordering the Manawatu River belongs to this type. All the soils of this type in the vicinity of this river are low in available and total phosphoric acid. Potash, however, is in very good supply. The hillside soils of Waikanae are also low in phosphate, but the Paekakariki soils of the silt loam category are well supplied with both phosphate and carbonate of lime.

(2) *Sandy Loam.*—These soils contain a higher proportion of sand and have a fairly general distribution on much alluvial land in the Manawatu. As a rule they are well supplied with potash but are deficient in phosphate.

(3) *Otaki Sands.*—These soils are derived from old consolidated sand-dunes at Otaki, Manakau and Shannon. The percentage of coarse sand in these soils approximates to 40 per cent. They contain very small quantities of silt and clay. Chemically they are deficient in phosphate but well supplied with potash.

Omitting the peaty soils of the swamp lands, the lime-requirement figures for Manawatu soils are lower than those of many other North Island soils. The soils, however, contain comparatively high percentages of lime and other bases which can be extracted by hydrochloric acid (see *N.Z. Journal of Agriculture,* Vol. xx., p. 273, Vol. xxi., pp. 57, 105, 'Soils of the Manawatu District,' Aston).

XI. SOILS OF NELSON AND TAKAKA

In these districts geology has a profound influence both on the texture and chemical properties of the soils. The districts contain some of the poorest soils in New Zealand and some of the most fertile. The soils derived from serpentine rocks of the 'Mineral Belt' country,[10] the Pakihi soils of Onekaka and the Moutere Hills soil derived from much weathered gravels of that name are well known for their infertility. In each case high deficiencies of plant foods occur, particularly in regard to lime and phosphate. In the case of the 'Mineral Belt' country it is thought that the very high content of magnesia likewise proves detrimental to plant growth. (Aston, Magnesia and Plant Growth,' *N.Z. Journal of Agriculture,* Vol. xi, 1915, p. 493.)

Experiments have shown that provided lime and phosphate treatment has been given to Moutere Hills and Pakihi land, satisfactory pastures can be established. The Moutere Hills soil has been utilised for apple culture at Tasman, Mapua, and other places in proximity to the sea. Experience has shown that provided attention is paid to the manurial treatment of the land excellent crops of high quality can be grown.

Much variation in the properties of alluvial soils are found in the districts. Great textural changes and chemical differences occur frequently in restricted areas of the soils. This is largely due to the striking differences in the parent rocks to which the streams and rivers have access. The Riwaka plain is noted for its soils of excellent textural qualities—loams and fine sands—and of high plant food content. These soils are extensively used for hops, tobacco and small fruit culture.

In the Takaka district, extensive areas of the alluvial soils are devoted to pasture, which under the higher rainfall of that district give excellent results.

The majority of Nelson and Takaka soils require lime treatment and show great response to phosphatic manuring. Experience has shown the importance of including potassic manures in the manurial programme for hops, tobacco, small fruits, and on certain fruit lands for apple culture.

10. A long narrow strip of ultra-basic igneous rocks running from D'Urville Island to a little north of Lake Rotoiti characterized by a peculiar plant association of low shrubs and herbs giving it a brown appearance in contrast to the green of the beech forests on adjacent geological formations.

Certain pasture lands located on light soils with a high content of organic matter have also been shown to respond to potassic manures.

XII. SOILS OF THE SOUTH ISLAND WEST COAST

One of the most striking features connected with the West Coast soils is the large area of Pakihi lands. These lands grow a stunted vegetation of rush and fern. The surface soil is a sandy silt containing a high percentage of organic matter. It is underlain by grey or greyish white fine sand which in its turn rests on a pan of iron and humus compounds. The Pakihi soil contains very small amounts of lime and phosphate, and owing both to the 'pan' and colloidal properties of the soil, the surface is wet and drainage slow.

Experiments have given very promising results for the utilization of the Pakihi lands for dairying pastures. Very successful establishment of pasture has been secured by burning the 'Pakihi' vegetation, liming at the rate of not less than 1 ton of ground limestone per acre and treatment with 5 cwt. of superphosphate or basic slag per acre. The experiments have shown that the presence of the 'pan' under the high rainfall conditions of the West Coast does not prevent luxuriant growth of grasses and clovers, provided lime and phosphatic treatment has been given.

The more recent soils of the West Coast river systems are usually fertile. They contain comparatively large quantities of available phosphate, but as a rule lime treatment is required in order to secure optimum growth of pastures (see *N.Z. Journal of Agriculture,* Vol. i., p. 22, 1910, and Vol. vii., p. 295, 1913—Aston).

XIII. MARLBOROUGH SOILS

Notable features in connection with Marlborough soils are the comparatively large areas of highly fertile soils in the Wairau and Awatere Valleys and the presence of much limestone and calcareous sands on the coastal belt extending from the Awatere Valley to Kaikoura.

Several geological formations have contributed material to the alluvial soils of the Wairau and Awatere Valleys. The soils for the most part are well supplied with plant food and have a low lime-requirement figure. They contain large amounts of lime, magnesia and other bases soluble in hydrochloric acid. Owing to the low lime-requirement of many Marlborough soils, lucerne thrives in a wonderful way. The low rainfall, the excellent textural and chemical properties of the alluvial soils favours seed culture, and much land is devoted to lucerne, peas and other seed culture.

Although the recent soils of the Wairau Valley are so fertile, it must be remarked that old gravel deposits bordering the Wairau River are deficient in lime and phosphate, resembling the Moutere Hills, Nelson, in many ways.

XIV. SOILS OF THE CANTERBURY PLAINS

Wild (*Journal of Agricultural Science*, Vol. viii., 1916, p. 165) stated: 'As would be expected from the mode of origin of the Plain, every sort of soil is to be found on the surface, from rich loams overlying clay subsoils to thin shingly soils on gravel beds. It is not possible, therefore, to divide such a district in a thoroughly satisfactory way into even relatively small areas each of which shall be characterized by a soil of constant physical and chemical properties.' The Canterbury Plains extend from Waipara in the North to the vicinity of Timaru in the South. They are widest at Rakaia, and narrow rapidly in the North and South where the foothills approach the coast. They consist of gravels, sand, silt and clay brought down by the rivers draining the Southern Alps. In places loess—considered by several authorities to be rock-flour derived from glacial action—covers the river deposits.

Wild gives the following description of the Canterbury Plains: 'The main types of country met with are three:

(1) The light and sometimes stony country bordering the foothills; in North Canterbury is an area of some 80,000 acres of manuka[11] and other scrub awaiting reclamation;

(2) The typical, originally tussock-covered plains land, the soils of which vary from light and stony, as at Burnham, to heavy silts as at Ashburton;

(3) The swamp areas, along the coast in the vicinity of the river mouths. The second type of soil responds immediately to the plough and seed-drill.'

The Canterbury plains are noted for their wheat and cereal culture, but peas, turnips and rape also do well. Phosphatic manures are most important for all crops and in recent years it has been shown that a profitable increase in yield of wheat and barley has been obtained by supplementing phosphatic manures with ¾ to 1 cwt. per acre of nitrogenous manure such as ammonium sulphate.

XV. SOILS OF SOUTH CANTERBURY

Some highly fertile soils occur in the vicinity of Waimate and Timaru. Yields of cereal crops are high and at Waimate small fruits—particularly strawberries and raspberries—give excellent crops. The soils of the Timaru Downs are derived from a wind-borne loess. They belong to the clay loam and loam category.

The Pareora Downs and the Mackenzie Country are largely pastoral. The country is either too broken or the rainfall too low for great success with farm crops.

11. *Leptospermum scoparium.*

While Canterbury soils are comparatively well supplied with lime and have low lime-requirement figures, recent experiments by the Department of Agriculture indicate that lime treatment gives a marked response in a number of localities.

XVI. SOILS OF CENTRAL OTAGO

Central Otago is the district of lowest rainfall in New Zealand. Certain localities receive under 15 inches per annum, while a large area has less than 20 inches per annum. Evaporation of moisture from the surface is high. This fact combined with the low rainfall prevents leaching of soluble salts and favours the accumulation of alkali and other salts near the surface. As might be expected in country of such low rainfall the vegetation is sparse. Large areas are in tussock[12] which supports about one sheep to seven acres.

Considerable areas of flat or gently sloping land have now been irrigated[13] and are used extensively for fruit and lucerne culture. In places the very porous nature of gravel and sand beds underlying the topsoil makes it difficult to secure optimum efficiency in the use of irrigation water.

Ferrar, in classifying the soils of the Waipiata, Galloway, Alexandra, Roxburgh, Cromwell and Queenstown localities, divides the soils into five series based on their geological origin. The Vincent series derived from disintegrated schist is the most important of these series. Soils of this series cover large areas in the Naseby, Blackstone, Lauder, Clyde, Ranfurly and Cromwell districts. Within the Vincent series Ferrar, without giving any analyses, has mapped three textural types: clay, silt loam and stony loam. The stony loams belonging to the Vincent series are subdivided into nine sub-types dependent mainly on topography and variations in the underlying formations.

The mica-schist soils of Central Otago possess some unusual features. The low rainfall and sparse vegetation does not favour the accumulation of organic matter in the soils and these are consequently low in both nitrogen and organic matter. The finer grades of mica-schist pack down very tightly owing to the flaky nature of the particles. On this account drainage on bottom-lands is slow and aeration poor.

Chemically the mica-schist soils are unusually well-supplied with all plant foods; the high content of available phosphoric acid being oustanding. The high content of available phosphoric acid is characteristic of many mica-schist soils of New Zealand and appears to be associated with the chemical composition of the mica-schist rather than with particular

12. See L. Cockayne, *N.Z. Journal of Agriculture*, 1919, Vol. xviii, pp. 1 and following.
13. See Tennant and Marks, 'Irrigation and Its Practice,' *N.Z. Journal of Agriculture*, 1924, Vol. xxviii, pp. 252-267 (96).

rainfall conditions (see *N.Z. Journal of Agriculture*, 1923, Vol. xxvi, p. 329 —'The Mica Schist Soils,' Aston).

XVII. SOILS OF THE SOUTHLAND PLAIN

The Southland plain lying between the Mataura and Aparima rivers is becoming of increasing importance to the dairying industry of New Zealand. The plain has been formed by the deposition of material brought by the Mataura, Oreti and Aparima rivers from the mountain chains which encircle the plains on the east, north and west.

Wild, in describing the soils of the Southland plain, states that the plain can be divided into two areas: '(1) A low plateau varying in elevation from 50 ft. on the seaward margin to a 1,000 ft. where it reaches into the mountain valleys. This plateau has been dissected into undulating country by the numerous streams consequent upon the fairly heavy rainfall. (2) A flat low-lying area fronting the plateau from its edges to the sea and including also the river flats in the lower part of their courses.

'The soils of the district fall fairly well into divisions based on these structural considerations and we have: (1) Shingly soils in the inland and more elevated parts. (2) Good deep loams underlain by deep clay beds on the rest of the plateau. (3) Alluvial soils, resting on gravels on the marginal flats and in the river-beds.'

Wild has shown that the soils of the plateau have been more leached and stand in greater need of lime than those of the river flats. The average lime-requirement figure for 26 samples from localities where liming was known to give a very definite response was 0·19 per cent. calcium carbonate. In the case of the river flats where the response to lime treatment is much less marked the average lime-requirement figure for 15 soil samples was 0·135 per cent. calcium carbonate. The amount of lime (CaO) soluble in strong hydrochloric acid was almost twice as great in the alluvial soils than was the case with the more lime-deficient soils of the plateau.

XVIII. LITTORAL AND ESTUARIAL SOILS

In a general description of the soils of New Zealand mention must be made of the various types of 'waste' lands, mostly bordering the seacoast, and including (1) sand dunes, (2) estuarial mud flats, lagoons, shallow lakes, and other areas permanently or temporarily submerged by fresh, salt, or brackish water.

The problem of the economic utilization of these lands has been approached through a detailed examination of the chemical and physical properties of the soils, and a study of the plant covering associated with the various soil types.

In cases where land reclaimed from the sea is to be brought into cultivation, success depends to a considerable extent on the soil texture, as a preponderance of clay particles would hinder the removal of the excess of salts during subsequent drainage. In the areas which have so far been studied there is considerable variation in soil texture, but it is encouraging to find that heavy clays do not as a rule occur.

Chemical analysis of the above-mentioned types shows on the whole a high proportion of available plant food, especially calcium and phosphorus, which are derived largely from the remains of marine life. The Hauraki plains soils near the sea, for example, contain about six times as much available phosphoric acid as that found in normal fertile soils.

The areas which have been most intensively studied are (1) Lake Ellesmere (Canterbury), a shallow lagoon of brackish water 100 sq. miles in extent; (2) parts of the Hauraki plains adjacent to the sea; (3) the Napier-Ahuriri lagoon; and (4) areas reclaimed or proposed for reclamation in the vicinity of Kaipara and Whangarei harbours (North Auckland). The Napier-Ahuriri lagoon lands were formed as a result of the Napier earthquake, which raised parts of the sea-bottom completely above water-level, and caused serious shallowing over a considerable area of the inner harbour.

The type of crop which can be grown on recently reclaimed land naturally depends on the salt content of the soil. Sodium, and especially magnesium salts in the concentrations which are usually found are toxic to most plants, and pasture and crops intolerant of salt cannot, therefore, be grown until drainage has reduced the excess of salts. It has been suggested, however, that certain cruciferous vegetables and also asparagus and other crops, which are tolerant of a fair amount of salt, may be profitably grown until such time as the land is fit for other purposes.[14]

XIX. MINERAL DEFICIENCY AREAS IN NEW ZEALAND[15]

Much attention in recent years has been devoted to the mineral composition of pastures grazed by stock. It has been found that great variation in the mineral composition of different pastures may occur and that particular deficiencies of lime, phosphate, iron and iodine are responsible for stock mortality or unfavourable returns from the stock industry.

Such stock ailments do occur in New Zealand and much work—particularly during the last five years—has been carried out in order to

14. Acknowledgments: In writing the foregoing article on the soils of New Zealand, the writers have drawn freely on material embodied in many published papers of different authors. In addition, use has been made of certain unpublished data referring to Nelson soils. In connection with that part of the paper dealing with Nelson soils one of the authors desires to acknowledge the valuable help given by his former assistants, Messrs. J. A. Bruce and L. Bishop, in the conduct of soil surveys in the Nelson territory.

15. The following sections are by B. C. Aston.

ascertain the nature of these deficiencies and the extent of country affected by them.

As a deficiency of minerals in the pasture must necessarily be closely connected with particular soil characteristics a short description of the different animal deficiency diseases of New Zealand, and the areas affected is included in this brief description of New Zealand soils.

The known deficiency diseases in New Zealand apparently mainly due to the lack of some element in the food of farm animals are:—

'Bush Sickness' or Iron deficiency.
'Dopiness' or Calcium deficiency.
'Waihi Disease' or Phosphate deficiency.
'Goitre' or Iodine deficiency.

All of these diseases are curable by treating either the soil or the animal with the element alleged to be deficient. With the exception of goitre, which is also found in horses and dogs, the above diseases are restricted to ruminants which include cattle, sheep, deer and goats. In the case of 'bush sickness' it is, however, likely at any time that pigs which are grazed on bush-sick pasture may be added to the list of animals affected since it is known that pigs are susceptible to iron deficiency, and an instance is given in Florida, U.S.A. (Bulletin 231, University of Florida; R. B. Becker, W. M. Neal, and A. L. Shealy (1931)), where grazing pigs suffer from a disease similar to 'bush sickness' and are curable by iron remedies to which a small amount of copper has been added.

'Bush sickness' and 'dopiness' are found in the same county of Waitomo or on adjacent ones but on different soils derived from different volcanic showers. Bush sickness is always found in the volcanic district on coarse rhyolitic pumice soils and 'dopiness' on soils derived from fine volcanic dust or mud showers. A soil on which 'dopiness' develops is a leached loam and is found on deteriorated lands, i.e., lands which originally were highly fertile due to the ashes from the 'bush burn,' the land subsequently becoming gradually less productive and the good pasture plants, red and white clovers, ryegrass and cocksfoot, which were at first abundant, afterwards dying out, and the land becoming gradually less productive owing to the replacement of good by poor pasture plants such as redtop (*Agrostis*), Danthonia and Chewings fescue. In this last stage of reversion 'dopiness' in sheep caused such mortality in hoggets that top-dressing with super, although it increased the carrying capacity did not eliminate the mortality which accordingly made the land unprofitable. Field experiments proved that liming the land was the remedy and when lime and superphosphate were used together as a top-dressing in the proportion of 5 cwt. ground limestone to 2 cwt. superphosphate the 'dopiness' was controlled and good returns were once more obtained from the land.

'Bush sickness' differs from 'dopiness' in always being more severe on newly broken-in country and the pasture and stock gradually do better with age. The percentage of iron present in both soil and pasture is abnormally low and the animals all recover if given appropriate iron medicinal dosage whereas if this is not given the mortality is 100 per cent. unless the stock is changed on to what is known by experience as healthy country. 'Bush sickness' is now combated entirely successfully by giving the animals a lick of limonite (hydrated oxide of iron) ground to the finest powder and mixed with salt.

Animals suffering from 'dopiness' do not exhibit any bone lesions or lameness due to swollen joints and this is a distinction from 'Waihi disease' of some importance.

'Waihi disease' in cattle gives as its most prominent symptom extreme lameness in milking cows. Epidemics of 'Waihi disease' occur in exceedingly droughty seasons in many parts of the North Island indicating a shortage of phosphoric acid in the herbage. Relief is at once obtained by dosing the cattle with phosphate solutions. The addition of superphosphate to the drinking water, 1 lb. to 100 gallons, is indicated as the quickest method of dealing with this malnutrition but regular top-dressing of the pastures with superphosphates should prove an efficient remedy in all but the droughtiest years. Both soil and pasture on analysis show extreme deficiency of phosphates (see *N.Z. Journal of Science and Technology*, Vol. xii, No. 5, pp. 304-20, 1931, 'Mineral Content of Pastures—The Wairarapa District,' B. C. Aston, and others).

A bone malnutrition trouble in sheep sometimes occurs in Wairarapa back country runs (*ibid.*).

Goitre in lambs occurs occasionally in some Otago central and Poverty Bay back country runs indicating a possible iodine shortage. There are indications that the whole west coast of the South Island is an area where iodine is generally deficient but evidence is difficult to collect (see 'Iodine Survey of N.Z. Live Stock,' by Ethelwyn Mason, *Trans. N.Z. Inst.*, Vol. lxiii, 1933).

ACKNOWLEDGMENT

The maps reproduced in this chapter have been previously published in the *New Zealand Journal of Agriculture*.

BIBLIOGRAPHY

A Bibliography of New Zealand soils is given as an appendix to this work.

Chapter VII

CLIMATE

By E. Kidson

I. General—A. Geographical Position and Relationships—B. Ocean Currents—C. Weather Régimes. II. Winds—A. Prevailing Winds—B. Relation to Fauna and Flora. III. Precipitation—A. Total Annual—B. Annual Variation—C. Influence on Fauna and Flora. IV. Temperature—A. Mean Temperature and Its Distribution—B. Annual Variation—C. Temperature Extremes—D. Diurnal Variation—E. Relation to Fauna and Flora. V. Humidity. VI. Sunshine and Cloud. VII. Phenomena—A. Snowfall—B. Ground Frost—C. Frost in Standard Screens—D. Hail—E. Thunderstorms—F. Fog.

I. GENERAL

A. Geographical Position and Relationships

THE three principal Islands of New Zealand are situated between latitudes 34° 4′ S. and 47° 2′ S. The main axis, along which lie the principal mountain ranges, runs in a north-easterly direction. From the centre of the North Island, however, a long arm which includes the Auckland Peninsula extends towards the north-west. The Islands thus present a curved appearance in the direction of their length, the concave side facing the west. The maximum width is only about a fifth of the length. Surrounding the Dominion on all sides are large expanses of ocean water, the nearest continent being the island continent of Australia, which is approximately 1,000 miles distant. Owing to its small total area, and especially its narrowness in the direction of the prevailing winds, New Zealand cannot, in the mean, have a very important influence on the character of the general circulation of the atmosphere in these regions. On the other hand, the high relief is responsible for very important local modifications. The principal factors controlling the climate of the country are, then, in order of importance, its latitude, its oceanic surroundings, and its high relief.

As regards latitude, New Zealand is in the temperate zone. It lies between the high-pressure belt of the sub-tropics and the low-pressure trough in the Southern Ocean, but nearer the former than the latter. It is, therefore, in the zone in which westerly winds prevail and subject to the rapid fluctuations of weather produced by the series of anticyclones and depressions which are moving continuously from west to east in that zone. Since abundant supplies of moisture are provided by evaporation from the surrounding oceans, and depressions are frequent and vigorous, the average amount of precipitation is high. Owing to the small extent of the country, the climate is everywhere predominantly insular in character. There is an absence of extreme variations of temperature

either irregular or seasonal. But the effect of the high mountain ranges is to cause large vertical movements in the atmosphere and much mixing of the various layers up to considerable heights. These processes in turn cause profound modifications in the distribution of water vapour and temperature in these layers. In consequence the distribution of rainfall is highly irregular; low cloud can seldom form in continuous sheets of any great extent; there is a high percentage of bright sunshine; and the diurnal variation of temperature is surprisingly large.

The range in climate from north to south is rather surprisingly small so that the country forms a single climatic unit. One of the methods of classification of climate now most generally accepted is that of Dr. W. Köppen. This is based primarily on temperature and rainfall and their annual variation. Köppen finds that he can, by means of these two elements, give simple definitions for the important climatic regions. The boundaries as determined by these definitions correspond closely with those indicated both by conditions of human comfort and ability to produce the means of livelihood, and by the character of the natural vegetation. Köppen's boundaries, therefore, are natural boundaries, and his definitions provide a simple means of comparing the climate of any particular region with that of any other. Though the summits of our mountain ranges extend through a climate of a Boreal type to one which is Arctic in character, the great bulk of the country, and the whole of that with which we are concerned from a land utilization point of view, falls well within the limits of Köppen's cool-temperate, moist climate, without marked seasonal variation in temperature or precipitation. This climate is designated by the formula Cfb, and is possessed, also, by Tasmania and portions of Victoria and eastern New South Wales, and by small areas in Southern Chile and Patagonia in the Southern Hemisphere, and in the Northern Hemisphere by much of Western Europe and the British Isles, a narrow coastal strip in Western U.S.A. and the islands of British Columbia, and patches of Japan and Korea. It is, however, more typical of the ocean than the land areas of the temperate zone.

B. Ocean Currents

Owing to the extensive spaces of open ocean surrounding it, the regular currents in the neighbourhood of New Zealand are not very strong. The principal set is towards the north-east. To the westward the north-easterly drift prevails off the greater portion of the coast, but in the south the stream divides, a small branch moving southward and round into Foveaux Strait. This branch prevails south of Jackson's Bay, but its average strength is slight to the north of Milford Sound. The climate of the Fiords is said to be relatively mild on account of this current. A second branch flows through Cook Strait. After passing North Cape, the general

current turns in a south-easterly direction past East Cape. Off the east coast of the South Island is a cold current, moving to the north-east; this encounters the warmer water from the north approximately on a line with Cook Strait, where it probably sinks to a lower level. The average speed of the main currents is of the order of a mile per hour. Farther southward, where the westerly winds are stronger, there is a rather more rapid set to the eastward.

Mean temperatures on the west coast and in the extreme north of the Auckland Peninsula, appear unaccountably low. This may be due to the ocean current from the south-west which prevails off the west coast. Much more information is required regarding ocean currents and temperatures around New Zealand.

C. Weather Regimes

The weather in New Zealand is controlled by the continuous procession of anticyclones and depressions which cross these regions. Normally, the passage of these pressure systems is so regular that they may be likened to a series of waves in the atmosphere. The distance between the anticyclone centres is fairly constant and equal to about 45 degrees of longitude. The average track of the anticyclones oscillates forwards and backwards, towards and away from the Equator, in the course of the year. It is at its southernmost range in February when it crosses the middle of the North Island, and at its northernmost in September or October when it passes between New Zealand and Norfolk Island. Individual anticyclones, of course, deviate considerably from the average path. Between the anticyclones are low-pressure troughs which are normally continuous from the sub-tropics to the Antarctic and oriented in a north-west to south-east direction. In the low-pressure trough is the boundary between cold and warm air, or in modern terminology, a 'frontal zone.' Wave depressions move along the front in a poleward direction. Occasionally the waves develop into deep central cyclones. Tropical cyclones also exert a considerable influence on the weather, at times, in the summer season.

In the fluctuations of climate which take place from one year to another, it has been found that certain large areas of the world tend to behave in opposition to each other. Thus Australia, the Indies and the Eurasian Continent have, generally speaking, variations of a similar character, while the contemporaneous fluctuations over the Pacific Ocean and South America are of an opposite kind. New Zealand is near the boundary between the two regions, but, on the whole, tends to follow Australia.

II. WINDS

A. Prevailing Winds

It has already been said that New Zealand is in the zone of prevailing westerly winds. Generally speaking, the frequency and average velocity

of the westerly winds increase as one proceeds from north to south. Owing to the broken nature of the country, conditions at the surface are extremely complicated, and, in low-lying areas especially, it is very difficult to secure sites whence observations will be representative of the general air flow. At Wellington, for instance, the direction and velocity of the surface wind will vary greatly over short distances owing to variations in the topography. Though the effects of these small surface irregularities disappear at comparatively low heights, the air is still forced to flow through Cook Strait as either a northerly or a southerly wind whatever be the undisturbed direction. It is not till a height of 4,000 feet or more is reached that the direction ceases to be controlled by the mountains. One consequence of these irregularities is that the windiness of the region shows itself at ordinary levels in gustiness rather than high average velocity.

Though the average force of the wind may not be great at low levels, it certainly is on the hilltops. An anemograph was installed for a short period on Mount Wakefield, near Wellington, at an altitude of 985 ft., and although there are many higher peaks in the vicinity, and a higher ridge to the westward, some extraordinarily high velocities were recorded, particularly in north-westerly winds. The maximum gust was 114 miles per hour. Anyone who has done much climbing on New Zealand hills and mountains is fully aware of the strength and persistence of the westerly and north-westerly winds. Their effect on vegetation is very clearly shown. Not only do they impose a severe strain on the material framework of trees and plants, but they also do much damage to foliage and cause excessive transpiration. In many situations the natural vegetation is only established after a long struggle with the wind. Hardy species and the hardier individuals manage to grow, and the less hardy then take advantage of their shelter. There is thus a series of growth stages during which a gradual change takes place in the nature of the predominant species, and the height and luxuriance of the vegetation increases.

The westerly winds are stronger to the south of New Zealand than over the Dominion itself, and their effect on vegetation is most strikingly displayed in the sub-Antarctic Islands. In the Auckland Islands, for instance, the trunks of the trees of the rata forest lie in a prostrate or semi-prostrate position and directed away from the west-north-west. On the hilltops, the scrub will be seen growing in lines parallel to the same direction. Some hardy individual has become established, and the others have been able to grow in its lee.

The most important modifications of our climate caused by the effect of orographical relief are associated with the forcing of north-westerly

winds over the ranges. This phenomenon reaches its maximum development in the central portion of the South Island, where we have the highest part of the Southern Alps flanked by the Canterbury Plains. The principal features are there well known in the heavy rain on the western side of the divide and the pronounced Föhn effects in Canterbury. In the summer of 1930-31, there was a protracted period of westerly weather, and a journey from Hokitika to Christchurch during this period was most instructive. The Taramakau and Otira Valleys would be ascended in pouring rain, the sky dark with ragged nimbus, but on coming through the Otira tunnel to Arthur's Pass, signs of clearing would be seen ahead, and within a very few miles one would be travelling under clear skies and in warm weather through country that was almost drought stricken. In January and February, 1931, the total rainfall at Hokitika on the west coast was 23·24 inches; at Otira, 30 miles further east, and on the western side of the divide, 65·16 inches; at Arthur's Pass, on the eastern side of the divide, and 5 miles distant from Otira, 64·58 inches; at Mount White Station, 40 miles from the west coast, 9·56 inches; and at Christchurch, near the east coast, 3·01 inches.

The Föhn wind does not, as a rule, set in until the ground surface has been heated by insolation. It is most frequent, therefore, in the afternoon. Once established, however, it may continue far into the night. In many cases the north-wester fails to reach the east coast, but is there undercut by a steady, moist, north-easterly breeze.

Though the north-wester reaches its greatest development in Canterbury, all eastern districts, as for instance, Hawke's Bay, Marlborough, Otago, and the east side of the Coromandel Peninsula, experience similar effects in some degree.

From spring to autumn, land and sea breezes are well developed wherever fairly extensive plains abut on to the sea, as in the Bay of Plenty, Poverty Bay, Hawke's Bay, the South Taranaki Bight, Nelson and the Waimea Plains, the Wairau Valley, the Canterbury Plains, and so on. In Nelson, for example, the sea breeze sets in very regularly at about 9 a.m. on clear days and blows freshly from 10 a.m. till near sunset. The land breeze is not so marked, but is sometimes conspicuous on steep coast lines. Mountain and valley winds, such as the drift from the Southern Alps on both east and west sides, and the flows from the Wairau and Clutha Valleys, are well marked, and have an important influence on temperature and the frequency of frost.

Since the westerly winds are so important an element in our climate, the annual variation in their velocity is also important. Unfortunately, we have at present no good direct measure of this. It is possible, however, by various direct and indirect lines of evidence to arrive at a close approxima-

tion. The average velocity is greatest in spring. The maximum is in October, but there is little falling off in November and December. A considerable decrease occurs during January and February, followed by a partial recovery in March and April. There is then a fall to the lowest value in June. During July and August there is only a slight increase, but in September the rise is rapid.

In Table XIX the percentage frequency with which the wind blows from different directions in the four seasons and for the whole year is given for Auckland, Wellington, and Invercargill. For summer, the three months December, January, and February were adopted; for autumn, March, April, and May; and so on. There is everywhere a preponderance of westerly winds, but in the north it is only slight, especially in summer and autumn. At Wellington, the concentration of the wind into two directions is very marked, while at Invercargill, a local effect is seen in the prevalence of north-easterly winds. But the conclusions to be drawn from observations of direction alone are very limited. When account is taken of velocity as well as direction, the prevalence of westerly winds becomes much more marked, even in the north.

TABLE XIX

Wind Direction, Percentage Frequencies

Station	Season	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm
Auckland ..	Summer	7	20	7	5	11	29	10	9	1
	Autumn	6	15	9	10	14	24	10	9	2
	Winter	5	12	6	9	14	25	14	11	4
	Spring	7	17	4	4	8	32	16	11	1
	Year	6	16	6	8	12	28	12	10	2
Wellington ..	Summer	18	5	2	16	13	2	1	39	4
	Autumn	17	8	2	16	13	3	1	31	8
	Winter	15	7	2	17	15	5	2	26	12
	Spring	19	4	2	14	12	3	1	41	4
	Year	17	6	2	16	13	3	1	34	7
Invercargill ..	Summer	3	5	12	7	3	31	13	9	17
	Autumn	2	12	17	8	3	24	9	7	17
	Winter	2	18	23	7	2	14	6	9	17
	Spring	2	10	13	6	3	27	10	13	16
	Year	2	11	16	7	3	24	10	10	17

B. RELATION TO FAUNA AND FLORA

Wind has a very important influence on the life supported by the country, though it is frequently rather obscure and difficult to isolate. Indirectly, of course, wind controls rainfall distribution, and, to some extent, temperature, but it is the direct effects with which we are concerned here.

The evaporation caused by wind reduces the efficiency of rainfall. Parts of Taranaki, for example, especially on the south side of Mount Egmont, are drier than would be expected owing to persistent westerly winds. Many of the effects on various parts of the coast attributed to salt may be due principally to wind. On the other hand, there would be many more swampy and peaty areas in New Zealand were it not for the drying action of winds.

Grasses suffer to a very large extent from excessive transpiration induced by dry and warm winds in districts east of the ranges. The absence of forest in the natural state over large portions of Canterbury and Otago was probably also due to this effect. The hard tussock grasses which flourished there were specially adapted to resist wind. It is wind, too, which has resulted in the tight-glumed Tuscan variety of wheat being selected for growth on the Canterbury Plains. In orchards, trees are damaged and fruit shaken down by strong winds, but, in addition, cold, dry winds, such as the south-wester at Nelson, cause serious damage to tender buds and young fruit. They also render the trees more liable to damage should a frost follow, as it frequently does. Seedling trees and much garden produce, including tomatoes, suffer in a similar way. So long as it does not become excessive, however, wind, especially when combined with sunshine, assists the production of clean and healthy fruit of a good quality. This is especially the case in regard to wheat. Wind also reduces the liability to frost by preventing stagnation of the air. There are numerous instances of these effects in New Zealand.

In some places much of the better portion of the soil is removed by winds. This takes place on a large scale on the Canterbury Plains. The best soils are found on the south sides of the rivers where the north-westerly winds have deposited some of the fine material picked up from the river beds. Much of it, however, is carried out to sea. The south-westerly wind is moister, less persistent and less gusty than the north-wester. Nor does it blow off-shore to nearly the same extent.

The absence of strong winds is one of the most important criteria for land suitable for growing tobacco, and this accounts for the success of the industry in the Nelson district. The best fruit-growing districts in New Zealand are found, also, where there is protection from strong winds.

The ill-effects of wind are combated by growing shelter belts. These are especially necessary about orchards and exposed areas such as the Canterbury Plains. In the early days in Canterbury it was not unusual for all the loose soil to be blown away from ploughed land. But even in the Waikato, where rainfall is abundant and very reliable, and winds are moist, shelter belts permit of a better and more luxuriant growth of grass.

The native forest trees generally have a foliage adapted to resist

wind, and the successful growth of the imported pines and firs is probably due to a similar adaptation.

In spite of the fact that one of the most important characteristics of the New Zealand climate is that domestic animals can live in the open all the year round, they suffer much discomfort and lose vitality when exposed to cold or raw winds. This necessitates the provision of shelter by means of thick evergreen hedges, clumps of natural bush, or plantations. The more valuable stock have to be covered with rugs in winter.

III. PRECIPITATION

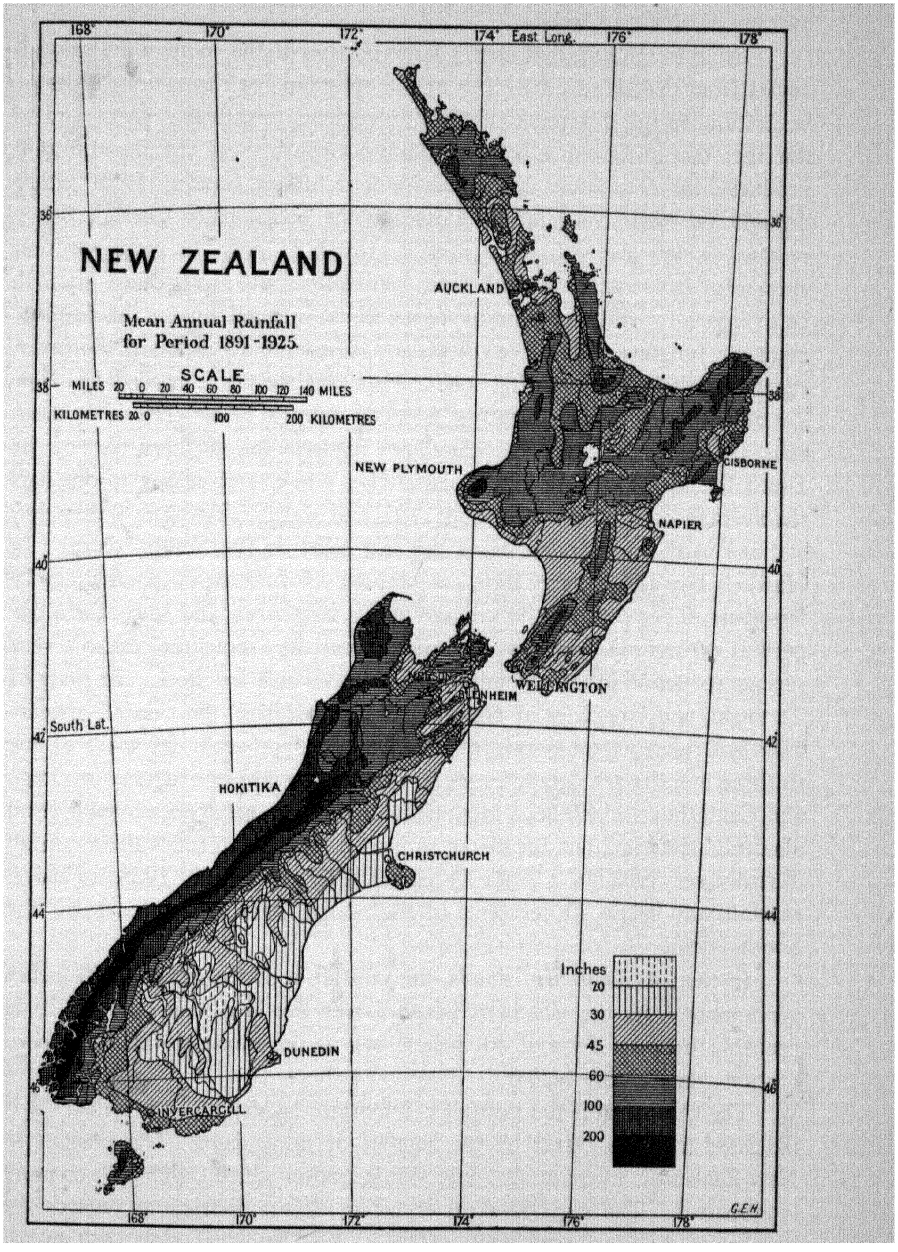
A. Total Annual

The amount and distribution of the total annual precipitation is shown in the following map. The average for the whole country is high, but over the greater part it lies between 25 and 60 inches, a range which includes the optima for most, at any rate, of the various grass plants which are suitable for growth in a temperate climate. It is a range, also, which is highly favourable to the growth of forest trees and much other vegetation. The area that receives less than 25 inches is small, and confined to Central Otago and parts of Canterbury. Most of the area with a rainfall above 60 inches is mountainous and unoccupied. On the west coast of the South Island there are, however, important areas which receive over 100 inches.

The map shows how remarkably complete is the control of rainfall by topography. Wherever a mountain range is directly exposed to the westerly or north-westerly winds, precipitation almost invariably rises to over 100 inches. On the other hand, there are numerous areas which are shielded by the mountains. The more important occur in the Poverty Bay, Hawke's Bay, Wairarapa, and South Taranaki Bight districts, in the North Island, and around Nelson and Blenheim, and in the eastern districts generally, in the South Island. The heavy rainfall in the northern part of Hawke's Bay, inland from Wairoa, occurs largely in southerly winds.

In the North Island the annual rainfall is practically nowhere less than 30 inches. Rainfall is, however, much less reliable in the drier summer half-year than in the wet winter.

In the South Island, the extreme contrast between the western and eastern sides of the ranges has already been referred to. On the west of the high levels the rainfall is everywhere over 100 inches, and over a large area it exceeds 200 inches. Indeed, there must be many small areas, where there is a special convergence of the winds, which have an average fall of over 300 inches. The variation of rainfall with height is not accurately known, but it is probable that the heaviest falls are between 3,000 and 4,000 feet. To the eastward of the ranges the precipitation falls away within a few miles to below 50 inches, and the greater part of the Plain country


NEW ZEALAND
Mean Annual Rainfall
for Period 1891-1925
SCALE
MILES 20 0 20 40 60 80 100 120 140 MILES
KILOMETRES 20 0 100 200 KILOMETRES
168° 170° 172° 174° East Long. 176° 178°
36° South Lat.
40°
42°
44°
46°
AUCKLAND
NEW PLYMOUTH
GISBORNE
NAPIER
WELLINGTON
NELSON
BLENHEIM
HOKITIKA
CHRISTCHURCH
DUNEDIN
INVERCARGILL
Inches
20
30
45
60
100
200
G.E.H.

Map 14

receives less than 30 inches. The driest part of Central Otago has an average of about 13 inches.

Owing to the fact that over a large portion of the country the rainfall varies from one side to the other of the optimum for the various types of vegetation, to the difference of the rain régimes in different parts, and to the fact that different epochs of the year are critical for the different products, the Dominion as a whole seldom suffers severely from either drought or excessive rainfall. Losses occur occasionally through heavy rainfall, which may cause too rank a growth of grass or crops, prevent successful haymaking, damage fruit, especially stone fruit, cause grain to be of inferior quality, or even to sprout in the ear, and favour the development of fungous and other diseases. Much more is heard, however, regarding the effects of dry spells. No case is yet recorded in New Zealand of any two consecutive calendar months being entirely without rain, although a near approach has been made in the northern part of the South Island. The only known cases of a year's total falling to one-half the average occurred in 1915 and 1930, and were confined to a very few stations in the drier portions of the east coast of the South Island. In Hawke's Bay and Poverty Bay, the total for six consecutive months may be less than 50 per cent. of the average over a large area, and since these dry periods occur in the warmest part of the year they sometimes cause a very serious reduction in the amount of pasture available for stock. In parts of Taranaki, and especially of Nelson and Marlborough, the rainfall appears to be less reliable than in most of the Dominion, and acute dry spells of one to three months are not uncommon. Further south, the regions in Otago and Canterbury which have low rainfall naturally suffer occasionally from abnormal shortage, but for places with such low annual totals their rainfall is really very reliable. From December, 1927, to March, 1928, inclusive, rainfall was below 50 per cent. of the normal over a large part of the South Island.

In the sub-Antarctic Islands, the rainfall is of the order of 50 inches per annum. At the Chatham Islands, over the low-lying portions it is probably between 35 and 40 inches, but in the more elevated southern portion considerably higher.

The character of the rainfall is important as well as its amount. It is indicated to some extent by the number of rainy days. The practice in New Zealand is to count as a day of rain one on which 0·005 inch or more is measured. The régimes experienced in various districts as regards the number of rain days are shown in Table XX. The distribution, both annual and geographical, resembles that of precipitation fairly closely, but the number does not increase in proportion to the amount of precipitation. For example, places on the west coast of the South Island which have ten

TABLE XX

Days with Rain

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Helensville	9·5	8·9	11·5	13·4	17·4	17·9	19·3	17·9	15·7	15·5	14·0	10·6	171·6
Auckland	10·4	9·7	11·2	14·1	18·7	19·5	21·1	19·5	17·7	16·6	15·9	11·8	186·2
Tauranga	10·7	8·6	11·0	11·5	13·8	13·8	14·9	14·2	14·1	14·8	12·2	11·4	151·0
Rotorua	9·9	8·6	9·5	10·8	12·6	13·0	13·7	13·5	14·4	14·0	12·7	10·0	142·7
New Plymouth	12·8	10·3	12·0	14·3	17·8	17·6	18·9	18·5	17·7	18·4	16·4	14·3	189·0
Gisborne	9·1	9·8	11·7	12·0	15·4	15·7	16·1	15·6	12·5	11·2	10·6	8·8	148·5
Napier	7·8	7·3	7·7	7·9	10·3	11·2	11·9	11·8	9·7	8·9	8·6	7·7	110·8
Ditton, Masterton	11·1	9·0	12·1	12·7	17·4	17·7	19·7	18·6	15·4	15·0	14·4	12·0	175·1
Waitatapia, Bulls.	10·0	7·7	9·4	11·5	12·6	13·4	13·7	13·7	13·4	14·6	13·6	11·4	145·0
Wellington	10·7	8·8	11·3	12·7	16·4	17·1	18·2	17·1	15·1	14·1	12·9	12·1	166·5
Motueka	9·0	6·7	8·4	10·6	12·0	12·7	13·0	12·4	13·4	13·3	11·4	10·0	132·9
Nelson	8·5	6·6	8·6	9·5	10·3	9·9	10·8	10·7	11·8	11·8	11·3	9·1	118·9
Marshlands, Blenheim	7·1	5·4	7·0	7·4	8·6	8·3	10·1	9·0	8·6	9·3	8·1	7·7	96·6
Hokitika	13·2	11·4	14·5	15·1	15·5	15·2	16·1	15·6	17·0	19·2	17·8	16·4	187·0
Highfield, Waiau	8·6	7·2	8·2	7·6	8·6	8·6	10·0	9·1	9·2	8·6	8·9	8·6	103·2
Christchurch	9·6	7·7	9·2	9·6	11·7	12·6	13·2	11·3	9·9	9·7	10·4	9·8	124·7
Peel Forest	12·9	11·6	12·1	10·4	8·8	8·1	8·7	8·7	10·1	12·0	11·6	13·5	128·5
Oamaru	10·3	7·3	8·0	7·1	7·9	7·9	7·8	7·7	7·5	10·0	10·6	10·3	102·4
Clyde	7·2	5·0	6·4	6·0	5·6	5·5	5·1	5·8	6·1	7·9	7·0	7·9	75·5
Dunedin	14·2	11·2	12·7	12·8	13·5	12·9	12·9	12·9	13·8	14·4	14·5	14·6	160·4
Invercargill	15·7	13·0	15·4	16·9	17·9	16·5	16·3	15·6	15·1	17·5	18·4	16·4	194·7
Half-moon Bay, Stewart Island ..	18·3	16·4	18·2	18·2	20·3	19·8	19·5	19·4	18·9	20·4	20·7	18·5	228·6

times as much rain as the driest portions of Central Otago, have less than two and a half times the number of rainy days. Portions of Marlborough have relatively few days as compared with their rainfall. Both here and in Central Otago, there are considerable areas with less than 100 days per annum. It is one of the great advantages of our climate that even where the rainfall is very heavy, the number of rain days is generally only moderate. In the extreme south-west, however, and in Stewart Island there is a rapid increase, and more than 200 are experienced. In the sub-Antarctic Islands, the number is much greater, and, at Macquarie Island, exceeds 300.

B. Annual Variation

The distribution of the precipitation throughout the year is little less important than its total amount, the effect of rainfall in winter, for example, being very different from that in summer. In Table XXI are given the monthly averages for a number of typical stations. The variation is controlled by three principal factors. The first of these is the proximity to the high-pressure belt in the sub-tropics. This belt is a region of low rainfall, and on the south side of it the rainfall year is divided into dry summer and relatively wet winter seasons. Since the high-pressure belt is further south in summer than in winter, the difference between summer and winter tends to be accentuated at northern stations. As the distance from the high-pressure belt increases, the contrast between summer and winter decreases also, so that by the time southern New Zealand is reached the variation due to this factor is small. The next most important factor is the influence of the prevailing westerly winds. These bring heavy rains to the areas exposed to them, while those which are protected from them by mountain ranges have little rain while the westerlies are blowing. The third factor is the convection caused by insolation. This is naturally greatest when the sun's rays are most intense and where their effect is most prolonged. Consequently, it is most strongly developed in summer and in places where there are long periods with clear skies and light winds. The most favourable situations in New Zealand are in the interior of the South Island and on the eastern side of the main ranges. Convection will be more active, also, when cold air has been brought over the land by southerly winds, since it will be more rapidly heated by the warm land surface.

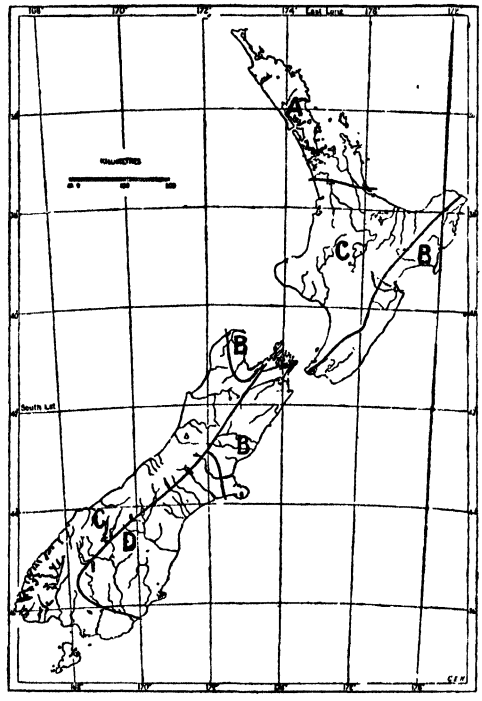
The first factor, then, tends to produce a summer minimum and a winter maximum of rainfall. It is most clearly dominant in the area marked A in Map 15. This is illustrated by the data for Auckland in Table XXI. A similar régime is no less pronounced in the northern portion of the area in the North Island marked B in Map 15. Here, however, protection from the westerly winds and the frequency of heavy rainfall

TABLE XXI

Monthly Rainfall in Inches

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Auckland	2·74	3·04	3·01	3·54	4·66	4·95	5·07	4·23	3·71	3·72	3·31	2·91	44·89
Rotorua	4·21	3·70	3·51	4·52	5·72	5·23	5·05	4·97	5·13	5·24	4·14	3·76	55·18
New Plymouth	4·20	3·81	3·75	4·54	6·21	5·98	6·46	5·46	5·06	5·47	4·82	4·28	60·04
Opunake	3·66	2·96	3·64	4·37	4·72	4·31	4·54	4·01	3·83	4·31	3·91	3·43	47·69
Waitatapia, Bulls.	2·55	2·43	2·37	3·08	3·42	3·18	3·25	2·71	2·77	3·57	3·24	2·66	35·23
Ditton, Masterton	3·14	2·96	3·58	3·67	5·45	4·98	5·59	4·78	3·71	4·36	3·56	3·01	48·79
Wellington	2·81	2·67	3·11	3·53	3·98	4·19	4·71	3·82	3·11	3·41	2·90	2·84	41·08
Motueka	2·73	2·96	3·35	4·01	4·93	5·53	5·04	4·90	5·08	4·04	3·05	3·16	48·78
Nelson	2·80	2·59	2·96	2·99	3·06	3·54	3·52	3·03	3·69	3·49	2·99	2·98	37·64
Marshlands, Blenheim	2·19	2·20	2·25	2·27	2·94	3·19	3·58	2·66	2·71	2·50	2·35	1·99	30·83
Highfield, Waiau	3·04	2·60	2·94	2·63	3·22	2·50	3·34	2·48	3·02	2·77	2·56	2·70	33·80
Christchurch	2·20	1·71	1·98	1·85	2·53	2·68	2·69	1·85	1·74	1·69	1·92	2·15	24·99
Hororata	2·76	2·28	2·59	2·28	2·35	2·32	2·65	2·00	2·25	2·43	2·39	2·75	29·05
Peel Forest	4·84	4·05	4·38	3·54	2·51	2·75	3·42	2·57	3·77	3·85	4·01	4·85	44·54
Oamaru	2·04	1·74	1·80	1·76	1·59	2·01	1·74	1·75	1·66	1·73	1·91	2·24	21·97
Clyde	1·82	1·06	1·50	1·42	1·00	0·93	0·92	0·80	1·05	1·62	1·35	1·79	15·26
Dunedin	3·42	2·71	2·94	2·74	3·11	3·16	3·01	3·09	2·75	3·12	3·25	3·54	36·84
Hokitika	9·89	7·14	9·74	9·29	9·71	9·30	8·87	9·27	9·21	11·83	10·73	10·44	115·42
Otira	15·77	10·10	16·61	18·24	16·36	13·53	12·45	14·07	21·21	24·23	20·81	17·99	201·37
Invercargill	3·96	3·11	3·89	4·14	4·34	3·63	3·28	3·25	3·27	4·50	4·41	4·07	45·85
Half-moon Bay	4·74	4·14	5·52	5·16	4·75	4·79	4·41	4·53	5·24	5·32	5·79	5·01	59·40

in winter due to cyclonic depressions, contribute to its prominence. Further south, in the area marked B, this prominence gradually wanes, as shown by the stations from Ditton, Masterton, to Christchurch, in Table XXI.



Map 15
Climatic Districts

The second factor produces a variation proportional to the flow of the westerly winds, with a maximum in October, a minimum in the late winter and subsidiary maxima and minima in the autumn and late summer respectively. It is clearly shown in the area in the South Island marked C in Map 15 and by the data for Hokitika and Otira in Table XXI. In the area in the North Island marked C both the first and second factors are at work. Rainfall is high in winter, and also in October, when the westerlies are at their strongest. This is illustrated by the figures for the stations from Rotorua to Waitatapia.

The régime of the remaining type gives a maximum in summer, and is dominant in the region marked D in Map 15 and the stations from Hororata to Dunedin in Table XXI. Peel Forest shows it in its purest form. The rains caused by convection are generally in the nature of isolated local showers which are sometimes very heavy. Occasionally they are accompanied by thunderstorms, and, in some instances, are of the

intensity of cloud bursts. Rains of this nature are typical of the interior of continents in summer, and are found in New Zealand where we have the nearest approach to a continental climate. They are of very great importance in these dry regions, coming as they do when they can do the maximum amount of good.

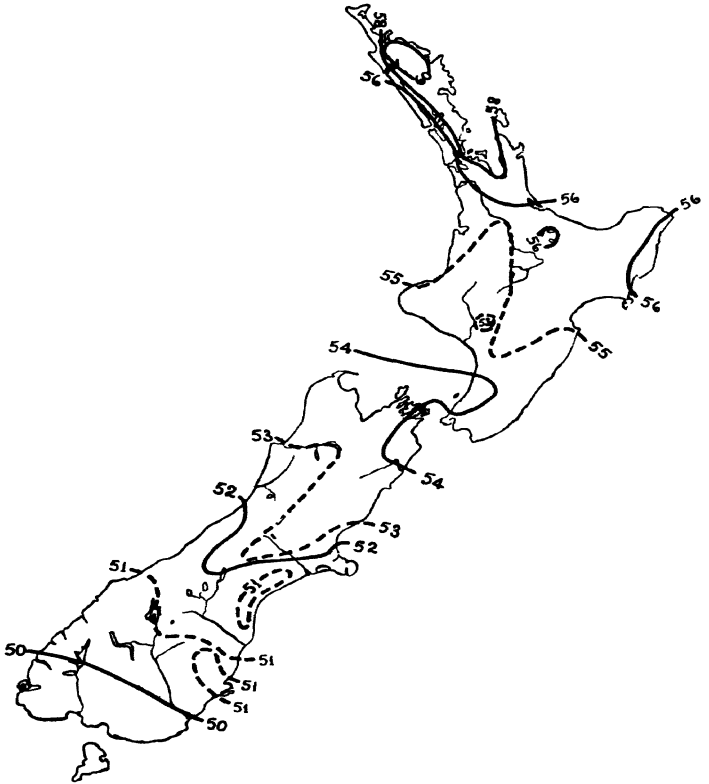
C. Influence on Fauna and Flora

Each of the factors mentioned, of course, has some influence in every district, and there is no sharp line separating the areas in which the separate factors are dominant. For example, nearly all stations show the effect of rains produced by the strong westerly winds in October. The divisions shown in Map 15 are, nevertheless, important natural boundaries coinciding fairly closely with those based on botanical considerations. The southern limit of district A is approximately that of the kauri forests at the time of first settlement. District D, which includes most of the areas with a low rainfall, was largely bare of bush but covered instead by tussock grass in the native state. It now includes most of the country devoted to the growing of wheat, which requires only a moderate rainfall but abundance of sunshine in the fruiting period. District C contains most of the heavy rain forests of New Zealand, where totara, rimu, and kahikatea are the important timber trees. The rainfall in the South Island portion is too heavy to produce good pastures unless the land is well drained. The North Island portion, however, includes the more important dairying districts, the frequent, heavy, and reliable rains ensuring also continuous growth of pasture. In district B there are considerable local variations depending on topography, aspect, etc. This district is, perhaps, characteristically, devoted to grazing. It contains, also, some important fruit-growing areas, the Hastings and Nelson districts being the principal ones.

IV. TEMPERATURE

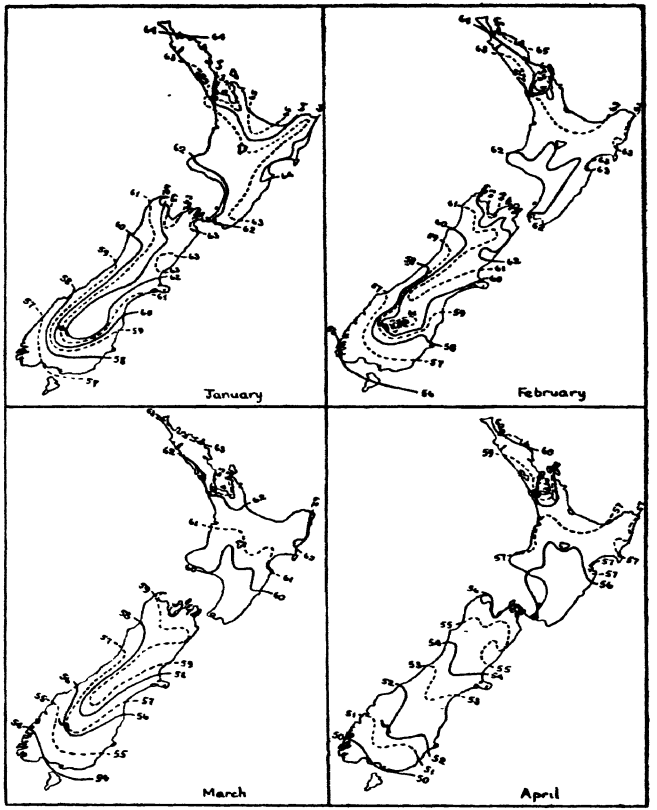
A. Mean Temperature and Its Distribution

Temperature and rainfall between them practically determine the nature of the climate of a locality and of the two temperature is, perhaps, the more important. But temperature is a more calculable element than rainfall and, in the Southern Hemisphere especially, the mean temperature of a place depends closely on its latitude. New Zealand, having as it does a maritime climate, is not subject to extremes of temperature, and there is a fairly regular increase in mean values from south to north. Owing to the mountainous nature of the country and the decrease of temperature with height, the distribution of actual temperatures is very complex. In the accompanying maps and in Table XXII, therefore, the data have been simplified by reducing them to sea-level. The correction added is at the



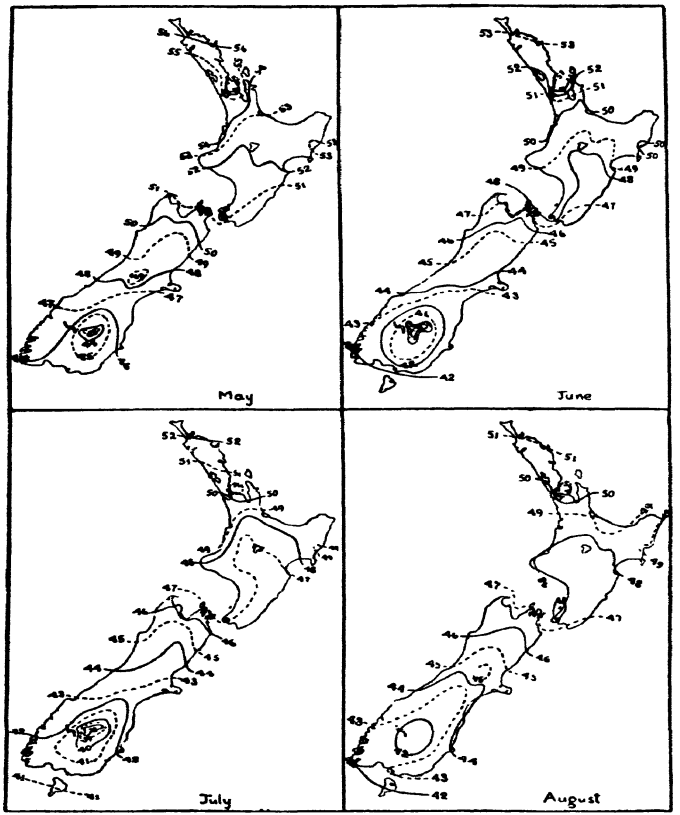
Map 16

Annual Isotherms



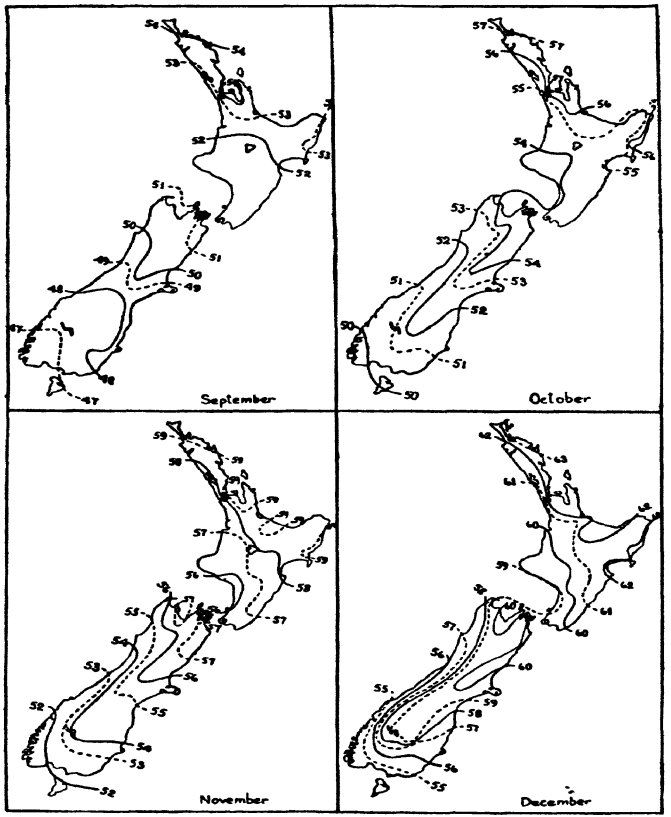
Map 17

Isotherms: January-April



Map 18

Isotherms: May-August



Map 19

Isotherms: September-December

rate of 5° C. per kilometre (2°·74 F. per 1,000 ft.) of altitude. The mean temperatures are derived from daily readings of maximum and minimum thermometers. From thermograph records the correction necessary at Wellington to reduce the mean of the maximum and minimum to the mean of day have been provisionally determined as:—

Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
—1·3	—1·2	—1·1	—1·0	—0·6	—0·2	—0·3	—0·3	—0·7	—1·0	—1·1	—1·2	—0·8

There are indications that the correction is smaller in the south than in the north, so that for places north of Wellington, the above figures are increased, while for places to the south they are decreased. Table XXII and the isotherms in the figures, then, give values for the mean of day derived in this way. The charts are rather crude since they are based on the records of comparatively few stations. The range of temperature is from about 60° F. in parts of the Auckland Peninsula to approximately 49° F. in the south of Stewart Island. The east coast is warmer than the west coast in the same latitude. This is due to the prevalence of westerly winds and the 'Föhn' effect which accompanies them.

The abnormally cool area which apparently exists on the west coast and in the northern extremity of the Auckland Peninsula, has already been mentioned. The high plateau in west-centre of the North Island, also, is rather cold, there being a specially cold spot around Karioi according to a short record kept by the State Forest Service. This may be due to the amount of snow which falls in this region. Another relatively cold area is to be found on the Canterbury Plains. Further westward, at the feet of the Southern Alps, on the other hand, are some warm spots, doubtless due to the Föhn winds. Auckland is relatively warm owing to its being almost surrounded by the shoal waters of landlocked harbours. A similar effect is experienced to a lesser extent at Napier, in parts of Nelson, and near some of the inland lakes.

B. Annual Variation

The annual variation of temperature is shown, by means of monthly averages, in Maps 17, 18 and 19 and for a number of stations in Table XXII. The range, or difference between the highest and the lowest of the monthly means is also given in Table XXII and, as would be expected in a maritime climate, is small, especially at coastal stations where the air-flow is from the sea or where the winds are strong enough to prevent stagnation of air. Waipoua (North Auckland), Auckland, New Plymouth, Wellington, Hokitika and Dunedin, for example, have low ranges. On the east coast the range is higher than on the west, the land having a predominating influence since the prevailing wind is off shore. This effect is seen in the cases of Napier, Christchurch, and Timaru. But the highest values occur

TABLE XXII

Mean Temperatures Reduced to Sea Level and Mean of Day

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Range
Waipoua	61·7	62·2	60·7	57·4	54·1	51·5	49·2	49·7	51·4	53·2	55·8	58·6	55·4	12·5
Auckland	64·9	65·2	63·3	59·6	56·1	53·4	51·5	51·9	53·8	55·9	58·8	62·3	58·0	13·7
Rotorua	64·7	64·4	61·4	56·7	52·4	49·3	47·8	48·9	51·9	55·3	58·6	62·0	56·1	16·9
New Plymouth	62·9	62·9	61·2	57·8	54·4	51·4	49·7	50·1	52·2	54·2	56·8	60·4	56·2	13·2
Napier	64·1	63·3	60·9	57·7	52·6	48·8	47·4	48·4	51·5	55·6	58·6	61·3	55·9	16·7
Masterton	63·1	62·2	59·6	55·1	50·4	47·0	46·0	47·0	50·4	53·8	56·5	60·5	54·3	17·1
Wellington	61·7	61·6	59·7	56·2	52·5	49·4	47·7	48·4	51·2	53·6	56·1	59·5	54·8	14·0
Nelson	61·8	61·4	58·9	55·1	50·1	46·3	45·3	46·3	49·7	52·9	56·0	59·0	53·6	16·5
Hokitika	58·8	58·8	57·0	53·4	48·9	45·7	44·5	45·6	48·9	51·5	53·4	56·7	51·9	14·3
Lake Coleridge	62·3	62·5	59·6	55·5	48·7	44·8	43·5	46·5	50·8	55·4	57·3	60·5	54·0	19·0
Christchurch	60·4	59·9	57·0	52·7	47·7	43·1	42·3	43·9	48·4	52·4	55·7	59·0	51·9	18·1
Ashburton	60·7	60·4	57·5	53·0	47·6	42·8	41·8	43·5	47·9	52·0	55·4	59·0	51·8	18·9
Timaru	59·8	59·3	56·6	52·5	46·5	42·8	41·8	43·9	47·7	52·3	54·4	57·4	51·2	18·0
Ophir	62·0	61·5	57·3	51·4	42·4	36·6	37·5	41·4	46·8	52·1	54·7	59·4	50·3	25·4
Dunedin	58·1	57·8	55·9	52·4	48·1	45·1	43·8	45·6	48·9	51·4	53·3	55·8	51·4	14·3
Invercargill	56·6	56·4	54·0	50·3	45·7	42·3	41·3	43·5	47·0	50·4	51·8	54·4	49·5	15·3

in the inland basins of the Mackenzie Country and Central Otago where there is the nearest approach to continental conditions. Thus, Ophir in Central Otago has a range of 25°·4 F. Summer is as warm at these places as in much of the North Island, while the winters are very cold. Being sheltered by mountain ranges, they experience much clear, dry weather and radiation is very active. The ground surface heats up rapidly in sunlight but it also radiates its heat freely out into space. The differences between summer and winter and day and night are, therefore, accentuated. It is to this feature of its climate that Central Otago owes much of its productivity and especially its suitability for fruit growing.

At coastal stations the temperature changes tend to lag behind those in the sun's position and at Auckland, for example, February is as warm as January and August almost as cold as July. The land responds more quickly to the changes in the sun's heat than does the sea, so that at most inland places January is considerably warmer than February, while at Ophir June is actually the coldest month. The fall of temperature in the autumn is more rapid than the rise in spring.

To the south of New Zealand, the annual variation of temperature over the ocean becomes very slight. Four years' record of temperature at Macquarie Island, as published in the reports of the Australasian Antarctic Expedition of 1911-1914, led by Sir Douglas Mawson, give a difference of only 6°·2 F. between the coldest and warmest month. In consequence of this, the temperature in New Zealand falls off with latitude more rapidly in summer than in winter.

The largest sudden changes of temperature naturally occur in eastern districts, and especially the Canterbury Plains, during a 'southerly buster' when the warm north-west Föhn wind gives way to the cold southerly.

C. Temperature Extremes

In Tables XXIIIa to XXIIIm are given data regarding extreme temperatures at a number of stations. The first line gives the average of the maximum temperatures as observed each day, the second the average of the highest temperatures observed in each month and the year, and the third the highest yet recorded. Corresponding information regarding minimum temperatures follows. The remaining figures will be discussed later. These tables refer to the temperatures as observed. The small range in the extreme temperatures is noteworthy. There is no record of 100° F. being observed in New Zealand in a standard thermometer screen in an open position. Temperatures over 90° F. are experienced only in the interior and in eastern districts. Owing to the effect of the Föhn winds, there is very little difference between the highest temperatures experienced in the interior of the North Island as, for instance, at Rotorua, and in the far south, as at Gore.

TABLE XXIIIA

Auckland (160 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	72·6	72·9	70·9	66·9	62·1	58·6	57·0	57·8	60·1	63·2	66·0	69·3	64·8
Mean highest maximum	78·6	78·6	76·4	72·2	67·3	64·0	62·5	62·8	65·4	68·6	72·0	75·7	79·7
Absolute highest maximum	81·5	85·0	79·0	77·4	71·0	67·0	65·0	67·0	70·0	72·0	75·5	79·0	85·0
Mean daily minimum	59·7	60·4	58·5	55·3	51·3	48·1	46·2	46·2	48·9	51·7	54·1	56·8	53·1
Mean lowest minimum	51·8	53·0	51·5	46·4	42·7	39·5	38·1	39·1	41·7	44·3	47·1	49·4	37·3
Absolute lowest minimum	48·0	48·0	46·0	41·0	38·0	36·5	35·0	36·4	37·8	41·0	41·0	43·5	35·0
Days of frost in screen	—	—	—	—	—	—	—	—	—	—	—	—	0·0
Days of ground frost	—	—	—	—	—	0·1	0·7	0·1	—	—	—	—	1·0

TABLE XXIIIB

Rotorua (925 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	75·1	74·9	71·8	66·3	60·6	55·9	54·6	56·3	59·9	64·0	68·2	72·6	65·0
Mean highest maximum	84·3	83·7	80·3	73·9	68·2	62·0	60·8	62·7	66·7	72·5	77·3	82·5	86·4
Absolute highest maximum	98·0	93·5	87·0	81·5	78·0	66·5	66·0	67·4	74·5	80·0	85·5	92·0	98·0
Mean daily minimum	52·6	52·7	49·8	45·6	41·3	38·6	37·1	37·7	41·0	44·4	46·9	50·0	44·8
Mean lowest minimum	39·9	41·2	36·6	32·9	30·3	27·2	26·9	26·6	30·0	32·5	35·2	38·4	25·3
Absolute lowest minimum	32·5	30·0	22·0	24·0	24·0	22·0	21·0	21·0	25·0	22·0	27·0	32·0	21·0
Days of frost in screen	—	0·0	0·1	0·8	3·2	6·3	7·9	6·8	3·2	0·7	0·3	0·0	29·3
Days of ground frost	0·8	0·6	1·4	5·6	11·1	13·8	16·3	16·2	10·8	4·8	2·6	0·9	84·9

TABLE XXIIIc

New Plymouth (60 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	70·0	70·2	68·5	65·0	60·6	56·4	55·1	56·5	58·0	60·9	62·6	66·1	62·5
Mean highest maximum	76·9	77·4	74·4	70·4	66·2	61·7	59·8	61·1	62·2	65·8	67·5	72·7	79·1
Absolute highest maximum	83·3	81·2	81·5	75·3	70·0	63·0	61·2	62·8	66·8	69·7	71·5	77·5	83·3
Mean daily minimum	55·5	55·3	54·0	51·2	47·7	44·1	42·9	43·1	45·6	49·2	50·2	53·4	49·3
Mean lowest minimum	44·5	45·7	45·3	39·8	37·2	34·0	32·3	33·7	35·6	37·6	40·4	41·4	31·6
Absolute lowest minimum	41·8	42·4	39·7	35·2	33·2	31·3	29·4	31·6	32·8	34·2	34·3	36·1	29·4
Days of frost in screen	—	—	—	—	0·1	0·3	0·5	0·6	0·0	0·0	—	—	1·5
Days of ground frost	—	—	0·1	0·3	1·0	4·1	4·6	5·0	2·2	0·6	0·1	—	18·0

TABLE XXIIId

Napier (5-70 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	74·6	73·4	71·8	67·2	61·0	57·2	55·7	57·0	61·4	65·6	68·6	71·6	65·4
Mean highest maximum	86·8	84·8	82·5	77·6	70·8	67·0	65·7	66·2	71·5	75·9	80·8	83·9	76·1
Absolute highest maximum	93·0	93·0	88·0	83·5	77·0	73·0	71·0	71·5	78·0	79·5	88·5	93·0	93·0
Mean daily minimum	56·2	55·9	54·1	51·0	45·2	41·5	40·9	41·2	44·3	48·0	50·6	53·9	48·6
Mean lowest minimum	45·9	45·4	43·4	38·6	34·7	31·4	31·1	31·1	33·9	37·4	40·0	43·9	38·1
Absolute lowest minimum	40·8	38·0	38·5	31·5	30·5	28·5	27·0	27·0	30·5	30·6	35·5	38·0	27·0
Days of frost in screen	—	—	—	—	0·1	1·1	3·4	1·7	0·4	—	—	—	6·6
Days of ground frost	—	—	—	0·2	2·2	7·7	7·5	8·0	7·0	2·5	0·3	—	35·4

TABLE XXIIIE

Taihape (2,157 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	68·0	67·3	64·6	59·9	52·8	48·5	47·4	48·8	52·8	57·4	59·6	64·3	57·6
Mean highest maximum	78·0	77·3	74·4	69·0	62·2	58·2	57·1	57·4	62·0	66·6	69·9	74·9	79·5
Absolute highest maximum	87·3	81·0	78·0	75·5	69·8	63·2	61·0	61·8	67·0	73·4	74·2	82·0	87·3
Mean daily minimum	50·0	49·8	48·2	44·9	40·7	37·6	36·4	36·6	39·1	42·1	44·0	47·0	43·0
Mean lowest minimum	39·5	39·5	38·2	34·6	31·9	29·2	28·0	28·7	30·0	32·0	34·4	37·0	26·4
Absolute lowest minimum	31·9	32·0	35·0	30·0	27·0	20·4	24·0	25·4	25·5	25·0	31·4	30·2	20·4
Days of frost in screen	—	—	—	0·2	1·4	3·6	6·0	4·2	2·5	0·5	0·2	—	18·6
Days of ground frost	0·2	0·5	0·6	2·4	5·3	8·5	12·0	11·2	6·0	2·6	1·0	0·6	51·1

TABLE XXIIIF

Wellington (Altitudes various)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	69·3	69·3	66·9	62·9	58·3	54·8	53·1	54·3	57·5	60·4	63·2	66·7	61·3
Mean highest maximum	78·1	77·7	74·9	70·2	65·3	61·3	59·6	61·5	64·5	68·0	71·0	75·0	79·8
Absolute highest maximum	85·0	88·0	80·5	74·0	71·0	69·0	66·0	66·0	69·0	75·5	80·5	83·0	88·0
Mean daily minimum	55·7	55·8	54·2	51·3	47·2	44·1	42·4	42·8	45·7	48·4	50·3	53·8	49·1
Mean lowest minimum	46·4	46·7	44·1	41·2	37·4	34·5	33·3	33·4	36·2	38·4	40·9	44·7	32·3
Absolute lowest minimum	39·5	40·5	39·1	35;7	31·9	29·9	28·6	29·2	31·0	34·0	35·8	38·4	28·6
Days of frost in screen	—	—	—	—	0·0	0·2	0·4	0·4	0·0	—	—	—	1·4
Days of ground frost	0·0	0·1	0·2	1·0	2·6	5·4	7·8	6·7	3·1	1·3	0·5	0·1	28·6

Table XXIIIg

Hanmer Springs (1,220 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	71·7	71·6	67·8	62·9	55·4	50·5	49·0	51·6	57·4	61·9	64·8	68·9	61·1
Mean highest maximum	86·2	86·0	80·9	75·1	66·7	62·8	59·5	62·5	68·5	73·5	76·3	83·1	89·6
Absolute highest maximum	96·0	97·0	90·0	81·0	72·0	70·5	66·0	69·5	73·0	83·0	85·0	93·0	97·0
Mean daily minimum	49·2	48·7	46·9	41·7	35·7	31·8	31·6	32·4	37·4	41·6	43·7	46·8	40·6
Mean lowest minimum	35·9	36·1	34·2	28·9	24·3	19·5	19·5	20·2	25·1	29·3	31·7	34·3	17·2
Absolute lowest minimum	30·5	26·0	26·0	24·0	19·0	14·0	9·4	12·0	18·0	23·0	29·0	31·8	9·4
Days of frost in screen	0·0	0·0	0·3	2·8	9·9	14·9	16·6	14·3	7·0	2·1	0·7	0·0	68·6
Days of ground frost	0·4	1·3	5·2	12·7	21·1	23·2	23·0	21·2	16·6	9·7	7·6	2·1	144·1

Table XXIIIh

Hokitika (12 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	66·4	66·5	64·7	61·2	56·8	53·3	52·6	53·6	56·4	58·7	60·6	63·8	59·5
Mean highest maximum	73·5	72·5	71·3	67·7	63·7	59·5	58·6	59·5	62·3	64·7	67·0	70·9	75·9
Absolute highest maximum	79·0	82·4	84·5	74·0	71·5	63·5	65·0	67·1	67·6	69·0	74·1	78·0	84·5
Mean daily minimum	53·2	53·1	51·0	47·1	41·9	38·5	36·8	38·0	42·3	45·7	47·9	51·5	45·6
Mean lowest minimum	43·2	43·5	40·6	36·5	32·1	29·9	29·0	29·8	32·2	35·2	38·4	41·9	28·1
Absolute lowest minimum	35·0	37·0	35·0	31·0	28·5	26·0	25·5	26·5	27·0	30·0	32·0	33·0	25·5
Days of frost in screen	—	—	—	0·0	0·9	4·0	6·9	4·6	0·7	0·1	—	—	17·2
Days of ground frost	0·2	0·1	0·5	2·4	6·9	12·4	16·1	13·8	5·9	2·4	0·7	0·2	61·6

Table XXIIIi

Christchurch (22 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	70·4	69·2	66·4	62·1	55·8	51·1	50·3	52·3	57·6	62·4	65·8	69·2	61·0
Mean highest maximum	86·6	83·7	81·4	75·7	68·7	62·5	61·5	64·9	70·6	76·1	79·8	84·0	88·4
Absolute highest maximum	95·7	94·1	89·8	82·3	77·8	69·3	70·0	70·0	81·1	87·8	86·8	92·3	95·7
Mean daily minimum	52·8	52·5	49·7	45·0	39·9	36·0	35·1	36·3	40·5	44·0	47·1	50·8	44·3
Mean lowest minimum	41·2	40·9	37·2	32·3	28·6	26·1	26·0	26·7	29·4	32·1	35·4	39·0	24·7
Absolute lowest minimum	34·0	34·2	30·4	25·6	21·3	21·5	22·7	23·0	25·5	26·0	30·8	33·0	21·3
Days of frost in screen	—	—	0·0	0·7	4·0	9·2	10·1	8·2	2·6	0·5	0·0	—	35·4
Days of ground frost	0·3	0·2	1·4	5·4	12·3	16·9	17·7	17·3	10·4	6·5	3·6	0·9	92·9

Table XXIIIj

Ophir (1,000 ft.)

	Jan.	Feb	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	72·0	72·8	68·4	61·2	50·8	43·3	44·1	49·1	55·4	61·1	64·4	69·8	59·4
Mean highest maximum	86·4	86·0	80·1	72·6	64·7	57·3	55·2	58·4	65·9	71·3	77·6	82·6	87·3
Absolute highest maximum	89·3	88·7	84·4	74·7	67·8	66·0	58·0	60·3	70·9	74·7	81·3	85·5	89·3
Mean daily minimum	47·7	46·8	43·2	38·1	29·6	25·1	26·2	28·9	33·9	39·6	41·6	45·7	37·2
Mean lowest minimum	35·7	33·3	30·8	25·2	18·7	15·3	16·0	19·0	23·0	27·6	28·9	31·6	14·3
Absolute lowest minimum	30·1	30·4	27·4	20·9	16·3	9·0	8·7	12·2	21·0	23·0	26·2	28·4	8·7
Days of frost in screen	0·1	0·3	2·1	7·9	19·1	25·7	25·1	20·7	11·6	4·9	3·7	0·7	121·9
Days of ground frost	4·7	4·6	10·0	15·4	24·7	27·7	28·3	26·6	19·8	14·2	11·0	5·7	192·7

Table XXIIIk

Dunedin (240-466 ft.)

	Jan.	Feb	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	66·5	65·9	63·1	58·9	53·3	49·3	47·9	50·3	55·1	59·1	61·6	64·5	58·0
Mean highest maximum	81·5	80·5	77·3	71·8	64·4	59·3	57·4	61·5	66·8	73·0	75·3	78·0	84·3
Absolute highest maximum	94·0	90·0	85·0	85·0	72·0	68·0	66·0	70·0	77·0	83·0	84·0	88·0	94·0
Mean daily minimum	49·7	49·5	47·8	44·8	41·0	38·6	37·4	38·2	40·6	42·9	44·9	48·0	43·6
Mean lowest minimum	41·3	41·5	39·1	36·7	33·8	31·2	30·5	31·2	33·0	34·8	37·0	40·0	29·4
Absolute lowest minimum	36·0	37·0	34·0	31·0	29·0	24·0	23·0	27·0	29·0	31·0	32·0	35·0	23·0
Days of frost in screen	—	—	—	—	0·1	1·4	1·7	1·1	0·2	—	—	—	4·5
Days of ground frost	—	0·1	0·0	0·7	5·9	11·0	12·4	9·5	4·7	1·0	0·3	0·1	45·7

Table XXIIIl

Gore (245 ft.)

	Jan.	Feb	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Mean daily maximum	69·0	68·9	66·1	60·1	53·7	47·7	47·1	51·7	56·8	60·9	63·1	66·4	59·3
Mean highest maximum	84·9	84·3	80·2	73·8	64·9	58·4	57·1	62·0	68·6	73·0	77·6	80·9	87·9
Absolute highest maximum	93·0	91·5	89·0	82·0	70·0	67·0	62·0	68·0	76·0	79·0	84·0	95·0	95·0
Mean daily minimum	46·7	46·0	44·0	40·4	35·7	32·4	31·6	33·2	37·5	40·8	42·2	44·9	39·6
Mean lowest minimum	35·1	34·9	32·9	29·2	25·9	23·5	22·9	24·6	28·2	30·8	32·6	35·0	21·4
Absolute lowest minimum	30·0	30·0	29·0	25·0	21·0	18·0	20·0	18·0	25·0	27·0	30·0	31·0	18·0
Days of frost in screen	0·1	0·3	0·5	1·9	6·7	13·1	15·4	11·1	3·7	1·5	0·3	0·1	54·7
Days of ground frost	0·8	1·4	3·2	6·0	13·0	22·0	21·4	19·9	11·1	6·1	3·2	1·1	109·2

TABLE XXIIIM

Invercargill (12 ft.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov	Dec.	Year
Mean daily maximum	66·8	66·0	63·4	59·4	54·0	49·8	49·5	52·1	56·4	59·4	61·0	63·6	58·5
Mean highest maximum	81·3	81·2	76·3	70·6	64·8	58·6	58·8	61·4	67·2	70·8	74·2	77·9	84·0
Absolute highest maximum	90·0	88·0	85·0	79·0	71·0	63·0	69·0	67·0	74·0	77·0	83·0	87·0	90·0
Mean daily minimum	48·4	47·9	45·8	42·5	38·0	35·2	34·0	35·4	38·8	42·4	43·8	46·4	41·6
Mean lowest minimum	37·6	36·8	33·9	30·9	26·8	25·5	24·8	26·2	29·8	31·2	34·0	36·2	23·3
Absolute lowest minimum	32·0	28·0	28·0	28·0	23·0	19·0	19·0	22·0	26·0	27·0	30·0	32·0	19·0
Days of frost in screen	—	0·1	0·3	1·2	3·5	6·7	8·9	6·8	2·0	—	—	—	29·5
Days of ground frost	0·2	0·3	1·2	2·5	6·8	9·9	11·7	9·9	5·1	2·1	0·4	0·1	50·2

The lowest temperatures recorded at Auckland are remarkably mild, and conditions are more severe further north.

The variations at inland stations, especially those sheltered by the mountain ranges, are naturally greater than on the coast, and eastern districts experience a greater range than western. Thus, the extreme ranges are 50° F. at Auckland, 77° F. at Rotorua, 59° F. at Wellington, 88° F. at Hanmer, 59° F. at Hokitika, 74° F. at Christchurch, 71° F. at Dunedin, 77° F. at Gore, and 71° F. at Invercargill. The record at Ophir covers seven years only, but already a range of 80°·6 F. has been recorded. In the interior of the South Island, especially the southern half, there are places at an altitude of about 2,000 ft. which must, at rare intervals, experience temperatures as low as 0° F., and an extreme range over a long period of years of 90° F.

It should be noted that the Napier record is partly from Meanee and partly from Napier. There have been changes of site, also, at Wellington and Dunedin.

D. Diurnal Variation

Little is known regarding the diurnal variation except the daily range. This is surprisingly large, being quite comparable with that experienced in continental areas. The large daily range is a very important feature of the climate of New Zealand which it owes to its transparent atmosphere and clear skies. The mean daily range in each month and the year can be got from Tables XXIIIa to XXIIIm by subtracting the mean daily minimum from the mean daily maximum. In the mean for the year it amounts to 11°·7 F. at Auckland, 20°·2 F. at Rotorua, 13°·2 F. at New Plymouth, 16°·8 F. at Napier, 14°·6 F. at Taihape, 12°·2 F. at Wellington, 20°·2 F. at Hanmer, 13°·9 F. at Hokitika, 16°·7 F. at Christchurch, 22°·2 F. at Ophir, 14°·4 F. at Dunedin, 19°·9 F. at Gore, and 16°·9 F. at Invercargill. The same factors are concerned in the variations of the daily range from place to place as in variations of other kinds, and there is no need to refer to them again.

E. Temperature and the Fauna and Flora

If the higher portions of the mountain ranges be left out of account, the range of temperature in New Zealand is small for a country with its extent in latitude. Furthermore, the temperatures experienced lie everywhere well within the temperate range. Consequently, there is no marked change in the fauna and flora from one end to the other. Nevertheless, a certain amount of differentiation does take place. An important natural boundary falls between the actual temperature annual isotherms of 55° F. and 56° F., and nearer the latter than the former. The growth in large quantities of citrus fruits, passion fruit, grapes in the open air, maize,

Paspalum grass, sorghum, and kumaras or sweet potatoes, is confined to the higher temperature side of such a boundary. The same is true of the kauri and the mangrove in the natural state. The area concerned includes most of that marked A in Map 15, a strip beyond it down the west coast towards Kawhia, the Bay of Plenty area, and coastal strips between Hawke's Bay and East Cape. Even in this area, the plants referred to are confined principally to coastal parts where the frequency of frost is low. Maize and especially Paspalum grass are, however, hardier than the others in this respect. There are, of course, sheltered spots even as far south as the South Island where citrus fruits, grapes, etc., grow well in the open air, but they are of practically negligible extent.

There are other characteristics of New Zealand agricultural products which are determined principally by temperature. Potatoes grown in the Auckland Province, for example, have relatively poor keeping qualities. By far the best oats are grown in Southland, black currants, gooseberries, and apricots do not do well in the northern portions of the North Island. Temperatures in the Auckland Province are too warm to cause vegetation to have any long period of rest. Growth is going on continually. Decay of vegetation is also more rapid and continuous. The soil becomes more quickly exhausted and regular manuring is more important. Top-dressing is necessary and very effective. In Canterbury and Otago, on the other hand, there is a considerable period of rest or only slow growth. The contrast between the two regions is accentuated by their difference in humidity as regards both air and soil. The range, vigour, and life cycle of many insect and fungous pests are controlled by temperature and there are many differences between northern and southern districts in this respect.

It is the absence of extreme temperatures, the relatively high humidity, and the abundant and uniform rainfall which accounts for the evergreen character of the native flora of New Zealand. The same factors have enabled the farmer to use the land to such a large extent for grazing rather than the more arduous, more hazardous and, generally speaking, less remunerative cropping purposes.

V. HUMIDITY

The figures for relative humidity given in Table XXIV are derived from the readings of maximum and minimum dry and wet bulb thermometers and give approximate value for the mean of day. Eastern districts are, as would be expected, drier than western, the prevailing westerly winds losing much of their moisture in crossing the mountains. The resulting desiccation is much more pronounced at stations in the interior of Canterbury and Otago than at any of those listed. Since the westerly

winds are most persistent in spring, the effect is most marked then. The amount of water vapour in the air at Auckland is approximately half as much again as that in Central Otago. Humidities below 50% are very common at 9 a.m. in spring and summer in the latter district.

TABLE XXIV

Relative Humidity (%)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Auckland	77	75	78	79	81	80	82	80	80	79	79	77	79
Rotorua	69	69	70	73	75	76	76	74	75	71	70	69	72
New Plymouth ..	75	75	75	76	78	80	79	78	78	77	77	77	77
Napier	71	73	74	74	77	79	78	77	74	72	71	72	74
Wellington ..	72	73	74	75	77	79	78	77	75	75	74	73	75
Nelson	70	70	74	77	80	81	79	78	76	75	73	72	75
Hanmer	68	69	67	73	73	72	74	73	67	67	68	68	70
Hokitika	82	83	84	85	85	85	85	82	83	83	82	84	83
Christchurch ..	72	72	76	76	80	83	81	78	73	71	70	70	75
Dunedin	74	74	75	76	78	79	78	76	74	73	72	74	75

Except during Föhn winds, when the excessive dryness is oppressive, humidities experienced in New Zealand are conducive to human comfort. There are, of course, some raw days. The easterly wind experienced at Christchurch is often unpleasantly raw, especially in the cold months, and the west wind sometimes has similar characteristics, for example, in Taranaki. Cattle in the dairying districts undoubtedly suffer from the raw westerlies and south-westerlies when no shelter is available.

As regards production from the soil, the effects of humidity are involved with those of temperature, sunshine, wind and frost. Places with air of a low moisture content are, generally speaking, those with a high proportion of sunshine and little wind. All of these factors tend to produce a large range of temperature, both annual and diurnal. A low humidity increases the liability to frost, leads to increased evaporation from the ground and transpiration from the leaves of vegetation, but is inimical to the development of insect and fungous pests. Many fruits do best with a low humidity so long as there is sufficient soil moisture. They are, therefore, grown very largely on irrigated lands. We have an example in Central Otago. New Zealand is probably not an ideal place for growing citrus fruits because, where other conditions are favourable, the humidity is relatively high.

Humidity is very important in connection with the storage and transport of products and their conversion into manufactured articles.

TABLE XXV

Bright Sunshine (Hours)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov.	Dec.	Year
Auckland	219·4	191·9	179·5	143·9	131·8	114·1	120·9	150·4	149·7	169·2	191·9	209·8	1972·5
Rotorua	238·3	201·7	187·1	149·2	137·3	118·5	127·3	144·4	155·1	180·7	211·7	222·5	2073·8
New Plymouth ..	256·0	230·7	221·6	164·9	159·8	132·0	143·6	178·2	166·0	174·3	209·2	238·7	2275·0
Napier	261·2	212·0	211·6	189·0	156·7	149·4	144·9	180·6	212·3	228·8	242·4	262·5	2451·4
Masterton	226·7	210·7	180·1	157·9	120·6	104·9	110·1	144·4	170·3	187·0	215·8	224·2	2052·7
Wellington	227·4	211·3	188·5	154·4	130·8	106·9	107·8	140·4	163·0	177·4	203·2	225·2	2036·3
Nelson	267·6	237·1	212·4	187·7	172·3	151·7	156·5	193·7	203·3	218·3	250·8	252·7	2504·1
Hokitika	213·5	189·7	183·1	138·9	136·4	114·0	127·5	152·5	146·9	163·9	175·0	200·8	1942·2
Lincoln College (near Christchurch.) ..	213·0	197·0	176·9	149·1	136·9	114·8	115·3	148·9	174·6	197·1	211·8	205·3	2040·7
Timaru	203·2	181·3	173·9	132·7	148·9	130·3	129·3	147·4	169·1	174·5	197·7	169·7	1958·0
Alexandra	230·8	223·9	217·9	172·0	130·7	108·2	118·0	149·0	174·3	219·0	198·8	223·8	2166·4
Dunedin	187·9	157·3	144·6	120·6	104·4	88·9	98·4	121·7	144·2	157·3	164·7	170·1	1660·1
Invercargill	193·1	167·5	122·6	95·7	84·1	79·6	81·9	113·0	126·7	138·2	162·4	165·7	1530·5

VI. SUNSHINE AND CLOUD

Observations of cloud amount in New Zealand are confined, practically, to one time of day, namely, 9 a.m. The records of the amount of bright sunshine, therefore, give a better indication of the degree of cloudiness. The average number of hours of sunshine is given for a selection of stations in Table XXV. For a temperate country with a high rainfall the amount is generally high. This, as has already been indicated, is one of the most favourable characteristics of our climate. The sunshine dries the ground surface, thus assisting in ensuring adequate drainage, stimulates the chemical action on which the growth of plants depends, and the transpiration which is responsible for the circulation of the sap. It also has a highly beneficial effect on human health. The greatest amounts of sunshine are experienced in places which are protected by surrounding mountains from the prevailing winds. The air is robbed of its moisture as it ascends the mountains and the skies to leeward are generally clear. Thus, Nelson has the best record, and is followed closely by Napier. But even at Hokitika, which is exposed to the westerly winds and has 116 inches of rain per annum, an average of 1,954 hours is experienced. But for the high percentage of sunshine, large areas of peaty soil would occur on the west coast of the South Island. The sub-Antarctic islands are covered with peat. It is for this reason that settlement has not been possible on the Auckland Islands.

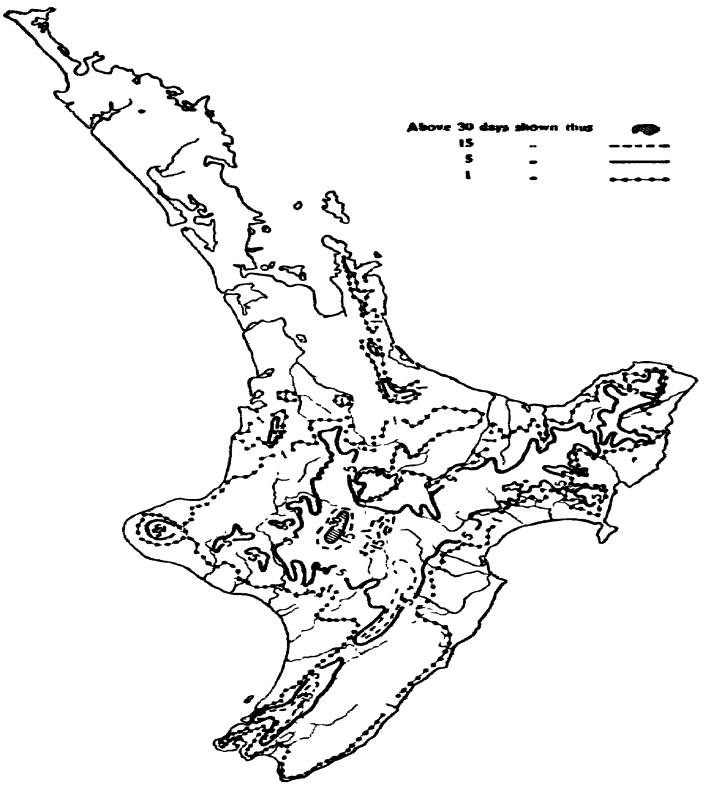
Abundant warm sunshine is an important factor, especially in the ripening stages, in the production of fruit of good flavour and keeping qualities, and free from diseases. It is essential, also, for the growing of wheat of good milling qualities.

VII. PHENOMENA

A. Snowfall

Snowfall is not an important factor in the control of land utilization in New Zealand but activities are, to some extent, limited by it in the central plateau in the North Island and in the interior of the South. In the latter region, more particularly at altitudes between 1,000 and 4,000 feet, losses of stock, principally sheep, are in occasional years heavy and on the average quite appreciable.

So far as it can be gathered from the records available, the average number of days on which snow falls is shown in Maps 20a and 20b. On the high ranges it rises to upwards of 30, but in most coastal districts is practically negligible. In the North Island, the only settled area which suffers much inconvenience from snowfall is the tableland, already mentioned, which surrounds the Ruapehu massif, especially on its western side. In



Map 20a



Map 20b

Frequency of Snowfall

the South Island, on the west coast and in Nelson, all but the high levels are remarkably free from snow. The localities where it is of greatest importance and where most of the damage is done, are east of the main range.

Most of the snow falling on the lower levels melts practically as soon as it falls. This is the case on the whole coastline except parts of the east coast of the South Island. Even in the interior of Nelson and Westland, it is surprising how little reaches the valley floors though they be at a considerable altitude. On the Canterbury Plains and to the southward, snow may lie practically down to sea level, but the number of days on which it does so is very small. In most years there are none. On the foothills of the Southern Alps snow becomes an important problem, especially since sheep are pastured up to high levels. In very bad years snow may fall to a depth of 2 or 3 feet. On being redistributed by the wind it will drift to great depths in some places and may lie for weeks. The areas most affected will depend on the winds prevailing during and after the original storm. There will be great local variations so that even in these very bad years, patches soon clear of snow. In any but the very severe years losses can be avoided by moving stock on to sunny slopes.

In the central plateau of the North Island snow may, in some years, lie in the hollows for as long as three weeks.

The frequency and amount of snowfall vary very much from year to year. The years in which losses of stock are heavy do not occur, on the average, oftener than about once in a decade.

Snow ploughs are used occasionally on the North Island Main Trunk Railway where it crosses the central plateau, and there have been three occasions on which traffic was disorganized by snowfall in Central Otago. But, on the whole, the interference to railway traffic caused by snowfall is practically negligible.

In the North Island, the only permanent snowfield is on the massive extinct volcano Ruapehu. Several small glaciers flow from this field. The neighbouring peak of Ngauruhoe (7,500 ft.) is frequently quite bare of snow, and even on Mt. Egmont (8,260 ft.) snow is occasionally reduced in the late summer to a few patches in the hollows. In the South Island, the snow line is roughly at about 7,000 ft. It is lower on the western than on the eastern side of the main range owing to the difference in the total amount precipitated. There is also some variation with latitude. It is due to the heavy precipitation on the western side, too, that the Franz Josef and Fox Glaciers descend to within 1,000 ft. of sea level.

Another important altitude limit which is controlled to a large extent by snowfall is the 'bush line.' As the altitude increases, the forest trees gradually become more stunted and finally disappear. The level at which

this takes place decreases as the latitude increases, falling from about 5,000 ft. in our most northern mountains to about 3,000 ft. in Stewart Island. Above the bush line snow lies for protracted periods in winter. It is probable that the checking of the water circulation in the soil and the severity of the winds are the principal factors determining the height of the bush line.

The storage of water in the form of snow is an important factor in regulating the supply for irrigation and hydro-electric purposes and the flow of rivers.

B. Ground Frost

In accordance with a European convention, a ground frost is considered to have occurred when the temperature recorded by a minimum thermometer, one inch above the ground on an open, grassed surface, has fallen below 30°·4 F. Damage, even to tender low-growing plants, is unlikely at higher temperatures.

Frost, however, is a very local phenomenon, and the frequency of occurrence may vary within wide limits over a comparatively small area. A level plain will be more subject to frost than a hill slope, and a hollow in a plain still more so. An area which receives the drainage of cold air from higher levels, also, is likely to be subject to frost. If, for some reason, there is a continuous wind at night time, the liability to frost is reduced. This is the case in the Cook Strait region, where there is little chance for the air to stagnate owing to the concentration of the wind through the Strait. The same is true in some valleys. For example, in the Clutha Gorge between Cromwell and Clive the night drainage from a large area is concentrated into so small a channel that it results in a moderate breeze, and ground frosts are infrequent. Proximity to the sea leads to fairly uniform temperatures and reduces the liability to frost.

The accuracy of Map 21 can, in view of the foregoing, only be rough. The object is to indicate average conditions in the localities concerned, such as would occur on fairly level ground. For the mountains, the data can have little significance owing to the complications introduced by altitude and topography.

The figures show that frosts are much more frequent inland than on the coast. The areas to the eastward of the main ranges, which have clear skies and light winds, are the most susceptible. It is possible for the air to stagnate there, and cooling by radiation takes place freely through the unclouded atmosphere. The greatest number of frosts is experienced at the feet of the Southern Alps where, in addition to the factors mentioned, there is a drainage of cold air from the snow-covered mountains. As would be expected, these conditions reach their culminating point in

Central Otago where, in the coldest parts of some of the valleys, as many as 200 frosts per annum must be experienced.

In the years of exceptional snowfall, periods of frost occur in the inland basins of Canterbury and Otago of a severity otherwise unknown in New Zealand.



Map 21

Frequency of Frost

There is practically no part of the country in which there is not a possibility of frost in every month. From December to March, however, the number of frosts is everywhere small. The amount of damage done is seldom serious and in many districts is negligible. From May to August, the number is large, and in the interior of the South Island, practically all clear nights are frosty. Data regarding the number of ground frosts are given in Tables XXIIIa to XXIIIm, in the last row.

C. Frost in Standard Screens

Many of the ground frosts referred to in the preceding paragraphs are confined to a very shallow layer at the surface and most plants are tall enough to escape their effects. Furthermore, the readings obtained by a grass minimum thermometer depend very much on the precise position in which it is placed. There is an increasing tendency, therefore, to concentrate on the readings of sheltered thermometers at a height of about 4 ft. above ground, such as are obtained in the standard Stevenson screen. In Tables XXIIIa to XXIIIm data regarding the number of days on which the temperature so recorded falls below 32° F. are given in the second last row. On such days, which are sometimes called 'frost days,' some damage is almost certain to be done to tender vegetation and at certain seasons fruit trees are likely to suffer. The contrast between the North and South Islands is not so great with these days as in the case of ground frosts and the effect of altitude is more marked.

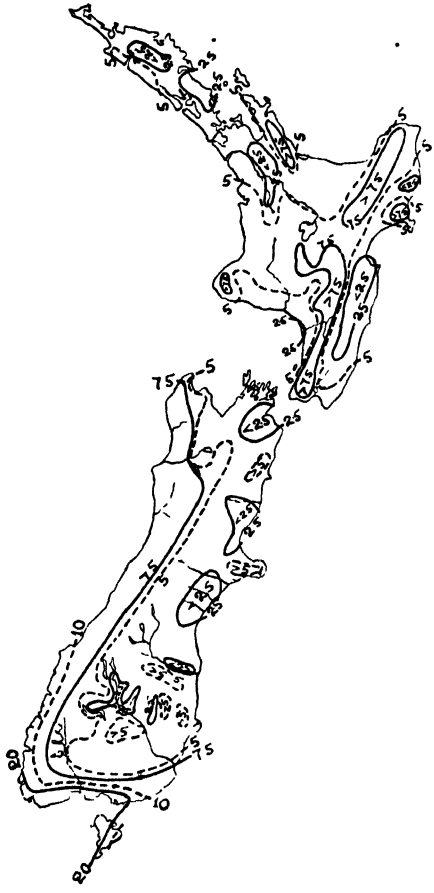
In some years a few days occur at localities at a high level in the interior of the South Island when the temperature fails to rise above freezing point at any time during the day. No such days have yet been recorded in the North Island, at any rate in the settled areas. The general mass of the air over New Zealand is never at freezing temperatures.

Losses due to frost are heavy in some years. This is to be expected in the case of tender plants such as tomatoes, when early yields command the higher prices and growers are prepared to take a certain amount of risk. But there have been a number of seasons when the losses in orchards have amounted in a single district to many thousands of pounds. In some cases, the orchards have been planted in areas where the prospects of success were remote, owing to the liability to frost damage. Protection against frost by means of artificial heat has been resorted to in some districts, principally Central Otago, but only to a comparatively small extent.

D. Hail

Hail is a meteorological phenomenon of some importance, since it causes damage to vegetation, especially wheat crops, and fruit. Glass houses, too, occasionally suffer. The frequency of hailstorms increases, on the whole, from north to south in New Zealand. But areas exposed to westerly winds are relatively much more subject to hail than those to the eastward of the ranges. There is a rapid increase in the frequency in the far south, and this continues to much higher latitudes. In those regions, however, most of the hail occurs in the form of soft hail. It falls in brief showers, and the stones are small. Map 22 gives the annual frequency of hailstorms for the various districts.

Very rarely, storms of exceptional severity are recorded with stones ½ in. to 1½ in. and even up to as much as 3 in. in diameter. In the eastern districts there are certain localities which seem rather specially liable to storms of this type, which tend to follow certain definite narrow tracks.



Map 22
Frequency of Hail

E. Thunderstorms

Thunderstorms are not very numerous. In general, the annual frequency decreases from north to south, but it is much greater in western than in eastern districts and increases with altitude. The average number of days with thunder is given for a few stations in Table XXVI, stations where conditions are similar being grouped together. In the extreme north, the number is about 21 per annum, but in parts of the eastern districts of the South Island, it falls below 2.

TABLE XXVI

Average Number of Days with Thunderstorms

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Rangiahua	1·1	0·9	1·0	1·0	1·4	2·9	1·8	2·2	2·5	1·6	1·2	0·9	18·4
Auckland	1·2	0·7	0·4	1·3	1·0	1·9	2·5	1·3	1·2	0·7	1·7	0·8	14·7
New Plymouth	0·6	0·6	0·3	0·4	1·4	1·3	1·6	1·0	1·2	1·1	1·0	0·8	12·3
Waitatapia, Bulls.	0·6	0·4	0·1	0·3	0·5	0·4	0·1	0·2	0·7	0·5	0·6	0·5	5·2
Wellington	0·6	0·3	0·3	0·4	0·4	0·4	0·5	0·3	0·5	0·4	0·5	0·5	5·1
Napier	0·9	0·9	0·5	0·5	0·3	0·1	0·0	0·1	0·2	0·3	1·2	0·8	5·8
Nelson	0·8	0·5	0·5	0·3	0·3	0·8	0·5	0·5	0·2	0·5	1·0	1·0	6·8
Hokitika	1·2	1·0	0·9	1·2	2·0	1·7	1·7	1·4	1·7	1·7	1·5	1·2	17·2
Invercargill (Wallacetown)	2·3	0·9	1·1	0·6	1·5	1·2	1·6	1·0	1·1	1·2	1·2	1·6	15·2
Marshlands, Blenheim	0·2	0·3	0·1	0·0	0·1	0·0	0·0	0·1	0·0	0·0	0·1	0·1	0·9
Lincoln College (near Christchurch)	0·8	0·4	0·3	0·1	0·0	0·0	0·0	0·2	0·2	0·4	0·6	0·8	3·8
Dunedin	0·7	0·6	0·3	0·1	0·2	0·1	0·0	0·1	0·2	0·5	0·7	1·4	4·8

TABLE XXVII

Days with Fog

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Rangiahua	0·5	1·9	3·1	4·6	4·3	4·4	5·3	3·4	2·1	0·6	0·4	0·2	31·2
Auckland	0·1	0·1	0·2	0·3	0·6	0·8	0·9	0·6	0·4	0·1	0·0	0·0	4·2
Wellington	0·1	0·1	0·2	0·5	1·0	1·5	2·1	0·5	0·2	0·1	0·0	0·1	6·6
Hokitika	1·0	1·0	0·9	0·7	0·4	0·5	0·5	0·6	0·3	0·4	0·6	0·8	7·7
Lincoln College	0·1	0·1	0·5	0·5	1·4	1·8	1·3	1·3	0·5	0·2	0·1	0·0	7·9
Dunedin	0·4	0·4	0·9	1·0	0·7	1·0	0·5	0·6	0·5	0·5	0·5	0·5	7·4

F. Fog

It is very difficult to secure accurate statistics of fog because it is usually a very local phenomenon and occurs principally at night. Furthermore, until recent years, there has been no very precise definition of what constitutes a fog. The figures given in Table XXVII will, however, give some idea of the frequency of its occurrence. Owing chiefly to the continual movement of the atmosphere, fogs are comparatively rare phenomena. They are more numerous about some of the land-locked estuaries of the Auckland Peninsula, as illustrated by the data for Rangiahua on Hokianga Harbour, than elsewhere. Most of the fogs recorded are radiation fogs and confined to the land or its immediate neighbourhood. Shipping is, therefore, seldom inconvenienced by them. Occasionally, however, they spread sufficiently far over the sea around Banks Peninsula and Otago Harbour to interfere with the movements of vessels.

The only persistent and widespread fogs occur on the eastern sides of cyclones.

Acknowledgment

The writer wishes to acknowledge assistance in the discussion of the relation of the various climatic elements to agriculture received from Mr. F. R. Callaghan, whose numerous suggestions proved very helpful.

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CHAPTER VIII

LAND SETTLEMENT AND SETTLEMENT FINANCE

BY D. O. WILLIAMS

I. State Settlement Finance—A. State Re-Purchase of Private Lands—B. Discharged Soldiers' Settlement—C. Miscellaneous Settlement Accounts—D. Public Works and Other Expenditure—E. Revision of Contracts—F. Deferred Payments—G. Land Finance Associations—H. Group Applications for Crown Purchase and Re-Sale—I. Finance for Undeveloped Crown and Settlement Lands—J. Disposal of Crown Lands Unsuited for Closer Settlement—K. Attitude Towards Land Settlement and Finance. II. Small Holdings for Unemployed—A. Origins—B. Types of Holdings—C. Extent of Holdings—D. Compulsory Powers. III. Native Land Settlement—A. Introduction—B. Difficulties of Communal Titles—C. Methods of Overcoming Difficulties of Titles: 1. Incorporation of Owners; 2. Consolidation of Interests; 3. Vesting in Statutory Bodies—D. Finance for Maori Farming—E. The Development Schemes.

I. STATE SETTLEMENT FINANCE

THE ensuing account of Government Settlement finance in New Zealand will relate chiefly to the settlement of Crown, Settlement and Discharged Soldiers' Settlement lands. State land expenditure which is recouped either from subsequent sale or lease, or from taxation, may first be considered.

A. STATE RE-PURCHASE OF PRIVATE LANDS

The first Land for Settlement Act (1892) provided for the purchase out of loan money of private freehold land offered to the Crown and deemed suitable for subdivision. The 1894 Act went much further and laid down the principle that private land could be compulsorily acquired by the State for subdivision, and provided for the question of compensation. The many amendments to these early Acts have not impaired the principles of 'voluntary' and 'compulsory' acquisition for settlement.

Statutory authority permits the Government to borrow moneys for this specific purpose. A portion of these borrowings is earmarked for road and bridge construction necessary to open up Crown land, and for drainage and survey. This expenditure is then allocated to the sections and subdivisions of the block purchased and is taken into account in fixing the capital value of the land; that is, the upset price of sections sold by auction, and the capital value of the rentals fixed for leases, should be sufficient to cover the costs of acquisition and subdivision.

As an alternative to Crown purchase and subsequent disposal, the Government may leave the work of preparing the estate for subdivision as well as the actual disposal of the sections, to the private owner. In such a case the function of the State is confined to advancing him the

cost of survey and necessary works. The compulsory powers have been exercised in respect of a few important estates; but the great majority of acquisitions have been made by agreement with the owner, and in recent years (until 1933)[1] there has been no attempt to employ other than voluntary methods. The number of estates offered to the Crown and considered by it has been far in excess of the possibility of economic State purchase and many have been found quite unsuitable for subdivision. In the three years 1928 to 1930 over two million acres were offered to the Crown but less than 50,000 acres were acquired. The following table summarizes some of the chief operations under this policy:—

TABLE XXVIII

Operations Under the Land for Settlements Acts

Up to Year	Area Acquired by Crown (in thousands of acres)	Purchase Price Paid by Crown £m.	Area Leased by Crown (thousands of acres)	Leaseholds as Per Cent of Area Acquired %
1900	324	?	268	83
1905	716	3·4	643	90
1910	1,238	5·4	1,125	91
1915	1,541	7·3	1,480	96
1920	1,891	11·4	1,631	86
1925	1,982	13·0	1,796	91
1930	2,046	13·6	1,835	89
1933	2,112	13·9	1,881	89

It will be seen that since 1920 the total operations under the Act have increased comparatively slowly. In the first decade of the policy the State expended nearly £3½ millions in land purchase; in the second decade nearly £4 millions, and over £4 millions in the five years 1915 to 1920; but in the 13 years since 1920 additional purchase expenditure has been only £2½ millions. It is possible that a return to stability and reasonable prosperity after these years of economic uncertainty may be accompanied by an expansion of State activity in this direction; unless the financial embarrassments in which the State itself has been recently involved in consequence of its extensive land mortgage transactions, counsel a still more cautious policy of future development. Land finance under the Land for Settlements Acts constitutes only a part of the State's total investment in farming properties and although the scheme, taking good times with bad, is self-supporting in itself and has some excellent achievements to its credit, there will in the future be a strong resistance to anything but the most conservative borrowing policy.

The next table indicates the manner in which the acquired estates have been subdivided and disposed up to March 31, 1933.

1. The Small Farms (Relief of Unemployment) Act 1932-33 has revived the principle of compulsion in a new form.

TABLE XXIX

Lands Disposed of by Lease or Sale Under the Lands for Settlements Acts to March 31, 1933

Land District	Number of Estates Acquired	Lands Leased by Crown			Lands Sold for Cash by Crown			Average Area of Freeholds as per cent. of Average Area of Leaseholds
		Number of Selectors	Total Area	Average Area per Selection	Number of Purchasers	Total Area	Average Area per Purchaser	
North Auckland	123	315	48,839	155	234	2,621	11	7
Auckland		928	129,042	139	774	136,246	176	127
Gisborne	73	235	70,432	300	46	7,082	154	51
Hawke's Bay		619	204,019	330	127	22,457	177	54
Taranaki	26	142	22,693	160	62	2,225	36	23
Wellington	155	947	145,887	154	494	14,400	29	19
Nelson	22	61	46,194	757	6	1,634	272	36
Marlborough	14	478	221,672	464	54	9,154	170	36
Westland	3	37	5,453	147	4	398	97	67
Canterbury	178	1,873	576,060	308	326	20,947	64	21
Otago	81	1,158	328,204	284	74	7,620	103	36
Southland	34	364	82,090	226	122	17,525	144	64
Totals	709	7,157	1,880,585	263	2,323	242,309	104	40

Under the scheme over 9,000 holdings have been carved out of about 700 estates. The net addition to the State's ownership of land when reserves and other allowances are included is approximately 2,000,000 acres, since less than a quarter of a million acres have been made freehold. Outside Auckland a very small proportion of the subdivisions has been acquired in freehold and for the Dominion as a whole leases account for nearly 90% of the lands disposed of. It will be observed, too, that in most districts the average area of leaseholds is much larger than that of freeholds.

The severity of the present crisis and the desire to meet part of the unemployment problem by land settlement, have given rise to new powers of compulsory acquisition which, if actively used, would give an entirely new emphasis to our land policy. These developments are discussed later in this chapter.

B. Discharged Soldiers' Settlement

The settlement of discharged soldiers on the land was an extension of this general policy. Special areas of Crown, Settlement and National-endowment lands were set aside for selection by discharged soldiers, and financial and other assistance was given. Since the inception of the scheme in 1915 up to March 31, 1933, 4,071 allotments aggregating 1,432,690 acres have been made; but the processes of sale, forfeiture and abandonment of properties has reduced the number of holdings to 2,727 and the area to 943,551 acres. Only 121 of these have been purchased for cash or on deferred payments, the balance, representing 95 per cent. of the total holdings, being held on leases and licences. The State has been liberal in its assistance to these settlers. Since the scheme began about £5,600,000 on current account and over £9,000,000 as assistance towards the purchase of farms, market gardens, and orchards and the discharge of mortgages has been advanced. At the present time financial operations are confined mainly to advances on current account for stocking and developing farms. The passage of time has made the war an 'historical episode' and there no longer appears any valid reason for a separate scheme outside the Land for Settlements Acts as far as new transactions are concerned.

C. Miscellaneous Settlement Accounts

Expenditure on native land settlement and on the Crown purchase of Native lands for subdivision and sale is additional to that on the plans already mentioned. In the aggregate considerable sums are involved. In all, over £25,000,000 of our gross public indebtedness is allocated to land settlement, including afforestation.

TABLE XXX

Allocation of Gross Public Indebtedness at March 31, 1933, to Land Settlement and Forests

	£
Cheviot Estate	160,918
Land for Settlements	9,230,574
Discharged Soldiers' Settlements	6,870,476
Hauraki Plains Settlement	815,924
Purchase of Native Lands	1,916,936
Native Land Settlement	4,711,081
State Forests	1,923,172
Settlement of Unemployed	70,848
	£25,699,929

The rapid growth of this allocation in post-war years is shown in the following table:—

TABLE XXXI

Allocation of Gross Public Debt to Land Settlement and Forests (in Millions of Pounds)

	1891	1906	1914	1919	1933
Total	1·5	7·2	11·2	14·6	25·7
Per cent.	4	12	12	8	9

Advances to settlers have not been included in the above figures.

D. PUBLIC WORKS AND OTHER EXPENDITURE

There is a large amount of State expenditure directly or indirectly helpful to settlement in addition to that included in the main settlement accounts. For over twenty years a modest policy of irrigating the semi-arid lands of Central Otago has been pursued. In recent years special votes have been made to provide access to outlying districts where in the past back-block settlers have been considerably handicapped for want of satisfactory communications. Other expenditure has been directed towards the drainage of low-lying and swamp lands, and river protection works.

It is impossible to make any satisfactory allocation of public works expenditure which is not specifically earmarked for one or other of the land-settlement accounts. Although it may be treated as general purpose expenditure in the public accounts, much of it is necessarily of direct or indirect importance to land development and settlement. Railway and road expenditure obviously comes in this class; but the economic benefits of transport services are so widely diffused nationally as to defeat any attempt at specific allocation.

Public works of assistance to land settlement are undertaken either wholly by the Public Works Department or in co-operation with local bodies, including rural local bodies. The local bodies themselves receive

from the Government, in addition to grants and subsidies for special works, substantial sums in the form of ordinary revenue, e.g., subsidies on certain rates collected, one-third of the State receipts from certain lands sold on deferred payments or held on perpetual leases; one-fourth of the rent derived from 'small grazing-runs.' The State also lends to local bodies (through the State Advances Board) for such approved settlement purposes as the construction of roads, bridges, water supply works, drainage and irrigation; and has authority to guarantee local body loans.

Expenditure of this sort is in general made in the hope and expectation that the Government will eventually be repaid from the revenues derived from the various projects themselves, or from the superior taxable capacity of a people having fuller access to the possibilities of its soil. The object has been to undertake as State enterprises works which bestow a common benefit but which could not always be effectively undertaken by private settlers; or to provide finance on easy terms by advance or subsidy to local bodies whose works while primarily of local value confer also some measure of district, provincial or national betterment. In this latter category might be mentioned the subsidy of river-protection works which, when adequately devised on a regional basis not only increase the carrying capacity of occupied lands but bring into utilization land previously in swamp, promote closer settlement and broaden the basis from which the national revenues are derived.

In New Zealand there has always been some conscious policy of land development since the day when Wakefield in his impatient enthusiasm forced this country as another colonial offspring into the lap of the reluctant Mother country. Wakefield himself established the tradition of a scheme of settlement. The Provincial Councils were consciously and competitively actuated by the motive of placing their shares of the Public Domain as quickly as possible in the hands of as many people as possible. After the Central Government resumed control of Crown lands in the 'seventies, thirty years were devoted to experimentation in State leaseholds and to the policy of closer settlement. To Massey the problem of land utilization in New Zealand could find its solution in a universal application of a liberal freehold policy. Since the war the dominant ideas in land settlement policy have been closer settlement, improved access, improvement in tenurial conditions and better finance both for the acquisition and development of the land.

At all stages in our land history, except the most recent, settlement policies have been associated with an active encouragement of immigration. The development of public works as a necessary part of a scheme of immigration and land settlement, first enunciated by Wakefield, achieved a spectacular place in Vogel's programme and after the outbreak of war

in 1914 became part of the working politico-economic faith of the country. The task of providing communications has been the chief public works problem. The country, in its geographical features, is such that land communications have acquired a special importance. There are few good harbours in proximity to good country. Often where there is magnificent country the harbours are poor, as on the east coast of the North Island, and where, as on the west coast of the South Island, there are magnificent harbours, there is often no accessible hinterland. Moreover there are no rivers sufficiently navigable to be of economic importance as transport. Internal land communications, therefore, have been of more than usual importance in our economy. In recent years the growth of the dairying industry and the change-over to home-separation of cream in the case of butter factory suppliers has intensified the demand for improved road transport. At the same time other construction enterprises, such as hydro-electric works, have been developed on an ambitious scale.

Whatever view may be taken of the efficiency with which State undertakings are normally conducted in this country, there can be little room for doubt that private enterprise was not equal to the task of pioneering the major constructional utilities upon which land settlement has depended in New Zealand. Critics of governmental extravagance and departmental incompetence have used familiar phrases to deck out a familiar theme and one unfailingly popular in democratic communities. But they have over-stated their case. No country can pass through over half a century of strenuous and difficult public works construction without providing abundant cause for public discontent. The railways in particular have been prolific in the occasions they have produced for moralizings on the dangers of State enterprises. It is true that their costs of construction have been high, that lately they have been in economic difficulties, that some recent undertakings were quite unjustified economically. Yet the State provided a uniform, well-balanced national system of communications at a time when private capital, with few exceptions, was unprepared to assume the risks. The costs were high partly because of slow and piece-meal construction; but also because New Zealand presented, particularly in the North Island, an almost uninterrupted succession of engineering difficulties. The recent economic difficulties of our railways are not peculiar to us, but are to be found universally whether the railways are State or private enterprises. They are necessarily more severe in any country where the geographical configuration does not permit of long hauls. From that point of view the problem here is as elsewhere, but with perhaps greater urgency, the problem of transport co-ordination.

To a considerable extent, the controversy over public works expenditure is a mere beating of the air. The benefits which have been con-

ferred are not susceptible of measurement by any system of departmental accounts; and all indictments which rest alone on published balance sheets are unavoidably fallacious if the issue is to be considered from a national point of view. The access provided to rich hinterlands brought in freights and passenger fares (which, however, were at no time levied on the basis of maximum profits); but it did not bring into the accounts of the department even a fractional share of the increment in land values which resulted. These increments were found to be politically unavailable. Yet a fair judgment of the national contribution of the railways to our economic advancement would embody an allowance for this unrecorded income. As it is, it has passed into the banking accounts of private individuals. Subsequent purchasers have no doubt paid their share in the purchase price of the land; but in one way or another it has been diffused throughout the community as a real if unmeasurable benefit. There is no proof that private enterprise would have yielded a greater net addition to our national wealth; although, in pursuit of their private interest, they could scarcely have failed to show a better balance sheet.

The chief grounds upon which public works policy is subject to criticism is that it has attempted too much in too short a time. It has not been timid or jejune but bold and over-ambitious. We have passed through more than one phase of unrestrained optimism in our public policies, and public expenditure has outreached the limits of healthy expansion. At such times schemes of wide ramifications and large capital responsibilities have been initiated in the short-sighted belief that prevailing prosperity would be indefinitely prolonged into the future. In short, the State has, at the same time and in much the same degree, paralleled the unwisdom of the generality of business men. The burden of this mounting load of overhead public charges is difficult to carry at the present time. The post-war period has revealed clearly the dangers of over-borrowing in a country whose economic life is based mainly on a limited number of specialized farming pursuits the products of which are for the most part sold overseas. The great instability of prices for primary products and the directness with which overseas depression impinges on us, strike at the security of accumulated surpluses and make our economic organization more fragile than one more diversified in its products and less dependent on external trade. There is now every reason to believe that land settlement in New Zealand would have been better if more conservatively promoted. But this is a comment and a criticism that would sound sour and ill-favoured in the mouth of the average voter who has seldom failed to press for bigger and brighter borrowing or to respond to the lure of an optimism that knows nothing of history and who, child-like, is recurrently unconvinced of the essential fragility of all bubbles.

E. Revision of Contracts

State settlement finance in post-war years has necessarily been affected by the depression. One important development has taken the form of revising the terms on which land was disposed to settlers. Broadly, these contract revisions include reductions of the price and rent of land, and remissions and postponements of rent, principal and interest. Almost every Crown tenure of interest to farmers has come within the scope of this ameliorative legislation.

The precedent for this type of legislation was established in pre-war years but applications of it have been important only in the last decade. The Consolidating Land Act of 1924 provided for the revaluation of Crown and Settlement lands disposed of by way of lease or licence, and for revaluation in certain circumstances of 'small grazing-run leases.'[2] The same principle was incorporated in the 1925 consolidating Land for Settlement Act in the case of renewable leases; and in 1927 is was made applicable to purchases of Crown and Settlement lands under the deferred payment system.

The most notable example of this policy, however, is found in the case of the Discharged Soldiers' Settlement Act. In 1923 a Central Revaluation Board was established and District Revaluation Committees set up. To the power to reduce valuations, to postpone rent, instalments and interest, and to remit rent and instalments, was added in the following year the power to reduce Crown mortgages held as security for advances made in connection with buildings, improvements and the purchase of stock. At the same time it was made clear that reductions in annual instalments of principal and interest could be secured in the case of purchasers under deferred payments. Five years later (1929) authority was given to make further reductions where necessary, in the value of lands that had already been written down under the 1923 legislation.

Up to March 31, 1933, the capital value of Crown leaseholds had been reduced by over £2,000,000 and the value of Crown mortgages by £870,000. In all, the capital reductions amounted to over 23% of the total capital dealt with by the Revaluation Board. Further, the Board interested itself in securing reductions in mortgages and debts owing by soldier settlers to private persons. In result, about £170,000 of private indebtedness was reduced to about £46,000. The Crown also purchased private mortgages and debts at a discount of over 40 per cent. The discount, amounting to over £30,000, has been credited to the settlers who have completed the negotiations by paying the difference. To these operations must be added £472,000 on account of rent and interest remissions; £440,000 written off through the retrospective effect of some of the legisla-

2. Now extended (by Land Laws Amendment Act 1932) to leases and licences granted for the growing, cutting and removal of flax.

tion; about £316,000 for postponements of arrears of rent, principal and interest (for periods up to 10 years) and £127,000 for postponements of instalments (to the end of the mortgage term) granted by the Revaluation and the Land Boards; and over £200,000 reduction in the capital of current accounts. Altogether the State has granted concessions to soldiers amounting in capital value to over £4½ millions.

Still other contract modifications are possible. In the case of Crown lands set aside as scrub, bush or swamp lands, immunity from the levy of local general rates may be granted for defined periods; while where this land is held on lease or licence, rent instalments may be waived in the initial years of occupancy. Where such provisions are made at the time when the land is selected, they are, of course, part of the contract, but it is provided that the exemptions may be extended to lessees or licencees who have not previously secured the concessions. Postponement and remission of financial obligations is, we have seen, extended also to tenants of Crown and Settlement lands; and the principle is again expressed in the Deteriorated Lands Act 1925, which made provision for the relief of occupiers of certain Crown and other lands where hardship was suffered either on account of the deterioration of the lands or because of their 'natural lack of productivity.'[3]

As mortgagee or lessor, the State has not been harsh or exacting. Crown tenants and mortgagors have been able to secure substantial and far-reaching revisions of the contracts into which they have entered. Whatever may be the term the leases have to run before revaluation, whatever may be the agreed rentals, or for that matter the agreed purchase price, their contracts are provisional only. They cannot indeed be revised in an upward direction until, in the case of leases, the renewal period is reached. But the machinery for downward revision is conveniently accessible, and in recent years has not been allowed to grow rusty with disuse. In a word, the contracts establish no more than maximum obligations; while abundant precedents now assure the Crown tenant that the maximum will not necessarily be enforced.

F. Deferred Payments

The system of deferred payments introduced by the Provincial Councils was, judged by modern standards, an austere one. The schemes varied in detail, but all had in common the spread of the purchase money over short periods of five or six years. The principle was carried over into the land legislation of the Central Government but, in the case of rural lands, the period of payment was extended to ten years. Although abolished

3. A further analysis of concessions made to farmers by the Department of Lands and Survey, the State Advances Department and the Public Trust Office is made in the Dairy Industry Commission Report, 1934, pp. 58-59, and in chapter IX of this work.

in 1891, the system featured again in Massey's administration, the period of repayment varying from ten to twenty years according to the tenure.

By 1920, a 5 per cent. deposit with payment of the balance spread over nineteen years had become typical. Characteristically, the terms of purchase have been considerably eased since then. The 1921-22 legislation provided for five years' grace when 'owing to a decrease in the price of stock or produce, or to general financial stringency, payments of unpaid instalments would be a cause of undue hardship.'

The 1924 Act went further in the same direction. The hardship clause permitted the extension of the licence to thirty-four years. The extension meant that the instalments payable were proportionately reduced 'as from the commencement of the term of the licence,' and that the amount which had previously been paid in excess of the revised instalments would be treated as payments in advance. The licence was, therefore, relieved of instalments until, with the passage of time, these 'advance payments' had been absorbed.

A further revision occurred in 1926. The position now is that Crown and Settlement lands may be acquired on such deposit as may be fixed by the Land Board, provided it is not less than 3 per cent. of the purchase price of the land. The balance, with interest, is spread over 34½ years payable in equal half-yearly instalments of principal and interest. In effect, the State makes an amortisable loan on very easy terms to all purchasers under the system.

G. Land Finance Associations

Legislation in 1909 permitted the formation, by five or more persons, of incorporated land settlement associations to purchase private freehold property for subdivision among the members. The Public Trustee is the Statutory agent of each association and raises the necessary purchase money by issuing debentures which are guaranteed by the State. Once the transaction has been approved by the Land Purchase Board and the purchase completed, the estate is transferred to the association, which in turn transfers the various allotments to the individual members. Each purchaser must pay at least 4 per cent. of the purchase price in cash, the balance to be met by instalments within 20 years.

The Public Trustee who holds the mortgage for the balance, is responsible for collecting the instalments of principal and interest from the mortgagors. These instalments are earmarked for meeting interest on the debentures, and for a sinking fund for the redemption of the debentures which, though they have a maximum currency of 21 years, may be redeemed at any time after five years from the date of issue.

Forty-six associations have been formed under the Act and approximately £600,000 contracted as the purchase price of some 44,000 acres.

For several years past, however, there have been no transactions. On this point Condliffe (*New Zealand in the Making,* p. 236) remarks: 'The conditions with which such schemes are necessarily hedged about are very cumbrous, restrict the transference of land in many ways, and are generally unattractive in times of rising prises and easy credit, though such conditions have insured the success of the schemes started.' Early in the history of the scheme the debenture provisions were subject to the criticism of the Public Trustee (Annual Report, 1912); and in 1915 he recommended the repeal of the Act.

From time to time it has been found difficult to collect all the instalments due, and the Public Trustee has, therefore, made concessions 'to the fullest extent compatible with his statutory duties.' The policy has been to grant extensions of time for payment wherever the financial position of the mortgagor was reasonably sound. In the meantime the Government sought new methods by which groups of settlers seeking to acquire private property for subdivision among them could attain their desire.

H. Group Applications for Crown Purchase and Re-sale

Under Part II of the Land Laws Amendment Act 1928 groups of two or more people may for cash or under the system of deferred payments, purchase land which has been acquired on their behalf by the Crown from private owners.

The group must obtain a firm offer of sale from the owner, prepare a description of the property and a plan of subdivision, and state the proposed purchase price of each allotment. On receipt of these particulars the Land Purchase Board investigates the propositions and, after some intermediate procedure, makes a recommendation to the Government. If the Government decides to purchase the property, each applicant must deposit 5 per cent. of the estimated price of his allotment. Once the subdivision is completed, the land is sold without competition to each applicant, either for cash, or on deferred payments extending over 34½ years. In considering the application the Land Board and the Land Purchase Board take into account the amount of capital, in cash or kind, possessed by the applicant. The amount is not definitely stated, but should be sufficient to satisfy these bodies that the applicant will be able to farm his allotment successfully.

In the regulations issued in connection with this Act, it is stated that the purchase price of any subdivision should not exceed £4,000 or £4,500 where there are buildings. The Act is intended, according to the Land Purchase Controller, to apply to subdivisions suitable for dairying or mixed farming, and to cases where the area of the property offered is too small for purchase under the provisions of the Land for Settlement Act 1925.

'The onus rests upon a vendor to see that all required forms and sketch plans are duly completed. The Crown is really an intermediate agent between vendor and applicants, and does not become a principal contracting party until the stage of approval of the whole transaction has been reached and the final terms of sale and purchase have been ratified by all concerned.' (Regulations.)

The likelihood is that this system of Group Settlement will supersede that of Land Finance Associations. Only two people are needed to form a group, and the terms are much easier for the purchaser. The 1909 Act is virtually a dead-letter. No associations have been incorporated since 1917; and, in view of the present alternatives, it is unlikely that settlers will in the future embark on the very cumbrous procedure necessary under the Act. In 1930-31 and 1931-32, 18 estates aggregating 10,859 acres were purchased under the new scheme and divided into 65 holdings; but no transactions took place in 1932-33.

I. Finance for Undeveloped Crown and Settlement Lands

One of the most recent developments is a plan for promoting the development of Crown and Settlement Lands (1929 Land Laws Amendment Act I and II). A Lands Development Board has now been constituted to make proposals for the breaking-in of these lands and to authorize advances to Crown tenants and occupiers of Settlement lands. District Advisory Committees are set up to assist the Development Board.

The scheme is in all respects the same for both Crown lands and Settlement lands; and provides both for developing these lands prior to disposal and for assisting financially present occupiers of undeveloped Crown and Settlement lands. On the recommendation of the Development Board, unoccupied lands may be improved by draining, reclamation, roading, fencing, clearing, grassing, etc.; and may have buildings erected on them. This development work under way, the Crown may then turn farmer and run stock on the improved properties until they are sold or leased. In fixing the capital value of the land for disposal, the Land Board is given customary powers of discretion, but subject to these powers is directed to take into consideration the money spent on improvements and the value of the works done.

Where undeveloped lands are already in occupation, advances may be made for erecting buildings and for the clearing, fencing, cultivation and general improvement of their holdings. Advances will be made for anything 'required for the profitable occupation of the land;' but not for the purchase of live stock.[4] While the Act does not fix any absolute

4. Assistance may now be granted for the purchase of live stock under the Land Laws Amendment Act 1932.

maximum to the amount of an advance, it limits it to 90 per cent. of the 'estimated value of the completed improvements for the purpose of effecting which the advance is made.' In practice the maximum has been fixed by the Development Board at £1,250.

The advances are made on current account and are secured by a flat mortgage over the land. The mortgagor may repay the advance in whole or part at any time without notice. On the other hand, once the progress payments for the work have ceased, the amount owing may be discharged from the flat mortgage and be secured by a table mortgage which runs for 36½ years. Up to March 31, 1933, 405 settlers have been assisted and loans approved amounted to about £173,000 mainly for improvements. Most of the loans have been confined to the Auckland and North Auckland districts.

The inevitable hardship clause is present. The payment of interest on an advance secured by flat mortgage, or of instalments in the case of a table mortgage, may be postponed by the Development Board for any period not exceeding five years.

In 1930 (Land Laws Amendment Act 1930) it was provided that lands developed under this scheme by the State could be set apart for allotment to men who have actually been employed on the development work. This applies also and particularly to the case of youths who are being trained for farm work at institutions. The scheme has been energetically pushed since it was inaugurated. A fairly complete investigation of undeveloped Crown lands has been made and a provisional estimate places the area likely to be affected by the provisions of the plan at 130,000 acres. Up to March 31, 1933, some 70,000 acres of undeveloped Crown land and purchased estates, mainly gum and pumice land, in Auckland and North Auckland, have been taken in hand at a development cost (including roading) of about £260,000. In several blocks the subdivisions, chiefly into dairy farms, are completed and the farms selected.

J. Disposal of Crown Lands Unsuited for Closer Settlement

State policy as expressed in all the preceding illustrations has been directed to the clear objective of promoting closer settlement. There nevertheless remain areas which for one reason or another cannot be farmed except extensively. The State now has power (under the 1930 Land Laws Amendment Act) to dispose of such land to any person, firm or company that will develop it. The land may be sold for cash or on deferred payments spread over 20 years; but the sale is conditional on a proper compliance with such special conditions as may be laid down in each particular case.

K. Attitude Towards Land Settlement and Finance

Only incidental reference has been made to advances which the Government will make to farmers to enable them to purchase land and effect improvements. The full treatment of this important aspect belongs to the succeeding chapter. It has been found convenient to distinguish between settlement finance (which is concerned primarily with the disposal of Crown lands) and rural credit (which relates primarily to the financing of private land purchase and of farming processes). While for instance the system of deferred payments is part of settlement finance, the system of State advances which enables a man to purchase private property direct from the owner without the Crown first acquiring the land, is part of the rural credit mechanism of the country. The difference is not important economically. In either case, the State is involved as mortgagee for many millions; and in the case of leases as landlord on a very large scale. No country has (relatively) gone further in these directions than New Zealand. The State has been a very generous financier and landlord. It has gone to elaborate trouble to encourage settlement and rural investment. The nominal deposits called for and the provision of credit on comparatively easy terms have been attractive to men of small means, while Crown tenants have in general found the State a tolerant and often amiable owner.

Hitherto few have doubted the wisdom of State policy in reducing the obstacles to land acquisition to a minimum, for New Zealand has, in the past at least, given itself over to the belief that land finance is virtuous to the degree that it is facile. The notion that there is something inherently and necessarily good in the mere fact of land settlement is as tenaciously held as the notion that local manufactures have a superior merit merely because they are local. None can deny that in principle the State has been right in doing its utmost to promote the utilization of our chief asset, the land; and we may rest assured that no excesses of disillusionment will ever provoke us into a reversal of this policy. It would indeed be unfortunate and unfair if all the adversities of post-war times were attributed to land settlement finance, as some have attempted; for economic problems here as elsewhere are too complex to admit of such simple accusations. At the same time no observer can entirely free his commendation of the largeness and pertinacity of the State's endeavour from a certain amount of reservation.

He is aware that New Zealand is in its private finance a very heavily mortgaged country and that land values have seldom been in close touch with economic reality. It is difficult to escape the belief that the post-war boom in land values was strongly influenced, although not initiated, by the presence in the field of large numbers of eager buyers possessing

little capital but abundant optimism, and aware that little capital was needed in a country where small deposits and large mortgages are a commonplace. In depressed times small equities melt away and if a price fall comes immediately or close after purchase equities have all the transiency of snowflakes in summertime. The State as chief mortgagee finds the pressure for contract revisions irresistible. Larger deposits and smaller mortgages would diminish the number of effective applicants for land; but it would mean also a closer correspondence of land values with economic facts. It is indeed possible that any system of sale which demands deposits of the order of 3 to 5 per cent. and spreads payment over 30 or so years, is a direct incentive to irresponsibility since the deposit sets no effective limit to the purchase price that can be offered even by the man of small capital, while the extended period of payment encourages those optimistic exaggerations of future success which are apparently part of the normal man's psychological equipment. Moreover, once it became apparent that all save outright cash buyers had at the time of purchase committed themselves to obligations which could without great difficulty be revised in depressed periods, the necessity for serious consideration of future possibilities was still further diminished. In a very real sense it is probable that things have been made too difficult for many because the State was over-anxious to make them as easy as possible. The retention of our present methods should in the future be conditional on a more searching consideration of the purely business aspects of State investment in land.

In the meantime the pressure of the crisis and the urgency of unemployment problems have compelled the Government to actions which could have far-reaching effects on future land policy.

II. SMALL HOLDINGS FOR UNEMPLOYED

In its most recent legislation directed to the unemployment problem, New Zealand has acquired a new set of precedents which, if energetically converted into practice and applied to industry and commerce as well as to farming, would establish a thorough-going policy of national planning. Not only does the new legislation drastically curtail the right to hold land unused but it equally curtails the right to use it inefficiently.

A. Origins

It is a matter of historical interest to note that the movement towards small holdings for unemployed commenced without any legislative support. At the end of 1931 and the beginning of 1932 the Minister of Unemployment (the Right Hon. J. G. Coates) emphasized closer settlement as a desirable unemployment policy and sought the co-operation of

the County Councils. There was little response except in Otamatea, the Minister's home county. There, the so-called 'Ten Acre Plan' was devised, though the acreage was not adhered to rigidly. Owners of surplus land agreed to provide a section for occupation by an unemployed married man. The Government was to find a cottage while the landowner provided a few cows and gave help and advice to the new settler. A number of farmers in the Ararua district, Otamatea County, made sections available, Government cottages were moved from abandoned Public Works Camps and the scheme was put under way in advance of any statutory authority or legal formalities.

B. Types of Holdings

The first legislation for placing unemployed men and their families on small farm holdings came into operation in May, 1932. It provided for two types of holdings:—

(1) Small holdings forming part of existing farms, where the section-holder might eventually acquire, by lease or purchase, a small farm with his original holding as part of it.

(2) Holdings of two acres upwards, so located that the holder would be able at different times of the year to obtain some work on neighbouring farms and in the district generally. In these latter cases no special consideration would be given to the possibilities of future enlargement of the holdings.

In both cases the object was to give men with families the opportunity of becoming holders of small areas in developed districts, where roads and social amenities already existed. Wherever possible the holding was to be a portion of an existing farm, the owner of which was asked to help in providing seeds and stock and in the loan of implements. The State undertook to provide a small cottage for each holding and to conclude all financial arrangements for the purchase or lease of the holding.

In the application of the scheme, share-milking arrangements were made under the following main conditions:—

(a) The existing owner of a property gave permission for the erection of a cottage, milking shed and other necessary improvements and undertook to purchase the buildings and improvements from the Crown at a maximum cost of £300 on a Table Mortgage spread over ten years.

(b) The owner undertook to provide sufficient cows to yield an income which would cover the annual costs on the buildings and improvements and pay the employee either a minimum weekly wage of £2, or provide him, as a share-milker, with not less than £104 per annum.

C. Extent of Holdings

By March, 1933, 341 small holders had been settled and 194 share-milking agreements concluded. In addition, 95 small holding propositions and 77 share-milking agreements had been approved and were in course of settlement, making altogether a total of 707. The average area of all holdings is approximately 21 acres, which is larger than the first advertisements of the scheme contemplated. In some cases the areas are as large as 50 or 60 acres. The average liability for both the small holdings and the share-milking settlements is about £260.[5] The class of country used varies considerably, ranging from the best dairying flats to undulating hill country where land has to be fully improved. The bulk of the settlement has taken place in the North Auckland district. There appears to be a fairly wide range of variation in the weekly costs which the new settlers have to meet on account of settlement charges, rates, etc. The Right Hon. Mr. Coates cited instances which varied from 10/- to 25/- per week; but said that probably half of the tenants were meeting their commitments without receiving any assistance from the Unemployment Fund.[6] In the remaining cases a sustenance payment was being made to help the families over the initial period of their occupancy.

The comparatively modest result of ten months' work with the scheme represents no lack of will on the part of the administration: but is due largely to the poor response of landowners who showed themselves disinclined to lease small areas to men about whom they knew nothing. Moreover, the idea was current that 10 acres was the maximum area required, and many landowners felt that this was inadequate to support a man and his family. From one point of view the 700 families that have been moved from the congested poverty areas of the cities and placed in the country represent some gain in human decency; but the impression made on the mass of unemployment is too small to be socially significant.

D. Compulsory Powers

The poor response of landowners under this voluntary scheme led to the new legislation embodied in the Small Farms (Relief of Unemployment) Act 1932-33. The purpose is to encourage the settlement on the land of registered unemployed and other approved persons. A Board is set up under the Act to administer the scheme and, by its personnel, to co-ordinate various State authorities. If sufficient areas of suitable unoccupied Crown lands are not available, private lands may be acquired and Crown lands at present held under lease or licence may be resumed. The State may acquire private lands either by purchase or by way of lease with the right of purchase. Unoccupied Crown lands, Crown lands

5. Hansard, 1933, No. 12, p. 261.
6. Hansard, 1933, No. 12, pp. 261-2.

resumed, and private lands acquired may be disposed of by sale or by lease with the right of purchase. The term of such leases will not exceed ten years and no right of renewal is specifically provided. The lessee may exercise his right of purchase during the currency of the lease at any time after four years of occupancy. In place of Crown acquisition of private lands and the subsequent disposal of the land, the State may arrange for direct leases to be granted from the present owner to the new occupier. If the lessee does not exercise his right to purchase the land, the State may do so. A refusal by the owner to grant such a lease to the applicant can be overridden. (Clauses 3 to 9.)

The acquisition of private land or the resumption of Crown land may of course follow upon voluntary agreement between the Crown and the owner or occupier. Where such agreements are lacking, the Crown may compulsorily acquire or resume a property if, in the opinion of the Board, a part or all of the land 'is not being adequately used'; or may, for the same reason, arrange to lease private land without first acquiring it. The owner's or occupier's right of appeal can rest on two grounds only: that the land is being utilized for productive purposes 'to a reasonable extent;' or that the loss of the land in dispute would leave him with an insufficient area for the 'reasonable requirements of himself and his family.' The appellant may carry his appeal from the Magistrate's decision to the Supreme Court. Neither Court determines the amount of purchase money or compensation to be paid when land is acquired or resumed in this way. In default of agreement the matter is determined by the Board. (Clause 14.)

Mortgagees are deemed to consent to the acquisition of land and to its disposal; but are given the opportunity to make objections to the Board before any decision is made as to the conditions either of acquisition or disposal and are protected in respect of both interest and principal sums due to them. (Clause 15.)

The rent of leases is to be fixed by the Board but must not be less than 5 per cent. of the unimproved value, or than 2½ per cent. of the capital value. 'Value' may be fixed by the Board in default of agreement. During the first four years of a lease the rent may be paid out of the Unemployment Fund should the lessee default. (Clauses 10 to 12.)

The price at which lessees may acquire the fee-simple is to be determined by regulations, but must not be less than the unimproved value of the land at the date when the fee-simple is acquired plus the value of the lessor's interest in the improvements as at the date of the lease. (Clause 13.)

This remarkable piece of legislation presents a number of features quite novel in our land history. Taken as a whole it is more direct and

more drastic than anything that has preceded it. On the administrative side, while it provides no new machinery, it can co-ordinate the work of the existing Departments which are immediately concerned with unemployment relief, land settlement and the financing of farmers; it gives the Board powers of decision which enable action to be taken without the customary impediment of red tape, powers to select its settlers instead of leaving the selection to the vagaries of the ballot box and powers to decide contentious issues instead of referring them to tribunals; and it establishes local committees to assist in settlement administration. The Parliamentary debates which criticized the Bill on the ground that all the proposed powers already existed under other legislation were astonishingly at fault. This Act gives a freedom and an initiative to its administrators which finds no parallel in earlier legislation.

Powers of compulsory acquisition have existed since 1894; but the new Act changes both the emphasis and the application. Thus the Land for Settlements Acts placed their emphasis on closer settlement as a means of breaking up large estates and preventing aggregation, so that any estate of less than 400 acres of first-class land (or its equivalent in other land) was exempt from the compulsory clauses of the legislation. The new Act ignores the question of size. The Act could not be invoked to acquire the largest estate in the country if it were being adequately farmed; while even small farms of 50 or 100 acres could be taken if they were neglected. The new emphasis is on productive efficiency, not size. It is both a new and a better criterion. It declares that incompetent private enterprise can be dispossessed by the State, and is to that extent an explosive charge in the encrusted doctrine that every individual is entitled to pursue his own unenlightened misfortune. To the traditional working belief that the State has a duty to the land has been added the complementary doctrine that the land has a duty to the State. State Socialism under the earlier doctrine was maternalistic. Under the new the State becomes the entrepreneur with power to plan and power to hire and fire. The same principle applied to commerce and industry would open the way to wholesale enforced rationalization.

The executive power given to the Administration also represents a new principle in land legislation. Previously, disputes in regard both to the land to be acquired and the compensation to be paid were settled by a specially constituted Court and the proceedings were often elaborate and protracted. Under the new Act, appeals are to be settled by the ordinary machinery of the law and are limited to the grounds previously stated. Disputes as to purchase price or compensation can be decided by the Board without reference to any external tribunal. Similarly, should a small holder wish to acquire the fee-simple of his holding but fail to

reach agreement with the vendor, the Board will determine the unimproved value which constitutes one element of the purchase price.

It is evident that an administration armed with those powers can, if it wishes, move largely and swiftly. Opponents of the scheme will see clearly that nothing but the right of appeal as described, technically stands in the way of an arbitrary redistribution of our farming lands, and that the Board has power not only to decide to what alternative uses land may be devoted but also to enforce new forms of farm management. Proponents of the scheme will argue that the most competent administration in the world cannot be successful unless it is reasonably free from departmental and legal ritual and unless it is trusted to exercise its powers wisely. The precedent established will be welcomed by all who believe that competent and swift experimental adjustment is our only possible hope in a world whose urgencies are too pressing and too crude to wait upon leisured ritual.

III. NATIVE LAND SETTLEMENT[7]

The following very brief account of Native Land Settlement is taken entirely from the two statements presented to both Houses of the General Assembly in 1931 and 1932 by the Hon. Sir Apirana Ngata, then Native Minister. The full text of these two statements should be read if it is desired to appreciate properly both the problem and the process of Maori land settlement in the present century. A selective, summarized account such as the one that follows, though made necessary through limitations of space, is an inadequate substitute for the original. In one respect only has it an advantage over the original: it can, without immodesty, pay a tribute to the great part which Sir Apirana Ngata himself has played in preserving while reconstructing the Maori culture.

A. Introduction

Until the beginning of this century no need was felt for a policy to assist the Maori to utilize and develop his own lands. The State's chief concern with the Maori centred round the problem of acquiring Native lands for the State or private individuals so that land settlement by whites could 'proceed unhampered by the difficulties surrounding the Native title.' The prevalent view was 'that Native landowners had more than they could possibly use, and could shift for themselves without direction or supervision or financial assistance.'

In opposition to this State policy of acquiring Maori lands and making them available for European settlement there grew up particularly in the first decade of this century, the competing view that further

7. Native Land Development Parliamentary Papers G-10, 1931 and 1932. Condliffe: *N.Z. in the Making*, Ch. II. Raymond Firth: *Primitive Economics of the N.Z. Maori.*

encroachments on Native lands should be resisted and, additionally, that State policy should be directed to assisting the Maori to settle on his own land. This new point of view was made emphatic in the Report of the Native Land Commission, 1907. As the Commission pointed out, Maori communities had made their own attempts to improve the utilization of their lands but had often failed through lack of organization and support.

B. Difficulties of Communal Titles

The first serious obstacle to this new objective lay in the nature of the Native title where it comprised a number of individuals or a community. The Native Land Court was set up in 1865 to carry out the declared policy of determining titles according to the customs and usages of the Maori. The elaborate texture of tribal tradition and genealogical descent had first to be reduced to such formal facts as the names of those who were declared to be beneficial owners, the relative interests of such persons, and details of sex, age, disability and guardianship. Subsequent succession and inter-marriage 'have further congested the titles. . . . If to those which are inherent in the Native usages on which the title is based are added restrictions imposed by oscillations of State policy, which sometimes emphasized the need for restricting the Native owners' powers of alienation and sometimes emphasized the policy of placing them on an equal footing with their European fellow-citizens it may be readily appreciated how serious the Native land problem became.'

C. Methods of Overcoming Difficulties of Communal Titles

Attempts to partition the land among the numerous owners of it often led to 'over-subdivision and chaos.' Other schemes to promote settlement by vesting large areas in the Public Trustee or in Special Boards for administration were not successful since they did not aim primarily at settling the Maori on the lands in question and 'were not supported by the goodwill of the communities interested.' In the last twenty-five years or so, however, several devices for overcoming the difficulties of the communal title have been experimented with:—

1. *Incorporation of Owners*

Owners of any area or contiguous areas (later of areas not necessarily contiguous but with elements of common ownership) were, with the consent of a majority in value, incorporated. The body corporate acted through a committee of management which was empowered to raise funds on the security of the land and to carry out farming operations. Although designed as a temporary measure only, the system helped to overcome the handicap of communal title, and to organize the land

resources of the community under its most efficient members and is likely to be retained 'where a family carries on farming and is not wishing to dispose of the land to any one member of it.'

2. Consolidation of Interests

The plan is to consolidate the widely-scattered interests of individuals or families into one location, or into as few locations as possible. 'The opportunity is seized to make the new holdings conform to modern requirements, particularly fencing boundaries, access, water-supply, aspect, and so forth; also to adjust the roading of the area; and, with the consent of the Crown and of private owners, to effect exchanges of mutual benefit.'

'Commencing in 1911 with the Waipiro blocks, on the east coast of the North Island, the principle of the consolidation of titles has been expanded until it now applies to Native-owned lands in five counties on the east coast and in the Bay of Plenty, five in the King country, and to practically the whole of the Native lands north of Auckland.

'It is now a stupendous undertaking. It has had to overcome considerable conservatism in the ranks of the Native Land Court as well as among the tribes whose lands have been subjected to it; but wherever it has been applied the Maori communities have been insistent that it should be carried out with speed and vigour. It is doubtful whether any movement ever aimed at the solution of the Native land problem is so deserving of the encouragement and assistance of Parliament.

'It may be added that consolidation further enables complete stock-taking to be made of the Native land titles within the scope of the scheme; also their classification for purposes of local taxation; and finally organizes the title in such a way that it is available for any purpose the owners may elect to adopt.

'While the incorporation of owners was deemed to be the readiest means of organizing a communal title for purposes of finance and effective farm management, it does not satisfy the demand instilled into the individual Maori or family by close contact with the highly individualistic system of the pakeha. Consolidation is the most comprehensive method of approximating the goal of individual or, at least, compact family ownership.'

3. Vesting in Statutory Bodies to Administer as Farms

'Concurrently with the methods of incorporation and consolidation lands held communally were vested in Statutory bodies with powers to administer as farms for the Native beneficiaries. A system of leasing to selected Native owners was put into operation with limited success.' The weakness of the system of vesting in Statutory bodies was that 'it

did not promote to any great extent the education of Maori communities in the farming of the land.'

'The accumulated effect of the application of these devices, in conjunction with education and other factors in the impact of Western civilization on the culture of the Maori people, has been to break down the wall of conservatism and to force a resignation to methods which appeared drastic, but emphasized settlement of the lands as against the niceties of title.'

D. Finance for Maori Farming

Until 1929 the Maori had little access to State funds to be applied in assisting the development of his lands. Accumulated Maori funds could be applied to this purpose through the Native Trustee or Maori Land Boards; but such funds were running low at the very time when financial assistance for effective land utilization appeared to be most necessary. Provisions similar to those of the 1929 Land Legislation providing for the development of Crown lands prior to selection were, however, made applicable to lands owned or occupied by Maoris, and comprehensive powers were given to the Native Minister to bring lands within the scope of development schemes, to forbid private alienation of any land within such schemes, and to step over obstructive difficulties in titles.

Prior to this departure, comparatively little direct or indirect State help had been given to the Maori in financing his farming. Although a Maori freeholder could raise money on mortgage, restrictions imposed by the Legislature made the procedure costly; and although advances to settlers were theoretically available to Maori landowners, the prejudice against the Native title was so great that few were able to get assistance under this legislation. At the same time many Maori communities were afraid of losing more of their lands by becoming involved with mortgages, 'and such as made substantial progress in the utilization of their lands were assisted thereto in various ways by private individuals, stock agents, or storekeepers without hypothecating their lands.'

In 1903, the Farm-management Committees of incorporated blocks were authorized to secure finance by way of mortgage over chattels and stock, and in 1906 to raise funds, but only from a State lending department, by way of land mortgage. Subsequent legislation revised and extended the borrowing powers of such bodies and in 1912 they were authorized to borrow on land mortgages from private sources.

In 1920 the Native Trust Office was established to organize funds—undisbursed rents, proceeds of the sale of Native lands, moneys belonging to minors and to other Maoris under disability—which had been accumulating in the Public Trustee's Account. The funds were made available

for assisting, among others, those Maoris or Maori committees who had sufficient securities to offer.

'Until 1922 there was no definite provision enabling Maori Land Boards . . . to advance moneys upon mortgage. Yet the bulk of the funds formerly held in the Public Trustee's Account, and later transferred to the Native Trustee, were investments by the Maori Land Boards of funds held on trust by them for Maori beneficiaries.' In 1922 Maori Land Boards were authorized, with the consent of the Native Minister, 'to advance moneys upon mortgage either for itself or on behalf of Natives.' Some advances were made to European occupiers of Native lands, but the main advances were confined to individual Maori farmers, or to Management Committees of incorporated blocks.

These gradual developments both in providing finance and in consolidating titles to land were not sufficient, however, to meet the requirements of the Maori people and their leaders who wished to speed up the pace at which land was being brought into effective use. One obstacle lay in the fact that advances could not be made until the title was complete or in a position to be completed by survey, or unless the land was vested in or administered by an authority competent to give the lender a valid mortgage. In 1926 it was provided that advances could be made by Maori Land Boards before the title was in such a condition as to be available for mortgage purposes. Such an advance became a charge on the land (covered by a registered memorandum) and could, once the title was clear, be secured in the orthodox manner. Obviously such an expedient would have been dangerous unless the Maori Land Boards were in a position to protect the charge. 'In the circumstances the expedient needed to be applied with great care, and it ultimately compelled the exercise of strict supervision. . . . The importance of the provision was that Parliament had come to recognize the predominant need to proceed with the cultivation of Native lands, allowing titles to be adjusted in due course.'

There was a considerable increase in the lending operations of the Boards after 1926. The drain of their accumulated funds through lending was accentuated by the demands of beneficiaries for rents and trust moneys following upon a reduction in employment on breaking in land and on public works. The imminent depletion of these funds at a time when the desire for land development by Natives was active led in 1929 and 1930 to the policy, already noted, whereby State funds were made available, through the Native Land Settlement Account, for Maori development schemes.

E. The Development Schemes

'The first conception of a land development scheme is that of a compact, connected area, comprising, it may be, a number of title subdi-

visions, but so situated as to present a block capable of being treated as an economic unit and of being subjected to a carefully-conceived settlement plan. For such a scheme budgets of expenditure can be fairly closely estimated and development proceed . . . according to an easily understood plan. The majority of schemes in operation fall within this class. . . .'

The sources of finance for the schemes vary: one is financed by the Native Trustee, others by Maori Land Boards and others by the Native Department from funds made available through the Native Land Settlement Account.

Of the 41 schemes in operation only six are predominantly pastoral. This indicates the preference which is given to areas suitable for subdivision into small blocks. Eighteen areas were totally unimproved and unoccupied lands when brought under development. In the other cases, where the lands were in occupation, farming and finance were both haphazard and the titles unsatisfactory. The problem was, therefore, to consolidate the titles, investigate and if possible clear up outstanding liabilities and raise the standard of farming. Once titles were consolidated farming could be 'conducted with a knowledge of ownership and boundaries. Top-dressing has been carried out extensively; the whole of the fencing is being reorganized with permanent materials; indifferent pastures have been ploughed up and resown with approved mixtures of good seed; increased provision is being made for winter feed; herd testing and culling have been commenced, and new dairy stock . . . introduced.' (The Ruatoki Scheme.)

As part of the general development policy, base farms have been established where young stock may be bred or held pending distribution to development centres. Tractors and other implements have been used by the contracting authorities. 'The policy is that as soon as development reaches a stage where it is desirable to subdivide an area into small farms for individual occupation, the heavy machines and implements are transferred to other schemes. . . . The cost is then apportioned between the schemes concerned.' The organization of the supply of fencing material and the bulk purchase of stock, grass seed and fertilizers have also been features of the work. Amongst the most interesting aspects of these schemes has been the response by the Maoris to the appeal that they should supply labour at a bare sustenance rate during the development stage in return for guarantees of eventual legal occupation of individualized holdings and of financial assistance. In some cases no wages at all were required by Maori settlers. In others a contract system was developed particularly where Natives who would not eventually become occupiers had to be employed.

The wide variety of conditions met in the application of this general

policy called, of course, for special adaptations to special circumstances. Where holdings of partially-developed fair to good land were small, fragmentary and scattered, the organization of a development scheme based on contiguity and connection between units in compact areas was not possible. In adapting the organization to such conditions supervision areas were located. 'Supervision of development and farming was linked to the plan for reorganization of titles, and Farm Supervisors and Consolidation Officers were required to exercise the closest co-operation in their work. . . .'

'Land development has materially assisted to break down difficulties in the way of consolidation of titles by hastening decisions among members of families as to exchange and occupation of their respective holdings. Consolidation has, on the other hand, acted as a brake upon the too rapid extension of the development, and restricted assistance to selected areas over which an effective charge could be made to secure the funds of the Native Land Settlement Account.'

The essence of these developments has been, as Condliffe points out, 'the emergence of Maori leadership competent to solve Native problems along lines combining Maori tradition and European legal and economic experience.' It is not too much to say that in many respects the European farmer in his difficulties may find it profitable to consider more closely what the Maori has done under a leadership which has emphasized so successfully the joint virtues of self-help, co-operation, and comprehensive planning in farm management.

Chapter IX

THE FINANCING OF LAND PURCHASE AND OF FARMING OPERATIONS[1]

By H. Belshaw

I. Long Term Credit—A. Private Sources of Long Term Credit: 1. The Outer Market; 2. Commercial Banks; 3. Long Term Mortgage Branch of the Bank of New Zealand—B. Public Sources of Long Term Credit: 1. The State Advances Office; 2. The State Advances Office During the Crisis; 3. The Public Trust Office—C. Long Term Credit Needs. II. Short Term and Intermediate Credit—A. Private Sources—B. Rural Intermediate Credit System: 1. Operation of the System; 2. Effects of the Depression—C. Recent Developments in Co-operative Credit to Farmers. III. Financing of Afforestation, Flax, Tobacco and Tung Oil Companies.

I. LONG TERM CREDIT

IN describing the system of rural finance in New Zealand it is convenient to adopt the conventional classification into long term, intermediate and short term credit.

The importance of long term credit may be appreciated from the fact that the total value of mortgages outstanding in New Zealand as on March 31, 1928, was about £220,000,000, of which amount £122,000,000 was on country lands. As on the same date in 1935, total mortgage indebtedness was estimated at £240,000,000, of which amount £135,000,000 was on country lands.[2] The great bulk of this indebtedness would be incurred against land purchase and permanent improvements.

The sources of long term credit in New Zealand may be grouped into two: private and public. The volume of credit provided from the former is much greater than from the latter.

A. Private Sources of Long Term Credit

1. *The Outer Market*

(a) *Private Lenders.*—As in many other countries private lenders provide a considerable volume of funds for investment against the security of rural mortgages. Some portion of the loans is advanced directly or represents a part of the purchase money secured by vendors against second or third mortgage. The greater proportion is advanced by solicitors, who transact a considerable volume of financial business as agents. Indeed this often appears to be their main business, especially in country districts, and on the whole they are well qualified to assess the value of the security and safeguard the interests of lenders. Although credit from this source

1. This chapter was written in 1933 and follows the treatment in Belshaw: *The Provision of Credit with Special Reference to Agriculture* (Heffer & Co.). See especially: Part III, Chs. I, II and V, and Part IV, Chs. I, II and V for a fuller discussion.

2. See Statistical Abstract, April 26, 1935.

has been of great value in the absence of an organized market, it is far from satisfactory and has considerable elements of danger. The period of loan is seldom more than five years and amortization is impossible. Procuration fees and other expenses are heavy, and there is the danger that renewal may become necessary at a time of financial stringency. The risk is concentrated between two persons, the borrower and the lender, and although, at a time of crisis such as the present, lenders are frequently prepared to readjust their claims, they are less able to show leniency in bad times than strong financial institutions, and foreclosure is more likely than under a properly organized system. At the present time private investors regard rural security with disfavour and there is little new investment in rural lands.

(b) *Dealers.*—The main dealers advancing long term credit are stock and station agents. The chief functions of these concerns are to supply the farmer with requisites and household goods and to buy his crops and stock or sell them on commission. Both by their commercial and their financial transactions they have played a very important part in developing the resources of the Dominion. The bulk of the finance which they provide is short term or intermediate, but they have in the past advanced some long term credit or arranged it from other sources, or have taken mortgages over land to strengthen the security against other advances. The funds which they advance are obtained from their own capital, commercial banks, from deposits bearing interest and in some cases from the London market. Their main profits are made on their commercial transactions, the rate of interest charged exceeding that paid by an amount sufficient to cover administrative costs and risk.

Dealers have played a very important part in providing the short term and intermediate finance necessary to develop the agricultural and pastoral resources of the Dominion. In the field of long term credit their operations have been less extensive. Their operations have been particularly useful to the sheep and mixed farming industries. They have been less useful in dairying since the volume of commercial business which might be attracted through the provision of finance is less.

In the provision of rural credit they possess many advantages. On the whole, the interest charged has not been exorbitant, they have frequently shown leniency to hard-pressed farmers in bad times. Since they are specialists in farming transactions, they are in a good position to assess the personal integrity and efficiency of the farmer, and the value of the security. So they are useful intermediaries between the banks and the farmer.

On the other hand, they possess serious limitations and dangers. Since their main profits have been in their commercial transactions, eagerness

to obtain the farmers' business has encouraged the granting of loans on inadequate security, and at the same time has offered a strong temptation to tie the farmer to them by insisting, as a necessary condition to the making of advances, that the farmer shall buy and sell through them. The former condition was an important contributing factor in the serious post-war inflation of land values, and recoiled both on the companies and the banks during the depression which followed. The embarrassment of many concerns was intensified by the drying up of funds from banks, depositors and in one or two cases the London market when the boom broke. The tieing of the farmer, though largely justified and though understood as a condition of advances by the borrower, is economically and socially undesirable, since it limits the farmer's freedom, reduces his bargaining power and, in some cases, hampers his efficiency. Hence dealers can scarcely be regarded as a satisfactory source of long term credit.

(c) *Insurance Companies.*—In some countries such as the United States, Canada and Germany, insurance companies make considerable advances against farm mortgages.[3] An enquiry made by means of questionnaires sent to insurance companies operating in New Zealand revealed that very few insurance companies had funds invested on rural security. It is doubtful if the total amount thus advanced exceeds £2 millions and over half of this is by one company. Especially by fire and accident insurance companies, mortgages are regarded as being too difficult to realize upon in case of need, while most companies prefer to invest in large sums rather than in small loans which 'demand a considerable amount of attention.'[4] In some cases also the competition of the State Advances Offices and the Public Trustee is found to be too strong. Finally the burden of company taxation, which is levied at a maximum rate of 4/6 in the pound on income makes it difficult for the larger concerns to compete with private individuals or smaller concerns on whom income tax is levied at a lower rate. So insurance companies prefer tax-free securities. The main barriers to the effective participation of insurance companies in rural finance appear to have been the high rate of company taxation and the existence of tax-free public securities, or securities otherwise favoured.

In addition to insurance companies, trust companies, finance and loan companies, and trustee savings banks provide a subsidiary source of long term credit. Of these the most important are the five trustee savings banks operating in New Zealand, the total amount from this source being between £1,300,000 and £1,500,000 prior to the crisis.[5]

3. See *United States Agricultural Year Book*, 1924, p. 197, Morman, Farm Credits in the U.S.A. and Canada, p. 275, and Cahill, *Agricultural Credit and Agricultural Co-operation in Germany*, Cd. 6626 (1913), p. 62.

4. Cf. Belshaw, op. cit., p. 155.

5. Cf. Belshaw, op. cit., pp. 159-160.

2. *Commercial Banks*

There are six commercial banks operating in New Zealand possessing in all some 540 branches. The following figures for the year 1933 give some idea of the extent of their operations:—

Paid-up Capital	£30·26 millions
Reserved Profits	£22·05 „
Deposits (Average for four quarters)	£57·62 „
Advances (Average for four quarters)	£45·71 „
Assets (Average for four quarters)	£69·66 „
Liabilities (Average for four quarters)	£65·28 „

In view of the great importance of agricultural and pastoral industries the banks are closely involved in the fortunes of rural industries, and play an important part in rural finance. Commercial banks are unsuited by the nature of their liabilities to engage to any considerable extent in long term credit business since they must keep their assets liquid and thus they do not regard this class of business with favour. Hence, although some advances to farmers may be properly regarded as long term, these are never likely to represent any substantial proportion of their total business or of the total long term credit advanced.

The usual practice is to make such advances in the form of a fluctuating overdraft up to an agreed limit. Normally this is payable on demand, though loans are not usually called up, apart from a considerable alteration in conditions. It is the policy during depression to reduce new advances rather than call up existing loans. Interest is payable on the day to day balances, the rate being determined according to the ruling charges, the size of the account and the risk involved. In most cases, the borrower may repay all or part of the loan without notice. Amortization in the accepted sense of the term is not possible, but the loan is expected to run off within a reasonable time. Normally loans are advanced up to 60 per cent. of the value of the security as assessed by officers of the bank or outside valuers.

The method of financing by overdraft possesses some advantages. Interest is paid only on the amount outstanding and within the agreed limits can be reduced or expanded to suit the convenience of farmers, while the financing of fixed and working capital may become combined in one account backed by the same security. To the substantial farmer it is a simple and convenient method of finance, but scarcely meets the needs of the small farmer, especially if he is located in a remote area, since he frequently has difficulty in obtaining accommodation on satisfactory terms.

Although the present volume of farm mortgage transactions by commercial banks is not sufficiently large to offer serious danger,[6] it is clear that any material extension is undesirable and is not likely to be under-

6. The danger is more likely to arise from the 'freezing' of advances made for working expenses, stock, etc.

taken. Hence commercial banks are likely to remain a minor source of long term credit.

3. *The Long Term Mortgage Branch of the Bank of New Zealand*

Under the Bank of New Zealand Act of 1926, the bank was empowered to establish a separate Long Term Mortgage Bank financed by the issue of shares and debentures. The bank was also empowered to transfer an aggregate amount not exceeding £500,000 from its ordinary funds to the Long Term Mortgage Fund. The capital thus obtained was to be utilized for the purpose of making advances on real estate, secured against mortgages. The rate of interest was not to be more than 6 per cent. It was open to the bank to advance a part of any loan from the fund and lend the remainder on overdraft.

Potentially the Act is of great value to rural interests, since it possesses all the advantages of long-term mortgage banks with the added advantage of being able to make use of the existing equipment, widespread branches and staff of the bank. To the present, however, the bank has not made full use of its powers. By March 31, 1935, shares to the value of £703,125 and debentures stock to the value of £607,050 had been issued. Advances totalled £1,034,190, of which very little was against rural lands.

B. Public Sources of Long Term Credit

1. *The State Advances Office*

(a) *The Advances to Settlers Branch.*—The State Advances Office was established by an Act of 1894 to extend, cheapen and improve the provision of credit to farmers and workers.[7] The office is now administered under the State Advances Act of 1913 and its amendments. Administration is in the hands of a Board consisting of high Government officials whose resolutions are binding on the Superintendent. Advances are made to workers for the erection and acquisition of dwellings, and to local authorities, as well as on rural lands. The bulk of the funds required is raised by means of Government loans. The total amount advanced from the establishment of the office in 1894 up to March 31, 1933, was £75·4 millions. Payments of half-yearly instalments, together with repayments in full to release securities, have to that date totalled £31·5 millions, leaving a balance outstanding of £43·8 millions. Of this amount, £19·7 millions was secured on rural lands and £24·1 millions on urban or suburban properties.

The general rate on new loans in 1930 was 6¼ per cent. reducible to 5¾ per cent. for prompt payment, except on loans advanced for the purpose of repaying mortgages, on which the rate was 6½ per cent. reducible to 6 per cent.

7. Cf. Hall: 'A Brief Review of Rural Credit Facilities in New Zealand,' *Economic Record*, November, 1928.

Loans are advanced for periods up to 36½ years and are amortized by semi-annual payments. Loans may also be repaid at half-yearly periods by sums of £5 or multiples thereof. After at least one-tenth of the loan has been repaid, the mortgagor may, with the consent of the Superintendent, readjust the loan, treating the balance of principal unpaid as a fresh loan for a new term. The annual interest and amortization payments are thereby reduced, but the length of the loan period is extended. This enables hard-pressed mortgagors to obtain relief while still permitting them to liquidate the loan should their financial position improve.

(b) *The Rural Advances Board.*—In 1925, a Commission set up by the Government recommended 'the creation of a special rural credit branch within the State Advances Office,'[8] controlled by a Board on which farmers should be represented. In 1925 the recommendations were given general effect to in the Rural Advances Act which established an additional branch of the State Advances Office to be known as the Rural Advances Branch, controlled by a Rural Advances Board, this being constituted by adding a representative of primary producers to the State Advances Board. The necessary finance was to be obtained by the issue of bonds which were Trust securities, and which constituted a floating charge on all assets of the Branch, including mortgages outstanding. Bonds are not secured against the public revenue and do not form part of the Public Debt. The aggregate amount of bonds, stock and other securities is not to exceed the capital value of the mortgages held. The total amount of advances current as at March 31, 1933, was £4,560,852, bonds to the aggregate value of £4,213,050 having been issued by that date. Loans are granted on similar terms as regards repayments to those by the Advances to Settlers Branch except that the maximum loan to any one person is increased from £3,500 to £5,500. Advances are made on the security of freehold land up to two-thirds of the value of the security, and on leaseholds up to two-thirds of the value of the lessee's interest in the land.

The aggregate of loans by the State Advances Office comprises only a small proportion of the total of long term credit outstanding to farmers, by far the greater part having been provided from private sources. Nevertheless it has exercised an important competitive influence because it has been able to charge a low rate of interest and impose low initial costs, largely because of the advantage which it possesses as a Government institution in obtaining the necessary capital at low cost. Low operating costs and the absence of the profit-making motive have also been factors of some importance. It may also claim the credit of having pioneered the principle of amortization and is still one of the very few institutions adopting this method.

8. Report of Royal Commission on Rural Credit, p. 7.

Although the operations of the State Advances Office have undoubtedly been beneficial to the rural community, they possess some limitations and dangers. There is still a large unorganized market which requires to be integrated. The difficulties in this market have tended to be enhanced because the more doubtful securities have been left to it by the Department, while the fixing of maximum limits of £3,500 and £5,500 on loans has made it necessary for large borrowers to apply to other sources.[9] It is doubtful also whether the lower rates charged by the Department represent a net advantage in the long run, since they tend to be capitalized in higher land values. Finally there is the danger that a State Department may be subject, through the Minister, to the pressure of party politics and that this may result in unwise finance.[10]

2. The State Advances Office During the Crisis

In common with other financial institutions, the State Advances Office has found it necessary to give some relief to borrowers as the result of the shrinkage in farm income.

(a) *Forms of Relief which may be Granted.*[11]—Relief may be granted in the following ways:—

(1) Under the ordinary powers in the State Advances Act:—
   (i) *Readjustment of Loans.*—This has already been discussed.
   (ii) *Extension of Term of Loans.*—The Board has power to grant loans on terms of 20 years, 30 years, or 36½ years. In appropriate cases where loans have been granted on 20-year or 30-year tables the Board may subsequently extend the terms of the loans to 30 years or 36½ years whereby the mortgagors have their instalments made less and the difference already paid credited to arrears or to future payments.

(2) Under the Mortgagors' and Tenants' Relief Legislation.—In addition to the relief which may be granted by the Courts under the Mortgagors' and Tenants' Relief Legislation, the Department has power under subs. (3) of s. 4 of the Mortgagors' and Tenants' Relief Act 1932, to extend the term of a mortgage by any period not exceeding two years, and postpone for a like period the due date for the payment of every instalment of principal and interest then due or thereafter becoming due. Under

9. As one writer points out, if a prospective farmer requires more than the maximum amount advanced by the State Advances Office, he must obtain the remainder on second mortgage from elsewhere at a higher rate, which may offset the advantages of the lower rate on first mortgage—Werry: *Rural Credit in New Zealand*, Unpublished Thesis. Since this section was written the Mortgage Corporation of New Zealand Act 1934-35 has been passed. Under this Act the securities of the State Advances Department and other State lending departments are to be transferred to the Mortgage Corporation which assumes the lending functions hitherto undertaken by the State Advances Department. See concluding chapter of this work.

10. This danger has not appeared to any great extent in respect of long term rural finance, but has been apparent in advances to workers for the building of dwellings.

11. The following information has been provided by the Superintendent, State Advances Office.

subs. (4) such extension may be made subject to terms and conditions. The securities of the State Advances Department, now transferred to the Mortgage Corporation of New Zealand, are also subject to the Rural Mortgagors' Final Adjustment Act 1934-35. See final chapter of this work.

(3) Under Special Legislation affecting the Department—Special provisions peculiar to the Department enabling it to grant relief are contained in ss. 19 and 20 of the Finance Act 1932, as follows:—

(a) By s. 19 arrears of interest may be capitalized and added to the outstanding principal moneys, thereby removing from mortgagors the burden of arrears and enabling them to commence afresh, usually with decreased half-yearly instalments.

(b) By s. 20 mortgagors who are in arrear with any previous instalment but pay a subsequent instalment on the due date are entitled to the rebate provided for in the principal Act.

It is to be noted that the two provisions mentioned above continue in force for three years from the date of the passing of the Act, namely, May 10, 1932.

(b) *Steps Taken to Meet Existing Conditions.*—The various forms of relief mentioned above have been granted in numerous cases to mortgagors of the Department, but before granting such relief the Department invariably requires some assurance that future instalments will be met on the due date: it would be futile to grant relief in cases where mortgagors could not meet even the lighter burden.

The Department's policy is not to force securities on the market. In some cases realization proceedings are necessary, but in the main a policy of 'nursing' securities against better times is being followed.

So far as rural mortgagors are concerned, the Department has taken active steps by means of arrangements made with stock mortgagees controlling the proceeds of its securities and the careful scrutiny and supervision of mortgagors' farming operations, accompanied in appropriate cases by an order on the mortgagors' dairy cheques or other proceeds of their farms, to obtain in most cases a reasonable proportion of the farm income, and to keep the farm expenses down to a minimum while yet not impairing productive capacity. The co-operation of District Valuers of the Valuation Department has been secured. These Valuers receive general guidance and instruction from the Department, and their local knowledge is of immense value to the Department, which through them keeps in constant touch with its rural mortgagors who are experiencing difficulties, and affords advice and in appropriate cases financial assistance in the carrying on of farming operations.

The measures taken by the Department in the better protection of its interests have called for a reorganization of the administration. Its lending operations are now negligible compared with those of the decade ending 1930. The pressing need is the supervision and management of its securities in all cases where the mortgagors are in arrear or have been dispossessed on account of default. The vast extent of the Department's operations has not, as may be imagined, lightened the difficulties, but the measures adopted have been justified.

(c) *Effect of the Crisis on the State Advances Office.*[12]—In common with all lending institutions of any magnitude, it seems inevitable that the Department will suffer losses. Owing to the prolonged economic depression the amount of the losses will not be ascertained until prices and wages are stabilized, and unless the price-levels of primary produce substantially increase, they will doubtless be considerable. That this should be so is obvious when it is considered that the Department stands almost alone in that its investments are not made with a view to profit, but to assist in the development of the country and that a very large proportion of its loans have been made to develop lands on which finance would have been unobtainable from any other source. To meet anticipated losses the largest amount available has been transferred to the Reserve for doubtful debts.

While the difficulties of some of the Department's mortgagors are apt to focus attention on the securities at present under control or supervision, there is also the other aspect which records the performance of those fulfilling their obligations to the Department. Although many of the Department's mortgagors have, through reduced incomes, intermittent employment, and increased taxation, been unable to meet the full requirements under their mortgages, 62 per cent. of the mortgagors were as at the date of the annual balance (1933) meeting their commitments to the Department within the rebate period and thereby earning the ½ per cent. reduction in the interest payments. Interest collected for the year ended March 31, 1933, amounted to £2,222,626, and principal repaid during the year was £1,362,776.

3. *The Public Trust Office*

(a) *Operations.*—The Public Trust Office was established in 1873 and now transacts a large volume of business as 'trustee, executor, agent or attorney.'[13] The amount of mortgage investments standing in the name of the Public Trustee as at March 31, 1933, was £18,799,906. The funds were obtained from the following sources:—

12. This section relates to the operation of the Office as a whole.
13. See N.Z. Official Year Book, 1930, p. 967.

Investments of the Common Fund	£13,751,425
Public Service, Railways, Teachers' Superannuation Funds and National Provident Funds invested in the name of the Public Trustee	4,598,834
Other	449,647
	£18,799,906

Of this amount about £9,000,000 was invested on rural security.

The device of the Common Fund is described as 'an unique creation in the sphere of trust administration.'[14] Normally, trust funds are invested independently in selected securities specified by statute, the risk falling on individual beneficiaries. In 1891 a 'common fund' was created to absorb all cash balances of estates, except where expressly forbidden by the creator of the Trust. Moneys from the fund were to be invested in securities of a specified nature, and on them interest was to be paid at a rate fixed by the Governor-in-Council. Capital and interest were to be guaranteed by the State.

The establishment of a Common Fund enables the pooling of small cash balances which receive interest at once and can be invested for long periods without prejudicing the interest of beneficiaries. Risk is spread over the whole body of investments and is guaranteed by the State. The device of the Common Fund serves much the same purpose as the pooling of deposits by a bank and permits the combination of small and discontinuous units of resources into an aggregate the greater part of which is available for continuous use. At the same time it cheapens the cost of credit marketing.

Loans are advanced on the amortization principle, for periods up to 36½ years, up to not more than 60 per cent. of the value of the security. The Public Trust Office exercises great care in the supervision of securities. Mortgages come up for revision every five years, and the necessary steps are taken to see that the security is maintained in good order and condition. Securities are inspected by officers of the Department, and covenants are enforced regarding the conditions of re-sale of the property, the maintenance of improvements and top-dressing. In general, the rate of interest on new loans varies in sympathy with, but is normally slightly lower than, ruling rates.

By and large, the Public Trust Office may be regarded as an important and efficient agent for the provision of long term finance. Except for the fact that its supply of funds is less elastic, it possesses most of the advantages of long term mortgage banks. The nature of the business it transacts is well known and its branches are sufficiently widespread to permit of reasonably close contacts with borrowers. Its officers are usually men of ability well qualified by training and experience to engage in transactions

14. Annual Report of Public Trustee, March, 1929.

connected with real estate, while the careful oversight of securities not only safeguards the interests of those whose estates it controls, but also should react in the long run to the advantage of the rural community.

(b) *Effects of the Crisis.*[15]—The period of economic stress through which the Dominion has been passing has materially increased the difficulties of administration of the investments of the Public Trustee.

In the earlier part of 1931, funds were freely available for advances by way of mortgage or for loans to local bodies. In the latter half of that year, however, conditions had changed suddenly and decisively to such a degree that practically all moneys received were needed to meet the requirements of estates and funds under administration by the Public Trustee; and it was therefore necessary to curtail the usual lending operations. Since then it has not been practicable to consider fresh applications for loans. The investments from the Common Fund are derived mainly from the realization of assets in estates under administration by the Public Trustee, and the difficulty of disposing of the assets on the unfavourable market has resulted in a marked diminution in the flow of moneys into the Common Fund for investment, though this diminution is of a temporary nature only, and will disappear in due course with the restoration of improved economic conditions. Curtailment from another source has also been experienced. A large number of the loans advanced by the Public Trustee are on an amortization basis, and normally a very substantial sum is received from this source by way of annual repayments of principal; but, during the period of depressed prices for primary products, it has been necessary to assist a number of mortgagors, particularly those who are engaged in farming operations, by postponing temporarily, payment of the principal portions due under their table mortgages.

The widespread and difficult economic and financial conditions have affected all classes of mortgage securities, but none more than a class of investment which was formerly regarded as 'gilt-edged,' namely, first mortgages on large sheep stations showing an adequate margin of security at the time the moneys were advanced. Loans have not, however, been confined to any particular type of security; and the effect of the prevailing conditions has, therefore, not been so severe as it would have been had lending operations been restricted to advances on rural securities.

The policy of the Public Trustee of advancing moneys on an instalment table basis has undoubtedly been of benefit both to the mortgagors and to the Department in the prevailing conditions. Almost without exception, loans on city buildings and dwellings have been granted on this system. The policy has had the effect of confining loans of this class to persons who were in a sound financial position and able to

15. This information was provided by the Public Trustee.

make larger annual payments than would be required under a loan on a flat basis, and eliminated at the outset borrowers who, even in normal times, were unable to make the required repayments of principal as well as interest.

As town and suburban securities have felt increasingly the effect of decreased returns from business and reductions in rent and salaries, it has been necessary to place a large number of mortgages temporarily on a flat basis. As a rule, this has afforded adequate relief to the mortgagor.

From 1925 onwards, the policy of granting loans on a table basis was extended to rural securities as far as possible. The margin of security for these loans has consequently increased by the amounts periodically paid off the principal sum, with the result that a very large number of the mortgaged properties, even on the present reduced basis of value, show a satisfactory margin of security for the amount of the loan outstanding. It has been necessary to assist the majority of these mortgagors by postponing principal repayments; but there are still many mortgagors who are paying the instalments in full.

In a substantial number of mortgages secured on farming properties, it has been necessary, in addition, to accede to requests for an extension of time for payment of interest; this particularly applies to sheep and mixed farming securities. It has also been necessary to enter into arrangements with stock mortgagees to ensure payment of the deferred interest when the farm produce has been realized.

C. Long Term Credit Needs

While no system of long term credit is free from dangers during a period of acute depression, the State Advances Office and the Public Trust Office compare very favourably with most other long term credit institutions in the efficiency with which their operations are conducted and their capacity to weather financial troubles. Nevertheless, they do not account for more than 20 per cent. of the total long term mortgage credit advanced to farmers. The bulk of the business is transacted in an unorganized market which is far from satisfactory, and there is an urgent need for the extension of principles and methods similar to those adopted by the German Landschaften or the Federal Farm Loan Board of the United States. This may be achieved, in part, by the extension of the operations of the Rural Advances Board, but it seems desirable that, in addition, legislative provision should be made for the establishment of Joint Stock Land Banks similar to those operating in the United States.[16]

16. This proposal has also been made by a Committee of the Christchurch branch of the Economic Society of Australia and New Zealand under the Chairmanship of Professor Tocker. Since this section was written the Mortgage Corporation of New Zealand has been established and this should contribute to the extension of the organized market for mortgage finance.

II. SHORT TERM AND INTERMEDIATE CREDIT

A. Private Sources

The main private sources of short term and intermediate credit in New Zealand are dealers of various kinds, particularly stock and station agents, and commercial banks. Dealers possess some advantages as a source of short term and intermediate credit, and, in the aggregate, direct a large volume of resources to agriculture. They are in close personal touch with the farmer, possess an intimate knowledge of his business and are able to advance loans with little formality and small initial cost. Loans frequently take the form of book credit or the sale of equipment on the instalment plan. Frequently dealers have been prepared to tide the farmer over temporary difficulties and have often shown considerable leniency in bad times. On the other hand, the dangers emphasized above in respect of their transactions in long term credit apply also in greater or less degree to the provision of short term and intermediate credit. The remedy is not, however, to curtail the operations of dealers, but to extend competitive facilities such as are provided under the Rural Intermediate Credits Act of 1927.

Commercial banks are the most important source of short term credit to farmers, and in addition provide a considerable volume of credit through dealers and other agents. One writer estimates that more than half of this type of credit is provided directly by banks and that indirectly through dealers and lending institutions of various kinds, they provide more than 90 per cent. of the short term credit necessary for the working expenses of farmers. As a source of short term credit they may be regarded as very satisfactory and the Royal Commission on Rural Credits which reported in 1926, failed to discover anything better in the countries visited. Nevertheless, the small farmer has had some difficulty in obtaining adequate supplies on reasonable terms, while neither dealers nor commercial banks are entirely adequate or satisfactory as sources of intermediate credit. There is here a need which the Government has attempted to satisfy by the setting up of appropriate machinery.

B. The Rural Intermediate Credit System

1. *Operations of the System*

Yielding to the pressure of farming interests, the Government passed the Rural Credit Association's Act of 1922, empowering the setting up of co-operative rural credit associations. The Act proved abortive and has since been repealed. The State Advances Amendment Act of the following year gave the State Advances Office authority to advance money to farmers up to a period of five years on the security of stock, farm implements or land either with or without collateral security. Interest was to

be charged at the rate of 7 per cent., reducible to 6½ per cent. for prompt repayment of interest and instalments of principal. Small advantage was taken of these facilities and to March 31, 1929, only £97,525 had been advanced. The main reasons for non-success appear to have been lack of knowledge on the part of farmers and undue delay in the granting of loans.

The Royal Commission, to which reference has been made, stressed the need for additional facilities in the provision of intermediate credit and recommended a scheme very much on the lines of the Federal Intermediate Credit system of the United States. The recommendations were embodied, in substance, in the Rural Intermediate Credit Act of 1927.

This Act established a board of seven members comprising the Public Trustee and six members appointed by the Governor-General in Council. At least one member was to have had farming experience. Of the members subsequently appointed two are practical farmers—one from the North Island and one from the South Island. Under the provisions of Section 29 of the Finance Act 1929, the Financial Adviser to the Government is also a member of the Board. For the purposes of the Act New Zealand is divided into sixteen districts, for each of which a district board of five members has been set up. The Board appointed District Public Trustees throughout the Dominion to be District Intermediate Credit Supervisors. The District Supervisors who are stationed at the headquarters of the district boards are chairmen thereof. The Act also provides for the setting up of co-operative rural intermediate credit associations. A group of not less than 20 farmers may form an association to which the Board may make advances to be re-lent to its members on securities approved by the Board. Each member must subscribe for at least 25 shares of the association to the value of £1 per share. Each association is required to elect a directorate of four members, and a secretary and a treasurer or a secretary-treasurer. Only one salaried officer may be appointed. The District Supervisor for a district is also ex-officio a director of each association in his district. Forty-three of these associations had been formed up to June 30, 1933.

The business of the Board is to make advances to individuals, associations and co-operative societies and to discount promissory notes. The funds of the Board are provided by means of advances from the Government and the issue of debentures, subject to the consent of the Minister of Finance. Advances from the Government are not to exceed £400,000 and are to be for a period of not less than 20 years. These are to be free of interest for a period of ten years from the date of the first advance and thereafter to pay such interest as the Minister of Finance may direct. One-third of every advance is to be credited to the Rural Intermediate Credit Redemption Fund and applied to the redemption of debentures

issued by the Board. The remainder is to be used by the Board in carrying on its business. In addition the Minister of Finance may make advances to the Board not exceeding in the aggregate the sum of £5,000 to be advanced by the Board to associations towards preliminary expenses. Advances to any one association are not to exceed £25 and are free of interest if repaid within ten years.

Debentures may be issued to the amount of the balance owing to the Government in respect of the advances totalling £400,000 together with the amount of all securities held by the Board; or to the sum of £5,000,000, whichever is the lesser. All debentures are to constitute a floating charge on all the assets of the Board and are to have priority over the claims of the Crown. They are to be redeemed at par at not less than six months nor more than five years from the date of issue. Pending the raising of funds by the issue of debentures, the Board may borrow an amount not exceeding the amount authorized to be borrowed by the issue of debentures. Interest on debentures is not to exceed 6 per cent. The debentures are trust securities.

Each member of a rural intermediate credit association may receive loans up to ten times the amount of his subscribed capital, with a maximum of £2,000, through the association of which he is a member. Where the advance required by any member is for a period of less than six months, an association may, with the approval of the Board, arrange for a loan from any bank or other approved financial institution.

Under Part III of the Act provision is made for the granting of direct loans to farmers without the intervention of rural credit associations.

All loans are normally secured by a mortgage of stock, chattels or land, and loans under Part III of the Act must be collaterally secured by an instrument of guarantee signed by one or more sureties approved by the district board. Sureties must be not less than 20 per cent. of the loan originally granted.

Part IV of the Act provides for the granting of loans to co-operative societies composed of not less than 30 members and having a subscribed capital of not less than £2,500. Loans may be authorized up to 80 per cent. of the value of the live stock or produce belonging to the society, against which the loan is secured.

Provision is also made to enable banks and approved financial institutions, companies, firms or persons to discount promissory notes and bills of exchange with the Board. The maker of the promissory notes is to be a farmer engaged in farming operations on his own account. The note is to be endorsed to the satisfaction of the Board which also determines the rate of discount chargeable.

The following figures show the nature and extent of the Board's operations as on June 30, 1933:—[17]

Investments (including loans made and face value of bills and notes discounted)	£354,944
Loans granted but not completed	10,079
Applications entertained and in course of consideration	15,486
	£380,509
The investments referred to above were as follow:—	
Advances to associations for preliminary expenses	£835
Advances to associations under Part II of the Act	256,024
Advances to farmers under Part III of the Act	92,785
Bills and notes discounted (face value)	5,300
	£354,944

Total loans made and bills discounted since the inception of the Act were £986,762. The total business dealt with or under consideration at that date amounted to £1,012,327. Up to June 30, 1933, advances totalling £400,000 were received from the Consolidated Fund and £262,900 was raised by debentures.

The Rural Intermediate Credit Board has been in operation since January, 1928, and the experience of its working up to the present gives ground for stating that it provides one of the most useful pieces of credit machinery so far established, whilst the policy of caution and steady development which appears to have been adopted by the Board offers abundant promise for the future. The scheme is now well established and farmers are becoming increasingly familiar with the facilities it offers.

It will be noted that by contrast with the Raiffeisen system the basis of the plan is co-operative credit associations with limited liability, organized from above and by the State. In other words, the central Board was first established and the creation of associations then encouraged. There is no doubt that any other plan would have had small chance of success. The principle of unlimited liability would have proved unacceptable to New Zealand farmers, while apart from State initiative, associations would never have been brought into being. The Raiffeisen method finds its main justification in the strengthening of the security by unlimited liability and personal oversight by members of societies. Under the New Zealand plan, although close control over conditions of loans is exercised by the district boards and supervisors and by the central Board, nevertheless the Board places considerable reliance on the supervision of securities by associations and recognizes that without the willing and gratuitous assistance of the directors of the associations the cost of administration would be greatly increased. Much importance should be attached to the extent to which co-operative societies, especially co-operative dairy companies, have taken advantage of the provisions of the Act. Little advan-

17. The Board commenced operations on January 1, 1928.

tage has been taken of the facilities offered for direct loans to societies, mainly because it is comparatively easy to obtain such credit from banks. On June 30, 1933, the sum of £92,785 was owing in respect of loans advanced directly to farmers, the great bulk of it being on the basis of a 20 per cent. guarantee by co-operative concerns. That amount represents the net investments after crediting repayments received over, in some cases, five years or more. Loans are usually reduced by a charge on the monthly butter-fat cheque. By this means the advantages of membership in co-operative societies are emphasized in a new way. Co-operative societies also perform a useful service in endorsing the promissory notes of members to enable them to take advantage of the discount facilities offered by the Board. By this means dairy farmers are able to finance expenditure during the off season, and repay loans by means of a deduction from the milk cheques in the following season. From January 1, 1928, to June 30, 1933, the discounts effected, of which practically the whole were in respect of notes endorsed by co-operative companies, amounted to £64,317.

In its early stages the system was utilized mainly by dairy farmers, but with the increase of the maximum loan from £1,000 to £2,000, and the introduction of special provisions instituted to enable them to carry over the 'dead' season and repay loans when receipts begin to come in, the system has recently been largely utilized by sheep farmers and to a smaller extent by grain growers, though the majority of the loans made by the Board have been made to dairy farmers. The loans to sheep farmers and grain growers take the form of fluctuating advances within agreed limits, secured by liens on stock, chattels, crops and/or land.

Although modifications will naturally be introduced from time to time in the light of experience, this provision for loans to sheep farmers and grain growers rounded off the system and opened up its facilities to a large and important class of borrowers. The present framework is excellently devised and the Board may claim to have laid the foundation of a system which will promote increased productive efficiency and improve materially the economic welfare of the rural community.[18]

2. *Effects of the Depression*[19]

The abnormal conditions at present existing in the farming industry have retarded to some extent the expansion of the rural intermediate credit system, as will be seen from the following figures giving the total business dealt with or under consideration at the end of the Board's years 1928 to 1934:—

18. Since the above was written, provision has been made under the Mortgage Corporation of New Zealand Act for the functions of the R.I.C. Board to be taken over by the Board of the Mortgage Corporation, as from a date to be specified by Order in Council.

19. Information provided by the Public Trustee.

30th June,	1928	£32,260
„	1929	273,244
„	1930	590,246
„	1931	840,301
„	1932	937,999
„	1933	1,012,327
„	1934	1,086,368

Up to June 30, 1930, the business showed a rapid annual increase, but in later years although an increase is still maintained it has been at a much slower rate than previously. The main cause of the smaller increase in later years is probably a reluctance on the part of farmers to undertake fresh developments or improvements, even of a productive nature, in view of the uncertainty of the markets and a doubt whether the increased expenditure would give an adequate return. One special item of expenditure which has been substantially reduced in this way is the provision of fertilizer for top-dressing farming properties, particularly dairy farms. In earlier years large sums were made available for this purpose, and although the Board is still granting advances freely the amount of credit utilized by farmers for the purpose has declined to a marked degree.

A further result of the depression has been its effect on the Board's policy with regard to the repayment of loans. In compliance with the spirit of the Rural Intermediate Credit Act which contemplates that loans should, as far as possible, be repaid within five years, the Board has generally provided for repayments by equal annual instalments for a five-year period. When prices for primary produce were high in the first three years of the Board's operations, no difficulty was encountered in obtaining the required repayments, but when prices fell, difficulties were met with. Although a surprisingly large number of the Board's borrowers have continued to meet their obligations in full,[20] it has been found necessary to grant concessions to many borrowers who, through reduced returns, have been unable to meet their payments. It has been realized by the Board that it cannot expect to receive its payment in full to the detriment of other liabilities for essential purposes, and provided the borrower's conduct and the position of the security have been satisfactory, concessions in the principal payments have been granted where they have been shown to be warranted. The policy adopted by the Board from the commencement of the system of not granting a loan unless the applicant could offer sufficient security and demonstrate that he would be able to meet his annual commitments, appears to have been fully justified, and the fact that a large number of borrowers have been able to meet their commitments is evidence of the care exercised in the granting of the loans and the subsequent supervision of the accounts.

20. Arrears of interest owing as at June 30, 1934, amounted to the small sum of £317 only.

C. Recent Developments in Co-operative Credit to Farmers[21]

During the past four or five years there has been an interesting and significant development of co-operative credit through the provision of finance by co-operative dairy companies to their suppliers. In January, 1932, a questionnaire was forwarded to all dairy companies in New Zealand, and replies from 160 companies were received. The following table shows the number of factories among these which provide finance to their suppliers:—

	Cheese Factories	Butter Factories	Total
Supplying finance	32	56	88
Not supplying finance	52	20	72
Total	84	76	160

It will be noted that the provision of finance is much more common amongst butter factories than cheese factories. There appear to be two main factors which explain this. In the first place, cheese factory companies are, in general, much smaller in size, whether this be measured in terms of membership, output or capital.[22] It seems probable that larger companies will be more readily able to obtain finance than smaller, other things being equal.

In the second place, the questionnaire referred to showed fairly well marked differences of policy in certain geographical areas. In Taranaki there appears to be a strong tendency to avoid expansion into subsidiary enterprises, largely as the result of some unfortunate experiences in the past. In the Auckland Province, the provision of credit is very common. The lead was taken by the New Zealand Co-operative Dairy Company, which dominates this area, and which established a subsidiary, the New Zealand Dairy Finance Company, in 1926. Other companies followed suit, largely in order to retain their suppliers. Hence the extension of farm finance as a subsidiary enterprise was actuated in large measure by competition among co-operative concerns. Since Taranaki is the most important cheese-producing district, and the Auckland Province the most important district producing butter, the above considerations are, perhaps, the most important in explaining the differences in policy between cheese and butter factories.

The credit supplied is intermediate or short term, mainly the latter, and dairy companies do not appear to provide long term credit. Short term credit is granted mainly for the purchase of fertilizers, and the extension of this type of credit has been very largely influenced by the rapid increase in the use of fertilizers of recent years. Credit for this

21. In collaboration with F. B. Stephens. Reprinted from *Economic Record*, May, 1932. The statement refers to conditions in 1932.

22. The annual list of factories shows that only about 7 per cent. of cheese factories have more than 50 suppliers, as against 89 per cent. in the case of butter factories. It must be noted, of course, that the factory is not always the administrative unit.

purpose is normally advanced for a maximum period of a year, and the loan is expected to be repaid from the proceeds of the ensuing season. Short term credit is also advanced to meet rates, interest and other outstanding debts. Intermediate credit is provided mainly for the purchase of stock, though some credit is given to purchase separators, implements or fixed plant and to effect farm improvements.

Advances are usually contingent on an agreement to supply the company during the currency of the loan, and interest and principal are liquidated by means of an order on the monthly butter-fat cheque, which varies from one-fifth to one-third of the cheque. The form of security varies, and is, of course, influenced by the purpose of the loan and the standing of the borrower. In some cases a promissory note is accepted as security, in others a lien on the borrower's shares in the parent company or a bill of sale or a chattel mortgage. Information as to the usual amount of individual loans is incomplete, but the New Zealand Dairy Finance Company makes short term advances up to £100, repayable during the season. Intermediate loans made by this company are limited to £1,000 for a period of not more than five years, the most usual amount being about £200. Advances for stock are made up to 50 per cent. of the value of the security. A full statement of the affairs of the borrower, verified by the company, is a condition of such loans. A small fee is charged to meet initial expenses. Promissory notes are normally discounted at 2 per cent. above bank rate, plus a charge of 10/6 per cent. to cover costs of supervision. In the case of secured advances, a valuation fee of £2/2/- is levied, and the rate of interest is 2 per cent. above bank rate. The parent company (the New Zealand Co-operative Dairy Company) endorses the promissory note, thus covering the Finance Company against loss. The parent company looks to recoup itself from the shares of the borrower in the event of non-repayment.

Provision is usually made for the supervision of the operations of the borrower during the currency of the loan. In the case of the New Zealand Dairy Finance Company, supervision is undertaken by organizers of the parent company who furnish periodic reports. By this means, and by an examination of the monthly butter-fat cheque and the charges upon it, a close supervision can be maintained.

Except in the case of the New Zealand Dairy Finance Company, which raised capital by the issue of shares, the necessary funds are normally obtained by means of a bank overdraft secured by a guarantee, which differs in different cases. The questionnaire referred to revealed several forms of guarantee:—

(a) Guarantee by the company, secured by a mortgage over its assets.
(b) Joint and several guarantee by the shareholders.

(c) Joint and several guarantee by the directors.

(d) Guarantee by the company supported by the deposit of bills of sale over stock or chattels. The bank usually imposes an overdraft limit determined by the size of the company and the nature of the security.

The New Zealand Dairy Finance Company provides the only example of which we are aware of a subsidiary company floated for the express purpose of providing finance. In all other cases the finance is undertaken by the companies themselves, largely because they are too small to justify the establishment of an intermediary with a separate identity. The New Zealand Dairy Finance Company was formed in 1926, with an initial capital of 75,000 shares of £1. All shares, with the exception of five, are held in the name of the parent company. The five shares are transferred to the directors for the time being, and are, therefore, director's qualification shares. Directors of the Finance Company are appointed by the directors of the parent company from amongst themselves. Hence shareholders in the parent company do not control the Finance Company directly, but through the directorate of the parent company. The primary object of the Finance Company is not to make profits, but to provide 'services' to shareholders. Nevertheless, the company has shown a profit in the region of 10 per cent. per annum on paid-up capital. Up to the present, the paid-up capital is £25,000, additional finance being obtained by means of a bank overdraft secured against the uncalled capital, the sureties of borrowers being deposited as collateral.

Sufficient information is not available to enable an estimate to be made of the total amount of credit obtained from the above sources, but the following figures indicate the extent of the transactions of the New Zealand Dairy Finance Company up to and including the season 1930-31 :—

Season	Amount Advanced
1925-26	£25,000
1926-27	67,000
1927-28	83,000
1928-29	100,000
1929-30	85,000
1930-31	80,000
Total	£440,000
Amount repaid	390,000
Amount outstanding as at 31/5/31	£50,000

If account is taken of the operations of other dairy companies, it will be seen that dairy companies as a whole are a useful subsidiary source of short term and intermediate credit to dairy farmers.

The initial incentives to the provision of finance by dairy companies were the desire to supplement other sources of finance, which were, on the whole, regarded as inadequate or unsatisfactory to small suppliers,

and to encourage the expansion of production or stimulate 'better farming.' In the case of the New Zealand Dairy Company, the appeal for better farming has been supported by persistent propaganda through its journal, *The Dairy Farmer*. Since 'better farming' involved finance, the formation of a subsidiary company providing credit was a natural development. It should be noted that the New Zealand Co-operative Dairy Company was in existence prior to the passing of the Rural Intermediate Credit Act, and it is possible that, had the intermediate credit system been fully established at that time, direct finance by dairy companies would not have been considered necessary.

It was apparent that the encouragement of greater production through the increased use of fertilizers, the purchase of more and better stock, or in other ways would react to the advantage, not only of the individual borrowers, but also of the suppliers as a whole, since with increased output cost of processing and marketing would tend to be reduced and average pay-out increased. But when once a dairy company in any district commenced the practice of advancing credit to its suppliers, other companies tended to be forced into line in order to retain suppliers. Hence competition amongst contiguous concerns has been a potent influence.

The form of credit organization described differs from the Rural Intermediate Credit System, in that the impetus towards organization comes from the factories themselves, while the Intermediate Credit System is organized from above. Both embody to a greater or less degree the principles of mutual guarantee, and to some extent make use of the same organization. Both take advantage of local knowledge and local supervision.

Where the financial position of the company is strong, more particularly where additional capital has been secured by the accumulation of reserves or the issue of shares, and where due care is exercised in the granting of loans, the system has much to commend it. The relationship between the borrower and the ultimate administrative authority is more close than in the case of the Rural Intermediate Credit System, and it is at least possible to grant credit with less formality and delay. Companies are in close touch with the affairs of their suppliers, and oversight of loans is not difficult, while the interposition of companies as intermediaries between the banks and individual borrowers strengthens the basis of security and improves the credit security of the borrower, especially if he is operating in a small way.

The granting of credit as an auxiliary operation should also tend to strengthen the bonds between the company and suppliers. On the other hand, there are serious elements of danger, especially during periods of rapid price changes. Competition amongst companies may tempt them to push their advances too far, and endanger their own assets. Cases have

occurred, especially among smaller companies, where the banks have taken over the assets which have been pledged as security. It would appear that smaller concerns would be wiser, either to take advantage of the facilities offered by the Rural Intermediate Credit System or join together in the formation of Finance Companies along the lines of the New Zealand Dairy Finance Company.

III. THE FINANCING OF AFFORESTATION, FLAX, TOBACCO AND TUNG OIL COMPANIES

During the past ten or twelve years, there has been an interesting development in the financing of land utilization on a large scale, especially in regard to timber, New Zealand flax, tobacco and tung (oil) tree plantations. From considerations of space, and because the methods of finance adopted are adequately dealt with elsewhere, it has been decided not to give a comprehensive account in this book.[23]

The method of finance adopted is through the formation of joint stock companies, usually with a small capital, which proceed to raise finance by the issue of so-called 'bonds.' In essence these are contracts to plant and maintain for a given period, a certain area of land for each bond. The title of the bondholder consists of an aliquot part of the area planted in respect of the series of bonds, of which his bondholding forms a part, and of his proportion of the proceeds therefrom. A proportion of the amount received in respect of each fully paid up bond is placed in a trust fund. This is the property of the 'parent' company and is normally repaid to it annually in stipulated amounts. If the company fails to fulfil its contract, the fund may be taken over by trustees who are appointed to look after the interest of bondholders.

It is difficult to estimate the total amount invested in land utilization companies of the above sorts, but the Commission into Company Promotion estimates that the aggregate investment of share and bond capital in such companies is not less than between £7,000,000 and £8,000,000, of which over £6,000,000 has probably gone into afforestation. By far the greater proportion of this has been raised from the sale of bonds.

The members of the Company Promotion Commission as well as the authors of the article referred to in footnote 23, were strongly critical of the bond system of finance, and the Commission recommended its prohibition for the future. The following are included among the main points of criticism:

23. For a discussion of the above, see: 'The Financing of Afforestation, Flax, Tobacco and Tung Oil Companies,' by H. Belshaw and F. B. Stephens, *Economic Record*, December, 1932 (Reprint Auckland University College Bulletin No. 22); also Report of Commission into Company Promotion, October, 1934. The Commission consisted of Mr. J. S. Barton (Chairman), Professor H. Belshaw and Mr. F. E. Graham, and dealt extensively with the above.

(1) The position of the bondholder is inferior to that of the shareholder or debenture holder in many respects. For example, an invitation to subscribe for 'bonds' is not a prospectus within the definition of the Companies Act, and the provisions of the Companies Act as to prospectuses for shares or debentures do not apply. In particular, information as to material contracts need not be disclosed.

The bondholder has no statutory rights and is merely entitled to the performance of a contract between him and the company. He has little remedy, in the event of default, beyond an action for damages.

Although the bondholder provides the bulk of the capital, he has no share in the control of the company, no rights to attend or vote at annual meetings, no right to receive accounts and balance sheets.

(2) Although the appointment of a trustee for bondholders affords some protection, this is inadequate because:—

(a) The first trustees are appointed by the Company, and in most cases bondholders have no powers to replace trustees.

(b) The bondholders are scattered and common action is therefore difficult in the event of their being dissatisfied.

(c) Frequently, no provision is made for holding meetings of bondholders, or registering a decision by them. In many cases action requires a unanimous decision and this is impossible to get.

(d) Powers and duties of trustees are limited by the conditions embodied in trust deeds drawn up by the parent company.

(3) It has been found that serious legal and practical difficulties face bondholders and their trustees when the time arrives for planning and putting into operation realization schemes. It is usually found necessary to incorporate bondholders. The Company Promotion Commission recommended legislation to make this possible.[24]

(4) The methods of promotion and organization lend themselves readily to exploitation of the bondholder. The parent company makes its profits out of the sale of bonds and not out of the commercial realization of the plantations, though in certain cases it may share in profits from realization. There is a strong incentive to take unconscionable profits at the expense of the bondholders and of the commercial prospects of the undertaking. The cost of selling bonds is heavy. Inflation of land and other assets and excessive charges by way of commission and brokerage are common. These are concealed and facilitated by the device of antecedent and subsidiary companies.

The Commission into Company Promotion found the difficulties of devising satisfactory remedies for these and other evils to be virtually insuperable and recommended the prohibition of the bond system of finance.

24. This recommendation was given effect to in the Companies (Bondholders) Incorporation Act 1934-35.

Chapter X

LAND TENURE AND LAND TRANSFER

By D. O. Williams

I. Land Tenure—A. Present Tenurial Principles—B. Distribution of Tenures—C. Tenures and Types of Farming—D. Distribution According to Size—E. Closer Settlement and Tenures. II. Land Transfer System. III. Transfer of Farm Lands. IV. Land Mortgages.

I. LAND TENURE

A. Present Tenurial Principles

Through all the elaborate detail of existing land legislation certain main principles are discernible. Under the 'Optional System,' Crown land notified as open for selection may be acquired, at the option of the applicant, either for cash, or deferred payments, or on renewable leases. Where more than one applicant for the same land has been received on the same day, the successful applicant is chosen by ballot. Other Crown and Settlement lands are disposed of by auction on any of the above tenures, at an official upset price.

Every tenure, with insignificant exceptions, embodies definite and often exacting conditions, notably of residence and improvement. Even in the case of Crown lands bought for cash, the Crown title is held to be contingent on carrying out satisfactory improvements within ten years of purchase. The purchaser is in principle a conditional purchaser in possession of an occupation licence liable to forfeiture if he fails to effect the minimum improvements required.

State leaseholds are of several kinds, but most are for comparatively long terms. The modern 'renewable leases' of rural Crown lands run for 66 years, and of Settlement lands (private estates purchased by the Crown and subdivided) for 33 years. 'Small grazing-run leases' for 21 years, and 'pastoral licences' for varying periods up to 35 years, are also available. A definite perpetual right of renewal for further periods of 66 and 33 years exists in the case of Crown and Settlement leases respectively while small grazing-run leases and pastoral licences may be renewed over the whole run at the discretion of the Land Board; or, if the run is subdivided and leased at the expiry of the original lease, the outgoing tenant may claim a new lease over one of the subdivisions. In all cases where leases are renewed, a revaluation is made, and where the lease is not renewed the outgoing tenant is protected in his improvements. The main State leaseholds may be converted into freeholds either for cash or on deferred-payments. This applies with few exceptions not only to the

modern leases, but also to those created under earlier legislation, and no longer available for new transactions, e.g., leases-in-perpetuity and perpetual leases. Alternatively, the old leases may be converted into the modern 'renewable lease,' while pastoral licences may be converted to small-grazing runs and these to renewable leases. The renewable lease is the standard lease into which nearly all other leases are convertible, and it best expresses present principles of such tenures, namely, long terms, rights of renewal, revaluation prior to renewal and conditions of residence and improvements.

The emphasis which has been placed on limiting land aggregation and promoting closer settlement is shown in the legislation which invariably sets a maximum to the area which can be acquired from the Crown under any important rural tenure; in the powers conferred on the Land Board to subdivide small grazing-runs and pastoral runs on the expiry of the lease; in the power of the Crown compulsorily to acquire private lands for subdivision; and in the graduated land tax.

B. Distribution of Tenures

Of the occupied land, there is slightly less held as freehold than on leaseholds of various sorts. The following table indicates the distribution of tenures in the land districts as at January 31, 1933:—

TABLE XXXII

Tenure of Occupied Lands

(In Thousands of Acres)

Land Districts	Total Area of Holdings	Freehold, including Deferred Payments	Total Leaseholds	Crown Leases
North Auckland	2,999	2,319	679	561
Auckland	4,212	2,954	1,258	873
Gisborne	2,628	1,446	1,182	521
Hawke's Bay	2,077	1,415	662	578
Taranaki	1,603	893	710	570
Wellington	4,857	3,431	1,426	690
Nelson	1,228	631	597	733
Marlborough	2,445	799	1,646	1,449
Westland	1,276	160	1,116	984
Canterbury	8,107	3,155	4,952	4,154
Otago	8,000	1,748	6,252	5,623
Southland	3,242	1,486	1,756	1,805
Totals	42,673	20,437	22,237	18,533

The column relating to 'Crown Leases' is not strictly comparable with that for 'Total Leaseholds,' since the former is taken as March 31, 1933. The error involved is slight, and it can be accurately enough said that Crown leases account for approximately 84 per cent. of all leaseholds.

Although for the Dominion as a whole total freeholds are not

greatly less in area than total leaseholds, the North and South Islands showed marked differences in this respect. About two-thirds of the total occupied land in the North Island is held on freehold, while in the South Island the proportion is barely one-third.[1]

TABLE XXXIII

Chief Features of Main Rural Leases

Lease or License	Maximum Area in Acres	Term in Years	Right of Renewal	Rental % on Capital Value	Remarks
1. Deferred Payments D.P.	666⅔ 1st class 2,000 2nd class 5,000 3rd class	34½	—	5½% interest 1% sinking fund	
2. Renewable R.L. (Crown land)	Ditto	66	Perpetual	4	
3. Renewable R.L. (Settlement land)	Ordinary land as above; but no limit on pastoral land	33	Perpetual	5	
4. Pastoral licence P.R. (Land Act 1924, Pt. VI.)	To carry 20,000 sheep or 4,000 cattle all year round	Up to 35	Subject to policy	Fixed by Land Board	Run may be sub-divided at expiry of leases. Lessee entitled to lease one lot if sub-divided or to lease whole run if not sub-divided
5. Small grazing run S.G.R.	20,000	21	Ditto	Ditto	Ditto
6. O.R.P.	As for 1 above	25	None	5	Tenure abolished for new transactions in 1926.
7. L.I.P. (Land Act 1892)	2,000 to include not more than 646 acres 1st class land	999	None	4	Tenure abolished for new transactions in 1907

1. The approximate percentage distribution of tenures according to land districts is as follows:—

Percentage Distribution of Freeholds and Leaseholds

Land District	Freehold Per Cent.	Leases and Licences Per Cent.
North Auckland	78	22
Auckland	70	30
Gisborne	55	45
Hawke's Bay	68	32
Taranaki	55	45
Wellington	70	30
Nelson	51	49
Marlborough	33	67
Westland	12	88
Canterbury	39	61
Otago	22	78
Southland	45	55
North Island	67	33
South Island	33	67

From the point of view of total acreage the main leaseholds are pastoral runs, small grazing-runs, renewable leases, leases in perpetuity (L.I.P.), occupation with right of purchase (O.R.P.), and deferred-payment licences. The L.I.P. and O.R.P. licences have been abandoned for future transactions, and may conveniently be referred to as "old" leases. Table XXXIII shows the main features of the chief leases.

These leases and licences together constituted about 90 per cent. of all leases held from the Crown at March 31, 1933, and of these, pastoral runs occupied about 9,000,000 acres. In reading the following table it should be noted that minor leases and licences are included in the total:—

TABLE XXXIV

Lands Held on Lease or Licence from the Crown at March 31, 1933

(In thousands of acres.)

District	L.I.P.	R.L.	O.R.P.	S.G.R.	P.R.	Total Crown Leases
North Auckland ..	67·6	218·8	121·9	—	0·6	561
Auckland	104·7	294·4	222·4	30·8	8·8	873
Gisborne	42·7	158·3	71·9	183·5	—	521
Hawke's Bay ..	110·7	218·5	51·2	42·9	73·5	578
Taranaki	149·8	165·1	160·7	3·4	—	570
Wellington	143·5	218·0	156·5	28·0	11·9	690
Nelson	113·1	242·2	22·8	9·6	199·4	733
Marlborough ..	181·4	156·0	19·7	276·2	802·2	1,449
Westland	40·9	82·3	4·3	—	589·8	984
Canterbury	251·6	358·2	1·0	466·8	2,809·6	4,154
Otago	276·3	365·0	22·9	1,451·8	3,276·3	5,623
Southland	90·9	87·6	32·9	65·0	1,147·1	1,805
Totals	1,573·0	2,564·4	888·2	2,558·1	8,919·2	18,533·0
Per cent. ..	8·5	13·3	4·8	13·8	48·1	100·0

If this table is read in conjunction with the preceding ones of this section it will be seen that over half the total Crown leases, and virtually half the total leases of the Dominion, relate to poor country. Most pastoral runs are very poor land, and the small grazing-runs are not in general good pastoral country. It is the existence of these tenures which are to be found almost wholly in the South Island that accounts for the high proportion of leaseholds there. As far as the available evidence goes it supports the belief that leaseholds predominate in those districts where there is a large proportion of poor land, and freeholds where there is a large proportion of good land.

There can be no reasonable doubt that with few exceptions the best land of the country has passed into private ownership. The slowing up in recent years of the rate at which additional freehold acquisitions have

been made indicates that from the point of view of private ownership the eyes have been picked out of the country. The extension of closer settlement on a freehold basis must now depend on private subdivision and sale of those better lands held at present in large areas, and on the use which the State makes of the Land for Settlements Act and of the new legislation designed to put unemployed on small farms. The young farmer, whether New Zealand-born or immigrant, must recognize that the acquisition in freehold of good land is no longer possible on a romantic pioneer basis, nor has been for a long while past. It is perhaps hardly necessary to emphasize this in the case of our own nationals, but people overseas, either from misunderstanding or misinformation, still show themselves ready to take an over-romantic view of the possibilities of land acquisition. If the freeholds of good land are desired, they must be sought, with few exceptions, from those who already own them, and that involves a business basis to the negotiations in which sentiment plays no obvious part.

C. Tenures and Types of Farming

Freeholds are definitely more common with some types of farming than with others. Dairy holdings consisting entirely of freehold land account for two-thirds of the area used for this purpose, but with sheep-farming less than one-third of the area is held in holdings which are entirely freehold. In all types there is an area comprising holdings which are partly freehold, partly leasehold, but the proportions of each tenure for each type of farming cannot be given.

As a working proposition, it may be said that, the more intensive the type of farming, the more common is the freehold.

The accompanying table gives the approximate proportions of land held under different tenures, according to the type of farming:—

Table XXXV

Percentage Proportions of Land Held Under Different Tenures Classified According to Purpose of Holding

Purpose of Holding	Wholly Freehold %	Mixed Freehold and Leasehold %	Wholly Leasehold %	Totals %
Sheep Farming ..	30	40	30	100
Mixed Dairy and Sheep	50	28	22	100
Mixed Agriculture and Sheep ..	57	22	21	100
General Mixed Farming ..	60	20	20	100
Dairy Farming ..	66	11	22	100
Poultry Farming ..	80	1	19	100
Orchards	85	7	8	100

It is interesting to note how much more common mixed tenures (partly freehold, partly leasehold) are in the case of sheep-farming than in that of dairying.

Holdings which are wholly leaseholds are held predominantly as Crown leases, and private leaseholds count for little in New Zealand, amounting to about 5 per cent. of the occupied area, or 10 per cent. of the leasehold area. In sheep-farming, private, Maori and public body leases account for about 10 per cent. of the area held as definite leaseholds, the balance being Crown leases. In dairying, Crown leases are less important, since little good land has in recent years been available under such tenures.

D. Distribution According to Size

In the following table, 'freehold' land consists of all land other than Crown and native leases.

Table XXXVI

Approximate Average Size of Holdings According to Tenure

Land District	Crown Leases Acres	'Freehold' Acres	All Occupied Land Acres
North Auckland	160	230	215
Auckland	210	375	325
Gisborne	670	1,030	933
Hawke's Bay	410	495	468
Taranaki	250	270	261
Wellington	185	590	453
Nelson	420	285	355
Marlborough	1,090	1,760	1,290
Westland	?	?	1,110
Canterbury	1,070	430	620
Otago	1,010	1,095	1,038
Southland	770	390	556
Dominion	570	500	509

It will be seen that, without exception, the average size of 'freeholds' in the North Island is larger than the average size of leaseholds, while in the South Island the reverse is the case except in the cases of Marlborough and Otago. The explanation is that the only Crown leases of large average area are the S.G.R. leases and the pastoral licences, which are to be found almost wholly in the South Island. If these two leases are set aside, the average area of Crown leases is reduced abruptly from 570 acres to 220 acres, the range being from about 150 acres to 290 acres. The average areas of the Crown leases, according to land districts, are approximately as follow:—

TABLE XXXVII

Approximate Average Area of Crown Leases

Land District	L.I.P. Acres	R.L. Acres	O.R.P. Acres	E.E.* Acres	S.G.R. Acres	P.R. Acres	Misc. Acres	Av. Crown Leases Acres
North Auckland	160	195	170	60	—	550	225	160
Auckland ..	270	210	280	315	4,250	8,750	100	210
Gisborne ..	445	485	670	580	2,725	186	220	670
Hawke's Bay ..	270	400	300	265	2,000	7,150	370	410
Taranaki ..	250	345	425	80	1,100	—	166	250
Wellington ..	140	170	370	200	1,480	1,760	50	185
Nelson	330	410	365	60	1,390	50,000	250	420
Marlborough ..	325	520	310	350	2,600	19,300	80	1,090
Westland ..		Figures	doubtful in some cases					
Canterbury ..	175	400	145	300	3,250	23,000	220	1,070
Otago	215	325	150	100	3,750	10,500	100	1,010
Southland ..	170	210	175	420	3,250	18,000	120	770
Dominion ..	210	280	290	200	3,250	15,000	150	570

*Education Endowment

The picture given in the foregoing of a Dominion average for 'freeholds' almost as large as the average for leaseholds is, nevertheless, not satisfactory. It overlooks the fact that, particularly with sheep-farming, leaseholds of various sorts are often combined with freeholds. From the practical farming point of view, a holding is the total land unit, however many tenures it may comprise. Holdings consisting of mixed tenures are sufficiently important to fall into a class by themselves. When distinguished from holdings wholly freehold, or wholly leasehold, a classification more in line with farming practice can be made.

TABLE XXXVIII

Approximate Average Size of Holdings According to Tenure

Wholly Freehold Acres	Wholly Crown Leasehold Acres	Wholly Private Leasehold Acres	Mixed Freehold and Leasehold Acres
295	855	155	1,510

Unfortunately, no similar analysis can be made for the separate land districts. For the Dominion as a whole, farm holdings which consist partly of freehold with leasehold areas attached are the largest sort on the average. Farms wholly freehold average about one-third the size of farms held entirely as leaseholds. The small size of private leaseholds is explained by the fact that they occur almost wholly in the most intensive types of farming.

Even so, these figures are not in any real sense typical. The existence at one end of the scale of a large number of untypically small holdings of small aggregate area, and at the other end of the scale of a

few untypically large holdings of great aggregate area, throws the comparison out of focus. Thus, in the case of farms wholly freehold, the elimination of holdings under 20 acres would raise the average from 295 to 390 acres. In the case of Crown leaseholds, the exclusion of the few estates over 10,000 acres would drop the average from 885 to 475 acres, and a similiar treatment of the 'mixed tenures' would lower the average from 1,510 to 745 acres. If both these very small and very large holdings are excluded in all cases we arrive at figures which are probably more 'typical' than any. Thus for freeholds the average would be in the vicinity of 350, for Crown leases 550, and for mixed freehold leaseholds 800 acres.

The most satisfactory approach, however, is to consider, under the various tenures, the average size of holdings according to type of farming.

TABLE XXXIX

Average Size of Holding Classified According to Tenure and Purpose of Holding

Purpose of Holding	Wholly Freehold Acres	Wholly Crown Lease Acres	Wholly Private Lease Acres	Mixed Freehold and Leasehold Acres	Totals All Holdings Acres
Dairy Farming	108	119	90	144	105
Sheep Farming	990	2,014	560	3,460	1,720
Mixed Agric. and Sheep Farming	415	370	300	585	425
Mixed Dairy and Sheep Farming	375	365	295	600	412
General Mixed Farming ..	140	112	111	195	142
Orchards	25	27	11	46	26
Market Gardens	9	13	14	17	12

Excluding the unimportant private leases, it is evident that leasehold farms are noticeably larger than freehold farms only in extensive farming. In the case of dairying the difference is not great, while with the various types of mixed farming, the average area of freehold farms is rather larger than the average area of Crown leases.

The conclusions reached by this analysis may be summed up as follows:—

(a) The bulk of the better land of the Dominion has been alienated from the Crown.

(b) Freehold farms are more common with intensive than with extensive types of farming.

(c) In general, freehold farms are of smaller average area than leasehold farms; but the difference is marked only in extensive farming, and with several types of intensive farming the freeholds are the larger.

(d) Leases are predominantly Crown leases, private leases amounting to about 10 per cent. of the total occupied leasehold area.

(e) Holdings of mixed tenures are most common in the case of extensive farming and are, in all cases, larger in average area than either the freeholds alone or the leaseholds alone.

E. Closer Settlement and Tenures

The net effect of closer settlement in reducing the average area of holdings is clearly enough reflected in our statistics. The crown leases and licences as a whole show a 5 per cent. reduction in average area since 1916 and this is about the measure of the reduction for all holdings in New Zealand. The policy of the State has worked itself out almost wholly through its leases, as not more than two million acres of Crown land has been converted into freehold in the last fifteen years. Closer settlement undertaken outside the Crown lands has, on the other hand, been predominantly through subdivision and sale as private leases of rural lands are unimportant. Whether by sale or by lease, private closer settlement has apparently been as important in recent years as the direct State activities in this direction. No adequate statistics exist to prove this important point. The inference is made on the grounds that the known reduction in Crown leases and licences affects roughly only half the total occupied area and that the balance, affected mainly by private ownership, must have been reduced equivalently to produce a lowering of the Dominion average equal to that of Crown leases.

For the future, closer settlement will develop mainly within the area of occupied land held in private ownership. There is little Crown land left for further disposal and there is a definite tendency to contract the area of occupied land chiefly through dropping the marginal lands which were workable only under boom conditions. The probabilities are, therefore, that we have now reached the maximum area of economic land occupation. The phase of extension which continued without serious check until a few years ago and which was complementary to the progress of more intensive settlement, has ceased. Closer settlement now tends to occur within a total area that is contracting, not expanding. Of this total area, the approximate half held under Crown leases offers little possibility for closer settlement. Many of the leases are already small and where they are large they are mostly very poor land; renewable leases have a perpetual right of renewal without subdivision while L.I.P. lands cannot come within the scope of State action for the best part of a thousand years. The State's power directly to determine closer settlement is therefore limited to the restricted new areas yet to be offered for selection, to the acquisition and subdivision of private estates, and to the subdivision

of pastoral and S.G.R. leases. These latter leases are unpromising fields for anything but extensive farming and it is wildly improbable that any significant increase in the number of tenants will be secured in these areas. Land already in private ownership, therefore, offers the chief prospect for future closer settlement either through the voluntary action of individuals or through the exercise of the State's powers under the Land for Settlements Act and similar legislation.

It is probable, too, that such developments will, in aggregate effect, be more important in the region of medium than of very large estates since the number of the latter worth cutting up is comparatively small. Further, as closer settlement develops within the region of freehold land, it is likely to carry with it an extension of the private leasehold system. The experience of the State has been that however attractive the terms of purchase may be made, Crown lands have, in the first instance at least, been more acceptable as leaseholds. It is possible that the future unsatisfied demand for Crown leases may in part be transferred to private lands. This tendency is likely to be reinforced by recent events which have shown how precarious is much freeholding in this country, and how onerous the capital responsibilities of land ownership can become.

II. LAND TRANSFER SYSTEM

The 'Torrens' system of Land Transfer, first introduced in South Australia in 1857, was later copied by the other Australian legislatures and by New Zealand. The Land Transfer Act 1870 which is the basis of our present system made but slight modifications on the original plan of Torrens and subsequent amendments have not in any way affected the central principle of the system as originally established. This principle is that registration gives a State guarantee of 'a practically indefeasible title.' An intending purchaser can place the question of title beyond reasonable doubt by an inspection of the register since the whole responsibility for the registration is assumed by the Land Transfer Department. There are no obstacles to a search of any title and the register is clear and unambiguous. All the complications involved in tracing the history of the ownership of a parcel of land, of ascertaining to what incidents the title is now or subsequently subject, with the attendant delay and expense of a probably involved search, are once and for all disposed of when the title has been registered. The system works cheaply, simply and quickly.

Until 1924 the system applied only to land alienated from the Crown since 1870 and to such other land as owners might voluntarily bring under the Act. It was thought that in this way the old system of 'deeds registration' would gradually be extinguished; but in 1924 it was estimated

that only a little over 81 per cent. of freehold land had been brought under the Act. There remained large areas under the old system and the number of holdings not under the Land Transfer Act was increasing at about 4 per cent. per annum as a result of subdivisions. The 1924 Act gave power to the Registrars to make an official examination of all these titles and to issue certificates of title, limited where there is a doubt or defect in the holder's title, unconditional and therefore fully guaranteed by the State where no doubt or defect is found. The work is practically completed except in Auckland, Nelson and Otago. Before long practically the whole of the freehold land in New Zealand will be clear in title.

The whole process has necessarily been linked up with the development and improvement of the survey system. The bulk of the land outside the Act was in the older settlements where for a long while the lack of reliable surveys and the natural unwillingness of holders to have doubtful areas investigated too closely or voluntarily to undertake the necessary expense, was the most serious impediment to the extension of the new system. In 1894 the Registrar-General of land, Mr. G. B. Davy, regretted that no remedy for this obstacle was apparent and pointed out that the imperfection of the survey system had to some extent communicated itself even to the Land Transfer system. 'Though sufficient for the primary purposes of settlement, the early surveys of the colony are for the most part inadequate and untrustworthy as the basis of a system to which perfect accuracy in this respect is essential.'[2] The work of coordinating scattered surveys and establishing a modern system for the whole of the country was first begun in 1876, and has proceeded systematically ever since. The effective progress of this highly important work made possible the bold attack in 1924 on lands still outside the Land Transfer system. The combind result of land transfer and improved survey is one of the finest technical and administrative achievements of the country and on the economic side represents an enormous advance on the medievalism of the old system.

III. TRANSFER OF FARM LANDS

There can be no doubt that land changes hands very rapidly in this country, although no accurate measures of the rate are available to place the matter beyond careless dispute. Several factors make for a greater mobility of transfer than is apparent in older countries. We had no medieval background or agrarian revolution as in the case of England and, to take a very different case, no political revolution as in the case of France. On the one hand we have avoided the system of large private ownership combined with tenant farming, and on the other the system of small peasant proprietorship. Approximately 90 per cent. of the land held

2. *N.Z. Official Year Book*, 1894, 216-7.

as freehold is farmed by the owner and even where family labour prevails, 'farmer-ownership' is in most (not all) cases different both in scale and spirit from peasant proprietorship. The social status of even the smallest working farmer remains mildly aristocratic in this urgently democratic community. The attachment to and love of the land is as strong here as anywhere; but it is a loyalty to the country in general rather than to a particular piece of land. Although the tradition of family farms handed on from father to son is strong in some localities and is growing everywhere, it is still mixed with a keen economic instinct which will not lightly refuse a good offer. In short, while there is a powerful loyalty to the land, there is little servitude: and there is a readiness to move about the country to a degree astonishing to a visiting observer of our manners. This mobility and this willingness to trade in farms is in part due to the fact that our most rapid development took place in definitely modern times and was in the hands of people who were of the adventurous type; it occurred after the transport revolution and at a time when rising prices put an edge to the demand for land and when refrigeration solved the immediate problem of markets. The acquisition of private land was, in the circumstances, determined mainly by economic circumstances, and to a very large extent it could be got at a price. The introduction and development of an efficient Land Transfer system diminished the legal impediments to the process; the transport and price situation disposed of the general economic obstacles; exemptions at the lower end of the scale of the graduated land tax was a direct incentive to transfers; the historical background was not sufficiently extensive or complicated seriously to slow down the tempo of the movement; and in recent times large-scale government borrowing for public works and land finance was a positive encouragement to farm trading.

When we come to convert these general impressions into some sort of statistical form we are immediately faced with the customary incompleteness of accessible information. What we have is, however, of some value if too much is not expected of it. The following facts are derived from the annual reports, H-3, relating to Land Transfer and Deeds Registration. Transfers relate to land subject to the Land Transfer Act 1915 which 'comprises all land alienated from the Crown since 1870, all land included in any order under the Native Land Acts vesting such land in any person in freehold tenure, and all land vested in any person in fee-simple by virtue of any Act of the General Assembly, besides land which has been brought under the Act on the applications of the proprietors after investigation and acceptance of the title by the Department, and land brought under the Act pursuant to the Land Transfer (Compulsory Registration of Titles) Act 1924.'

TABLE XL

Transfers of Country Lands

Year	Number of Transfers	Area	Area Transferred as Percentage of Area Occupied	Index of Export Prices	Index of (3)
	(1)	(2)	(3)	(4)	(5)
		Thousand Acres	%	1909–13=100	1909–13=100
1913–14	—	2,206	5·4	109	108
1914–15	—	2,130	5·2	124	104
1915–16	5,312	2,414	5·8	146	116
1916–17	8,515	2,677	6·2	166	124
1917–18	7,951	2,008	4·6	168	92
1918–19	9,559	1,992	4·3	178	86
1919–20	16,784	3,775	8·7	181	174
1920–21	18,299	4,557	10·5	171	210
1921–22	10,525	1,985	4·5	136	90
1922–23	8,191	2,499	5·1	161	102
1923–24	8,304	1,797	4·1	179	82
1924–25	8,387	2,008	4·6	189	92
1925–26	9,320	2,007	4·6	154	92
1926–27	8,455	2,059	4·7	153	94
1927–28	7,409	1,893	4·4	168	88
1928–29	7,846	2,161	4·9	162	98
1929–30	8,455	1,697	3·9	128	78
1930–31	6,974	1,474	3·5	98	70
1931–32	5,035	1,215	2·8	89	55
1932–33	4,322	991	2·3	90	45

It needs to be noted here that 'occupied area' is an imperfect unit against which to measure the magnitude of transfers. Since the war, Crown leaseholds have represented, on the average, nearly twenty million acres, or close on half the occupied area; and these, of course, do not come under the Land Transfer Act. The correct unit of measurement would be restricted to those lands actually under the Act and these would be less than the total of freeholds. The necessary information is not available for computation on this basis, and the next best measure, total freeholds, is of doubtful accuracy for earlier years at least. As a first approach 'occupied area' provides, however, an approximate guide to changes in the velocity of transfers.

If column (1) number of transfers, is observed in conjunction with column (4), index of export prices, a clear association is apparent. The movement of prices is followed by a movement in the number of transfers, the increase or decrease in transfers being usually one or two years behind that of prices. The lag is of no economic significance and is due to the time that elapses before a transfer is registered.

The implication that rising prices encourage transfers, and falling prices retard them, is in line with the general belief that in New Zealand

the ownership of land is peculiarly sensitive to economic considerations. Changes in the number of transfers give a better index of the responsiveness of transfers to price changes than changes in the aggregate area transferred, since aggregate area will be affected by the average size of holdings changing hands, and this alters considerably from year to year. The transfer of many small holdings in any year might lower the total acreage transferred, even though the total number of transfers was greater. This was so in 1918-9, 1925-6, and 1929-30. Even so, the general conformity in the two series, acreage transferred and export prices (columns 2 and 4), is remarkably close.

The conclusion that the turnover of farms is strongly affected by the direction of prices is difficult to evade. It is necessary to make the point, because leaders in the farming community have at times strongly denied that farmers have indulged in property speculation. To prove innocence here is to acquit the farmer of any responsibility for land value inflation, and therefore to place the blame wholly elsewhere. But it is a curious line of argument which seeks to exclude the buyer from playing any part in determining the bargain. The transfers could not have taken place without the buyers, and their increased willingness in periods of rising prices is evident enough in the above facts. The increased velocity of farm turnover during rising prices is unmistakeably a part of the process of inflation of farm values. A turnover less responsive to price changes would have limited the injurious effect of inflation; but as it is, the period from the war up to 1920 must have added greatly to the overhead changes of a very large area of our freehold land.

Nothing short of a minute search of all the county registers in the Dominion will show what absolute area of land was affected in this period. The total area transferred does not give the required answer, since the same properties may have been transferred several times. From 1915 to 1921, the sum of transfers amounted to nearly 17½ million acres, or to about 40 per cent. of the average occupied area, to about 75 per cent. of the average freehold area, and (at a guess) to about 90 per cent. of the freehold area under the Land Transfer Act. It is impossible to say how much of this 17½ millions consists of re-transfers, and therefore impossible to compute how much freehold land in the Dominion was exempt from direct inflationary influences, and while reliable statistical evidence is lacking it is better to avoid numerical statements on this point. It is clear that a big proportion of freehold land changed hands on a rising market, and that the rate of turnover was greatest in the later stages of the upward movement.

It is also evident from the average area per transfer that the turnover has been mainly in small and medium holdings:—

TABLE XLI

Average Acreage per Transfer

Year	Average	Year	Average	Year	Average	Year	Average
1917–18	253	1921–22	190	1925–26	215	1929–30	201
1918–19	208	1922–23	305	1926–27	243	1930–31	211
1919–20	235	1923–24	216	1927–28	256	1931–32	241
1920–21	249	1924–25	238	1928–29	275	1932–33	210

Average 1917-18 to 1932-33 = 233½ acres.

Mr. D. G. Clark, Commissioner of Inland Revenue, stated in his evidence before the 1924 Royal Commission on Land and Income Taxation (p. 33) that the operation of mortgage exemptions in the lower reaches of the graduated land tax was a great encouragement to land speculation in holdings up to £8,000 unimproved value or a little larger. To this it must be added that such holdings were more numerous, and were more keenly desired than larger areas, and although the tax exemptions placed these holdings in a relatively favourable saleable position, the bulk of farm trading would in any circumstances concentrate on these areas. The extension of public works, and the provision of easy land finance, operated in the same general direction; it supported rising land values and encouraged the speculative tendencies inherent in a large section of our farming community. The combined influence of these factors operating on the basis of a highly efficient and simple land transfer system, and in a community where small cash deposits were found to be acceptable, was apparently irresistible. Government finance and private finance alike have exerted their influence in the same direction, and of the two private finance has been the more important in magnitude. The competitive nature of our Commercial Banks and our Stock and Station Companies is highly important in this respect. The competitive scramble for accounts, and the prodigal ease with which advances of all sorts were made in prosperous times demonstrate the dangers of an unorganized finance system. But however various and complicated the contributory causes of land speculation may be, the farmer cannot play the rôle either of simpleton or of injured innocence. As Condliffe tersely remarks: 'The fact is that land speculation in New Zealand is firmly rooted in the desires of the farmers themselves.'[3] In extenuation, it must be urged that the farmers of the period beginning with the war had a tradition of rising land-values to support their optimism, and might fairly have expected better guidance from responsible institutions. In the future, farmers will be able to ask that their own recent strenuous endeavours to meet the

3. *New Zealand in the Making*, pp. 253-7.

situation and repair the damage shall be complemented by a similar earnest reorganization on the part of our great financial bodies.

The importance of trading in farms in this country is, after all, best seen in periods of comparative stability. A surprisingly large volume of transfers takes place whatever happens to prices. Even in the post-war period, after the peak and before the present collapse, when the future of prices was uncertain, transfers averaged annually about 4½ per cent. of the occupied area, or about 8 per cent. of the freehold land, and the average of the pre-war years since 1901 is of much the same order. This illustrates, more than anything else, how persistent farm trading has become here. Periods of prosperity and recession accelerate and retard a process which has apparently become established in our rural economy.

There are considerable variations in the rate of turnover in different districts. As an approximate measure of this, the area of transfers in any year multiplied by one hundred has been divided by the area of 'freehold' land in the same year, i.e., by occupied area less Crown leases. The 'freehold' divisor is obviously too big, and therefore understates the percentage turnover, but over a period of years it remains remarkably constant, and so affords a better comparison of the same district at different times than of different districts at the same time.

TABLE XLII

Estimated Rate of Farm Turnover, Expressed as Per Cent. of 'Freehold' Land

District	1916 %	1919 %	1921 %	1924 %	1927 %	1931 %	1933 %
Auckland	13·5	12·5	25·0	8·0	11·5	6·0	6·0
Gisborne and Hawke's Bay	6·5	7·5	13·5	5·0	6·5	6·0	4·0
Taranaki	12·5	12·0	27·0	10·0	6·0	5·5	7·0
Wellington	13·5	9·0	21·0	8·0	6·5	6·0	4·0
North Island	11·5	9·5	21·0	7·0	8·5	6·0	5·0
Nelson	7·5	9·5	20·0	7·5	10·0	4·5	3·0
Marlborough	14·0	4·5	9·5	7·5	5·0	6·5	4·0
Canterbury	8·0	5·0	13·0	5·0	6·0	5·0	3·5
Otago	10·0	8·5	22·0	12·5	15·5	7·5	6·0
Southland	9·5	8·0	15·0	6·5	6·5	6·5	5·5
South Island*	9·5	6·5	15·5	7·5	8·5	6·0	4·5

*Omitting Westland—figures doubtful, but the area involved is very small.

The area affected in the North Island is much greater than that of the South Island. For the Dominion as a whole, the average area transferred in twelve years has been about 2,250,000 acres per annum, but the North

Island has accounted for about 64 per cent. of this total. The average annual turnover of Auckland alone is equal to nearly 90 per cent. of the whole South Island turnover. Wellington is next in ranking from the point of view of average area transferred. Hawke's Bay and Gisborne together, Canterbury and Otago show much the same annual turnover, followed in order by Southland, Taranaki, Nelson, Marlborough and Westland. The relative positions may be shown thus, using 10 to indicate the district with the lowest average area of transfers:—

Auckland	Wellington	Gisborne and Hawke's Bay	Canterbury	Otago	Southland	Taranaki	Nelson	Marlborough	Westland
350	200	140	140	135	80	70	40	40	10

When we turn to rate, as distinct from area, of turnover, the relative positions are altered, except that Auckland still retains first place. Taranaki and Otago show velocities of turnover nearly as great as that of Auckland, with Wellington and Nelson following. The remaining districts do not show marked differences on the average. The North Island as a whole has a higher rate than the South, although in the years since the boom the rates of turnover are not significantly different. From the available data, it seems clear that during the boom years a greater acceleration occurred in the North Island than in the South, and that since then the recession in the North has also been greater. At the height of the boom, speculative inflation affected about twice as much land in the North as in the South. In 1921, for instance, the area subject to transfer in the North Island represented nearly 70 per cent. of the total Dominion transfers, and although Otago and Nelson showed high rates of turnover the combined area of their transfers was small compared with that of the Northern districts. The generally higher rates of turnover in the North during peak years, combined with the larger areas affected, suggests that land speculation was more intense there, as well as wider-spread. On the whole, the 'younger' areas, those which have been brought in comparatively recently, or which have been converted into smaller holdings for such purposes as dairying, show a higher rate of turnover than the older-established districts.

IV. LAND MORTGAGES

The large turnover of farms is associated with heavy mortgage transactions. The only measure of the movement of this item over a period of years is the tabulation of mortgages registered under the Land Transfer Act. A useful distinction is made between 'country' holdings and 'town and suburban,' but the utility of these figures is materially

lessened by the fact that no similar distinction is made for mortgages discharged. Mortgages registered under Deeds Registration are not classified separately as 'country' or 'town and suburban' holdings. The figures available are defective also, because until 1929-30 the amount of duplication (in cases where the mortgaged property was situated in more than one registration district) was not known, and because the figures include 'collateral and guarantee mortgages not representing money indebtedness.'[4] But the omissions are more important. Many mortgages and many discharges are not registered. and the figures do not attempt to include credit advances secured by instruments under the Chattels Transfer Act. The statistics of land mortgages tell only part of the story, and are of no value except as an index of the movement over a period of years.

TABLE XLIII

Land Mortgages Registered

Year	Town and Suburban (Under L.T. Act) Millions of £	Country (Under L.T. Act) Millions of £	Total (Including Deeds Reg.) Millions of £
1915–16	2·4	16·0	22·5
1916–17	4·2	13·4	21·1
1917–18	3·3	11·6	18·1
1918–19	3·3	12·5	19·0
1919–20	9·7	30·9	48·4
1920–21	16·1	39·9	67·0
1921–22	10·7	17·7	34·8
1922–23	9·5	11·8	26·0
1923–24	15·5	15·9	37·9
1924–25	16·3	17·8	41·0
1925–26	18·0	21·8	47·1
1926–27	17·5	17·3	40·0
1927–28	15·6	13·8	33·2
1928–29	15·4	15·0	33·6
1929–20	18·9	17·7	39·8
1930–31	14·3	14·2	30·5
1931–32	5·8	6·8	?
1932–33	4·1	4·8	?

The great increases in land mortgage registrations during the peak years of the land boom and the subsequent recessions are clearly shown. Registration on country lands in particular in 1919 to 1921 attained unique dimensions, and accounted for practically 75 per cent. of all registrations under the Land Transfer Act. Since 1922 the registrations of 'town and suburban' land mortgages have very nearly equalled those on country properties. 'Town and suburban' registrations do not show a recession

4. *N.Z. Official Year Book*, 1931, 723.

from the peak in any way comparable with that of 'country' registrations. In the years 1915-19, country registrations were on the average four times as great as town and suburban, but the growing reluctance in recent years to invest money in rural ventures has altered the position entirely, until now country registrations are much the same as town and suburban.

Much more exact information in regard to land mortgages has been made available since 1928 under the land tax classifications (see *Statistical Reports on Prices, Wages—Land and Land Tax*" from 1928), but the figures for two years only are available.

TABLE XLIV

Land Mortgages Recorded for Land-Tax Purposes

Type	Year	Total Mortgages	Mortgages	
			Per Acre	Per £1,000 Unimproved Value
Country or Farming Lands	1928	£109,798,634	£4 13 9	£741
	1929	115,390,176	4 17 2	753
Town Lands or Business Sites	1928	32,570,612	87 12 5	708
	1929	37,433,262	127 17 6	634
Partly Country and partly Town Lands	1928	2,287,853	6 13 10	553
	1929	2,391,392	5 8 0	525

In this table no allowance has been made for cases where returns were not furnished. The inclusion of these raises the total of land mortgages on 'country or farming lands' to about £114,000,000 and £117,000,000 in the years 1928 and 1929 respectively, but does not affect 'mortgages per acre' or 'mortgages per £1,000 unimproved value.' On these figures, land mortgages represent approximately 75 per cent. of the unimproved value of country or farming lands, a proportion considerably higher than that for town properties.

It must not be forgotten that land mortgages are only one of the mortgage charges on property. In addition, there are the liens in force secured on stock, wool, crops and other chattels; but there is no way of even guessing at the magnitude of these charges. Whatever the exact situation may be, there can remain little doubt that New Zealand farming is a heavily-mortgaged occupation, and the overhead charges from this source constitute a chief burden on farmers in depressed times. The evidence available suggests that in boom times the normal rapid turnover of land was greatly accelerated, and that easy finance assisted the scramble for land by accepting a smaller proportion of the purchase price in cash

and carrying a larger proportion on mortgage. If this is so, the boom weakened the economic structure of farming, not only by inflating land values but also by narrowing the margin of equities and making the chief industry of our country more than ever susceptible to the pressure of falling prices.

CHAPTER XI

AGRICULTURAL LABOUR IN NEW ZEALAND[1]

BY H. BELSHAW

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I. General Conditions—A. Farm Population—B. Absence of an Agricultural Proletariat—C. Factors Influencing Supply of and Demand for Labour—D. Status of Labour on Farms—E. Share Farming. II. Changes in Number of Hired Workers. III. Terms of Hiring. IV. Seasonal Labour. V. Wages. VI. Organization of Agricultural Labourers.

I. GENERAL CONDITIONS

A. FARM POPULATION

THE estimated mean population of New Zealand for the year ended March 31, 1930, was 1,477,494. For the year 1929-1930 the total farm population was returned as 345,770, or about 23 per cent. of the total population. Of this number, 138,121, or about 40 per cent., were actually engaged in farm work, of whom the majority (105,210) consisted of occupiers and their families. The total number of farm employees not members of occupiers' families consisted of 31,427 males and 1,484 females. These figures are illuminating, for they indicate a farm economy markedly different from that of most other countries, and certainly far removed from the ideal envisaged by the early attempts at colonization on the Wakefield Plan between the years 1840 and 1850.[2]

B. ABSENCE OF AN AGRICULTURAL PROLETARIAT

These attempts endeavoured to establish a rural economy in which an agricultural proletariat formed an important element. Early difficulties frustrated the efforts of the New Zealand Company and its offshoots to establish a nicely-rounded system of agriculture based on a sufficiency of hired labour, but in any case political and economic conditions would have forced development far away from the Wakefield ideal.

Despite the great importance of farming industries, it is almost true to say that there is no agricultural proletariat in New Zealand. It is certainly true that there is no hereditary class of farm labourers. This is perhaps typical of most young countries, but there are probably few in which hired labour, except perhaps seasonal labour, is of less importance. Nevertheless, agricultural labourers are probably the most important group

1. The writer desires to acknowledge the assistance of Mr. F. B. Stephens in collecting information, and of secretaries to Trades Unions who furnished information in reply to a questionnaire.

2. Cf. Condliffe: *New Zealand in the Making*, Ch. 1. See also Chapter I of the present work.

in point of numbers.[3] Of great significance, also, both from the economic and the social point of view, is the small importance of female labour. During the season 1928-1929, only 12 per cent. of the females living on farm holdings were engaged in farm work apart from domestic duties. Hired female workers composed only 1 per cent. of the total of females on farms. Prior to the world crisis the importance of female labour declined, largely owing to the increased use of milking machines on dairy farms, which employ by far the largest number of female workers.[4]

C. Factors Influencing the Supply of and Demand for Labour

The nature and organization of labour supply is, of course, primarily dependent on the types of farming and the organization of farming industries. These in turn are determined mainly by conditions of soil and climate and by marketing conditions, though *general* economic and political factors, particularly as they affect the supply of hired labour, are of considerable importance. Thus it has been the policy of successive Governments to discourage land aggregation and encourage subdivision into small or moderate holdings, both directly by progressive land taxation and the method of alienation of Crown lands, and indirectly by granting financial assistance. Further, except of recent years, finance for settlement has been readily available from private investors, commercial concerns and financial institutions. Hence it has been possible for men of comparatively small resources to take up holdings. This has encouraged the development of a type of farm requiring little hired labour. On the other hand, wage rates have been lower and conditions of work have normally been less satisfactory than in other occupations.[5] Hence there are comparatively few who regard wage labour on farms as a satisfactory permanent condition. The majority become farm labourers with the intention of gaining experience to take up farming, or because no better job offers at the moment. In consequence there is considerable mobility amongst agricultural workers, who seldom stay on any one farm for long.

The difficulty of obtaining satisfactory hired labourers who are likely to remain for any length of time with one farmer, though itself a consequence of the factors referred to above, has also been a condition

3. According to the census of 1926 the number of wage earners was as follows in April of that year:—

Agricultural and pastoral	52,010	Metal workers and engineering	16,017
Hotels and restaurants	43,059	Sawmilling, forestry, etc.	14,111
Land transport	28,499	'Other manufactures'	12,366
Building and construction	22,822	Mining and quarrying	8,106
Food, drink, etc.	19,054	Paper manufacture and printing	7,319
Shipping and cargo workers	16,146	Textile and weaving	4,844
Clothing and drapers manufact.	16,314		

4. In 1928-1929 the figures showing the number of farms were as follows:—

Holdings mainly agricultural	1,721	Pastoral and other	6,142
Dairying	17,861		

It is possible that female family labour may have replaced some hired male labour during the crisis, but no information is available to the writer on this point.

5. On this point see Table L below.

making for a type of farming which can dispense with hired labour.[6] The combined influence of the above conditions has revealed itself in the growing relative importance of the dairying industry, which relies less on hired labour than the agricultural and pastoral groups, and in which the representative unit tends to be the family farm. The extent of this movement will be clear from earlier chapters.

The progress of dairying is of some importance from the standpoint of farm employment. Since grass is the main crop, and cattle are not normally housed in winter, the labour required to produce a given value of product is probably much less than in European countries; but it is much greater than in agriculture or sheep farming. Hence the growth of dairying has resulted in a larger increase in farm population than would have followed from a similar expansion in the agricultural and pastoral groups. Table XLV must be regarded as only approximately correct, but it serves to show the great and increasing relative importance of dairying as a source of employment.

TABLE XLV

Total Numbers Occupied, Including Working Proprietors and Managers, in Certain Years, 1900-1901 to 1928-1929

(in thousands)

Year	Holdings Principally Agricultural		Holdings Principally Dairying		Pastoral and Sundry		Total	
	Males	Females	Males	Females	Males	Females	Males	Females
1900–01 ..	63		9		12		—	
1910–11 ..	49		26		27		—	
1914–15 ..	21	4	31	14	47	9	98	29
1919–20 ..	14	3	42	19	45	10	101	32
1924–25 ..	11	2	51	23	41	9	103	35
1928–29 ..	12	1·7	57	18	44	6	113	26

Further, the scale of operations in dairying is, in general, smaller than in agricultural or pastoral production, and the dairying unit tends to approximate more closely to the family farm. Hence the effect on the demand for hired labour has been less than would have resulted from a similar expansion in the volume of output, or in the total numbers engaged in agricultural or pastoral farming.

D. STATUS OF LABOUR ON FARMS

It is difficult to obtain reliable data as to the relative importance of family and hired labour in different branches of farming at the present time, but Table XLVI shows the status of farm workers as revealed by the census of 1926.

6. It may be mentioned in passing that the desire to dispense with hired labour as far as possible has been one factor encouraging the increased use of farm machinery, economizing in the use of labour.

TABLE XLVI

Status of Farm Workers on Different Types of Farm as Shown by the 1926 Census

Type of Farm	Employers of Labour	Working on own Account	Relatives assisting but not in Receipt of Wages	Wage Earners	Wage Earners Unemployed	Not Specified	Total
	Males						
Agricultural ..	736	794	282	1,549	32	5	3,398
Sheep	3,274	2,515	596	8,419	171	24	14,999
Dairying ..	5,694	11,480	2,871	7,502	106	29	27,682
Mixed farming ..	10,786	18,877	5,080	23,612	822	302	59,479
Fruit	569	1,007	86	1,146	25	5	2,838
Market gardens ..	355	898	40	794	43	9	2,139
	Females						
Agricultural ..	36	17	—	3	1	—	57
Sheep	144	40	4	73	—	—	261
Dairying ..	299	499	215	247	1	—	1,261
Mixed farming ..	569	530	104	197	3	9	1,412
Fruit	43	29	19	140	1	1	233
Market gardens ..	7	8	4	4	—	—	23

The basis of classification is different from that adopted in Table XLV, so that comparison is not easy. In particular, the introduction of 'mixed farming' as a class raises difficulties, since this would be subdivided under the headings (principally) agricultural, pastoral and dairying in the previous table. The group 'wage earners' must also include relatives assisting and in receipt of wages, so that it does not comprise farm labourers only; nevertheless, as the following comparison will indicate, it is clear that the relative importance of hired labour, other than paid family labour, is much less in dairying than in other groups:—

TABLE XLVII

Relative Importance of Hired Labour on Different Types of Farms as Shown by the 1926 Census

Type of Farm	Employers, workers on own account, and relatives assisting but not in receipt of wages			Workers in receipt of wages, including those unemployed and members of families		
	Males	Females	Total	Males	Females	Total
Agricultural ..	1,812	53	1,865	1,581	4	1,585
Sheep	6,385	188	6,573	8,590	73	8,663
Dairying	20,045	1,013	21,058	7,608	248	7,856
Mixed	34,743	1,203	35,946	24,434	200	24,634
Fruit	1,662	91	1,753	1,171	141	1,312
Market gardens ..	1,293	19	1,312	837	4	841

For each 100 employers, workers on own account and relatives, there are about 84 paid workers in agriculture, 131 in sheep farming, 68 in mixed farming, and only 36 in dairying. On the other hand, 448 out of 670 paid female workers are in the dairying and mixed farming groups.

E. Share Farming

In the season 1929-1930, 781 holdings out of a total of 85,167 were recorded as being occupied by share farmers. Of the remaining holdings, 83,164 were occupied by owner or lessee, and 1,222 by managers. Share farming is confined mainly to dairying, the practice being rare in other branches of farming. All except 139 holdings were in excess of 100 acres in area, so that the representative share-farming unit is fairly large.[7]

Share holdings fall into two main classes, though within these classes there will be considerable variations.[8] In the first class, land, buildings and plant are owned by the landlord, while the herd and all labour is supplied by the tenant. Usually one-third of the proceeds from butterfat goes to the landlord, who, in addition, frequently obtains a proportion of other revenue. Usually, the landlord meets some part of the cost of fertilizers.

In the second class, the landlord supplies all the capital, including land, buildings, plant and herd, and may provide labour to assist in harvesting hay or ensilage. The landlord normally receives two-thirds of the net proceeds. Both types of agreement frequently include optional or compulsory purchasing clauses.

Generally the standard of farming is less efficient than under either the freehold system or cash tenantry, and capital and improvements are apt to deteriorate.

In many instances, share farming is regarded as a step towards occupying ownership, and in normal times is a useful means of obtaining the necessary capital, but of recent years there has been a tendency for a permanent share-holding class to develop in some districts.

Landlords usually consist of retired farmers or farmers who hold an area larger than they wish to occupy and cultivate themselves.

II. CHANGES IN NUMBER OF HIRED WORKERS

Of recent years there is reason to believe that there has been a substantial decline in the number of agricultural wage earners, but it is difficult to verify this by adequate statistics. According to the census

7. The following statistics throw some light on the nature of the farming operations:—

Number of holdings	781
Area occupied (acres)	150,001
Total cattle	70,234
Sheep shorn	12,687
Lambs tailed	7,869

8. After F. B. Stephens: 'The Organization of Dairy Farming in the Waikato, New Zealand.' (Unpublished M.A. Thesis, Auckland University College.)

returns of 1926 there were some 44,680 workers in receipt of wages on the date of the census, but this total includes relatives in receipt of wages, as well as unemployed wage earners. Figures for employees not members of familiies are available for the years 1928-1929 and 1929-1930 only. These support the view that the number of wage earners has tended to decline.

TABLE XLVIII

Farm Employees Not Members of Families

Year	Males	Females	Total
1928–1929	32,713	2,760	35,473
1929–1930	31,427	1,484	32,911

Since 1929-1930 it is probable that there has been a further considerable decline in the number of employees not members of families. The fall in female workers is possibly accounted for in part by greater precision in the definition of female employees,[9] but there is no doubt that a decline in numbers has occurred, apart possibly from workers engaged under unemployment schemes, and it is tolerably certain that this movement has been taking place for some time, particularly on dairy farms. A number of factors account for this decline. Of paramount importance is the increased use of fertilisers for the top-dressing of pastures, and of machinery and electrical power which economises in the use of labour. In consequence the prolificacy of pastures has increased considerably, and the need for cultivated, supplementary crops has been reduced. The net result has been a reduction in demand for labour, since the care of pasture crops requires less labour than does the cultivation of arable crops. The demand for ploughmen, for example, has practically disappeared in some dairying districts.

While, in part, the increased use of machinery and power is indicative of an expansion of operations requiring some increase in labour, yet in large measure it represents an attempt to reduce expenses by economising in labour. This has resulted partly in a reduction in the amount of female family labour, partly in a reduction in hired labour, and partly in a change in the type of labour. These changes are most strongly marked in dairying, and less marked in sheep and arable farming. The subdivision of farms has operated in the same direction, both because it has led to (at least) a partial transition to dairying, in which the economies consequent on the use of power and machinery are strongly marked, and because the need for female (family) labour or hired labour becomes less great. Dairy farmers operating on a small or medium scale, when they are unable to dispense entirely with hired labour, prefer to engage a youth,

9. Cf. *New Zealand Official Year Book*, 1932, p. 370.

rather than a mature man or married couple. Not only is the wages bill thereby reduced, but also the necessity is obviated of finding a house for a married couple. Consequently married men find it increasingly difficult to obtain satisfactory employment.

A further factor of importance is the difficulty, at least prior to the crisis, of obtaining satisfactory hired labour, owing to the competition of town jobs which offer higher wages and more congenial conditions of employment. The youth of twenty who requires more wages is discharged and another youth takes his place. With the advent of machinery, a greater mechanical aptitude is required than in the past, but the type of skill which needs the slow accumulation of experience is less necessary. Maturity and responsibility are less important. Consequently, in dairying at least, the farmer tends to be satisfied, or at least to put up with, youthful employees. To them, farming is a blind-alley occupation, and they must go elsewhere when they desire adult wages. When they are seasonally unemployed, they drift to the cities, and, if placed, remain there. For these reasons there is a growing disinclination to seek employment on the land.[10]

For some time prior to the economic crisis the public works policy of the Government also tended to draw workers away from farming. The Government paid full award rates on relief works, and complaint was very general that the policy made it increasingly difficult for the farmer to obtain hired labour.[11]

III. TERMS OF HIRING

Farm labourers are, in the main, recruited through private labour agencies and stock and station agents, and by newspaper advertisements; normally, very little use appears to be made of Labour Bureaux, though they have been used to an increasing extent since the depression, because they have been the local centres of the Unemployment Relief

10. The age compositions of workers on farms is, again, difficult to arrive at. The census figures for 1926 give the age compositions as follows:—

Age (years)	Males	Females
Not specified	224	5
Under 14	196	5
14-16	2,669	80
16-21	16,477	406
21-25	11,097	198
25-35	22,721	299
35-45	23,507	571
45-55	20,700	775
55-65	12,540	620
Over 65	6,822	497
Total	116,953	3,396

These figures include occupiers and their families, as well as hired workers, and cover Government employees (males 621, females 23). Out of a total of 19,342 males under 21 years of age, 10,514 are on mixed farms and 5,207 on dairy farms. Out of a total of 491 females under 21 years of age, 267 are on dairy farms and 114 on mixed farms.

11. The monthly average of persons employed on public works in 1930 was 10,867, as against 6,765 in 1925, and 3,993 in 1920.

organization. The terms of hiring naturally vary from district to district, and from industry to industry. In all types of farming the more responsible and highly-skilled jobs will be undertaken by permanent employees. This applies especially to married workers, who are naturally less mobile. Single men are frequently difficult to hold even for a complete season. Thus, in dairying districts, it is common to offer a bonus of as much as 5/- per week to employees who will stay for a full season; but very few earn the bonus, as there is generally friction towards the end of the season.

In districts close to villages, or where small farms exist in proximity to larger holdings, casual labour is common. Manual labourers in small centres of population are usually very versatile, and can turn their hands to most of the farming operations for which casual labour is appropriate. Many of the workers engaged permanently by one farmer may be properly described as casual, since they are frequently engaged only when the weather is suited to the work for which they are needed. In other cases they will be paid a weekly wage.

IV. SEASONAL LABOUR

The demand for seasonal labour, which is most important on sheep and arable farms, is met, partly by casual labourers, partly by migrating labour operating individually or in 'gangs.' Threshing has in the past usually been performed by gangs working a fairly well-defined district with a traction engine and threshing machine.[12] Shearing, and to a less extent harvesting, are performed largely by gangs who frequently work from North to South, following the season, and who travel considerable distances. Many of these come across from Australia, but probably the majority are from towns in New Zealand and return to town occupations or to swell the ranks of the unemployed when the season is over.

Labour utilization for shearing in the case of sheep farming depends to a large extent on the size of the farm. The gang system is used in districts where there are a number of large sheep stations. The gangs travel their districts shearing each owner's sheep by contract, in a prearranged rotation. A large gang may comprise twelve or more shearers, shed hands, pressers, a machine expert, a wool classer, and a cook. Division of territory between gangs is often arranged by a district representative of the Shearers' Union. When shearing is completed on the larger stations, the gangs generally disband, the members seeking work at the sheds of the smaller flock owners.

The gang system, particularly where territorial specialization is practised, reduces labour competition to a minimum and is highly economi-

12. This applies less now than formerly. New types of machine permit threshing and harvesting to be done more readily by farmers, while there has been some tendency for local farmers to co-operate for shearing in some districts.

cal as regards time and travelling. To the owner it provides a complete labour organization upon which he can normally rely; but he has to be ready to shear when the gang arrives, otherwise he loses his place in the rotation and may have to wait a long while for their return, or make other labour arrangements.

The gang system is seldom used except on large stations. The medium flock owner requires a smaller shearing force, and is as a rule accessible to fairly settled districts where labour is usually available when he requires it. He generally has his own shed equipped with shearing stands and provides some labour from the permanent farm staff. The small flock owner, on the other hand, seldom has his own shed. The practice, therefore, is for a number of such farmers (usually mixed farmers) to form themselves into groups, the sheep being shorn in a shed belonging to a member of the group. As a rule no hired shearers are employed, the members of the group assisting each other in rotation.[13]

There is also considerable movement from the shearing shed to the harvest field and to the freezing works. In the dairying industry, where seasonal variations are less marked, the labour requirements for making hay and ensilage are partly satisfied by co-operation among farmers themselves, though in some districts mobile gangs, many of which have their own light Ford trucks and camping gear, and so can move rapidly from place to place, assist in these operations. Gang labour also plays an important part, especially in the North Island, in clearing the land of bush, scrub or stumps, and fencing, and is sometimes used for grass-sowing and top-dressing. In certain parts of the North Island, parties of Maoris have contributed greatly to development in these ways and in shearing, crutching and mustering.

Much bush felling, drainage and fencing is also performed on contract by parties of Dalmatians, who make excellent workmen.[14]

V. WAGES

As already indicated, wages are appreciably lower in agriculture than in other comparable operations. This is clearly indicated by the comparison of award rates paid to manual labour in other occupations and to farm hands set out in Table XLIX.

Making no allowance for unemployment and short time, which in any case are difficult to take into account, it will be seen that the earnings of agricultural labourers are appreciably lower than those of general labourers in non-farming industries. The comparison with other classes of

13. The writer is indebted to Mr. D. O. Williams, Economist of Massey Agricultural College, for the above information in regard to shearing labour.

14. Hogwood: 'An Economic and Social Survey of the Waikato Valley' (unpublished M.A. Thesis, Auckland University College) gives an interesting discussion of gang labour in that area. Both Maoris and Dalmatians are more easily satisfied than British labourers with conditions of work and are less difficult to handle.

labour is still less favourable, since those selected for comparison are amongst the lowest-paid groups. It should be noted that the wages quoted for non-farming labourers are award rates, and that in some cases wages may be paid above the award rates. Of recent years, however, it is possible

TABLE XLIX

Unweighted Average Award Rates of Manual Labourers and Estimated Money Wage Rates of Farm Workers (in Four Principal Districts) at March 31, 1930, and March 31, 1932

Non-farming Occupations	Weekly Wage		Farming Occupations	Weekly Wage	
	March 31 1930	March 31 1932		March 31 1930	March 31 1932
	s. d.	s. d.		s. d.	s. d.
Sawmilling, general hands	86 9	78 1	General farm hands (agricultural) ..	69 0	45 5
Skin and leather working, general hands ..	85 8	77 1	Ploughmen ..	70 0	48 8
Mineral and stone working, general hands ..	87 4	78 7	Shepherds ..	80 0	49 11
Mining, surface labourers	87 7	78 10			
Builders' labourers ..	82 6	74 3	Dairy farm hands	69 0	43 5
Meat freezing, general hands	91 8	82 6			
Butter factories, general hands	81 9	73 9			

that award rates are maxima in the great majority of cases. Wages of farm employees include board and lodging, which is estimated at 30/- per week. This allowance seems much too high, so that the above comparison is unduly favourable to farm employees.[15] While it is difficult to arrive at a proper basis of estimation, an allowance of 25/- per week would be very generous.[16] On the other hand, most farm employees obtain higher rates during harvest or shearing, and this would increase somewhat the average weekly wage.

The disparity between agricultural and other wages is common to most countries, and for reasons which are of general application. In New Zealand, as in most other countries, wages and conditions of work are

15. In regard to the discussion on the allowance of 30/- per week for extras Mr. J. W. Butcher, Government Statistician, writes as follows:—

'When the special collection of data as to wages of farm labour was taken in 1929 it was found that the wage rate in cases where no extras were provided in addition to a money wage, was, on the average, approximately 30/- above that where board and lodgings were supplied. At this stage it may be as well to point out that the "extras" apply in many cases to wife and/or family as well as to the worker himself.

'The collection referred to was made as part of the search for necessary data to permit of a revision of the wage-rate index numbers; and in the new series of index numbers the allowance of 30/- was taken as representing the value of board and lodgings to farm labourers in 1929. A combined food, rent and fuel and light retail price index number was compiled back to 1914, with a base 1929 = 1000; and the allowance made for board and lodging fluctuates in sympathy with the movements in this index, taking 1929 = 30/-. The allowance is worked out each year to the nearest shilling.

16. University students can obtain good board and lodging in the main centres for 25/- per week, or less. Dr. I. W. Weston, of Lincoln Agricultural College, also considers that 25/- is a very generous allowance.

determined mainly by individual bargaining. On December 31, 1925, there were only 2,903 agricultural and pastoral workers on the roll of registered unions, or about 6 per cent. of the total number of wage earners in these groups, as disclosed by the census of 1926. By December 31, 1929, the number had increased to 6,219, who were members of 12 registered unions. The percentage of union members is therefore still very small. By and large, the method of collective bargaining does not apply, and individual agreements operate. Further, except in the case of shearers, shed hands, musterers, packers, drovers and threshing-mill hands, farm employees are not covered by awards of the Arbitration Court, and do not enjoy its protection.

Owing to his fairly high degree of mobility, the (single) farm hand is more independent than in many other countries, but the weakness of such trade unions as exist, and the fact that wages and conditions of work are not covered by the Industrial Conciliation and Arbitration Act leave him still in a weak bargaining position.[17]

During 1929 a special enquiry was conducted, to ascertain how closely wages actually paid corresponded to wages as returned by officers in charge of Government employment bureaux. For the purposes of the enquiry, schedules were sent to all farmers employing five hands or more, and some 800 returns, representing slightly less than half of the total, were made. The actual average rates (as set out in the Table L) are somewhat greater than those returned by officers of the employment bureaux. This is only to be expected, since a farm employing five or more hands is scarcely representative, and it is practically certain that the inclusion of wages paid in small and medium farms would bring down the average.

Wages of permanent hands do not take into account employment at somewhat higher rates during shearing and harvesting, or the payment of a bonus for such work. As might be expected, the wages paid to different classes of labour show wide differences. Shepherds, who are amongst the most highly skilled of the permanent employees, receive appreciably higher wages than any class except station cooks, while seasonal labourers—harvesters, shearers, musterers and cooks (at shearing)—are paid at much higher rates than permanent hands. This is accounted for, partly because the work is urgent and farmers are in keen active competition with each other so that the bargaining strength of the wage earner is increased, partly because the work is usually more arduous, and partly because time is lost in moving from one job to another. Where the labourers operate in parties this tends to increase their power in collective bargaining and helps to set the competitive wage standard.

The money estimate of the value of board and lodging and other

17. The Amendment to the Industrial Conciliation and Arbitration Act of April, 1932, replaced compulsory arbitration by a system of compulsory conciliation and voluntary arbitration.

payments in kind to permanent employees as indicated by the difference between the figures in the first and third columns appears to vary between 28/- and 33/- per week. As already indicated, the official estimate used to calculate the money value of total wages is 30/- per week, and is based on the above difference as revealed by the special enquiry. It seems clear that the money value placed on board and lodging by the employers covered by the inquiry is higher than its money value to a single man, since these could be obtained even in towns at a much lower figure.

TABLE L

Wages of Agricultural Labourers in 1929

Type of Farming and Class of Labour	Money Wage Rates Per Week*		
	Board and Lodging Supplied	Free Housing	No Extras
AGRICULTURAL FARMING—	s. d.	s. d.	s. d.
Ploughmen	42 0	60 0	70 0
Harvesters	1 10¾†	—	1 11¾†
General hands	41 0	63 0	69 0
DAIRY FARMING—			
General hands	38 0	57 0	69 0
PASTORAL FARMING—			
Shepherds	50 0	68 0	—
Shearers	29 0‡	—	34 0‡
Musterers	107 0	—	119 0
Fencers	55 0	—	74 0
Cooks (station)	68 0	—	—
Cooks (at shearing time)	94 0	—	—
Cowboys	29 0	—	39 0
General hands	41 0	59 0	74 0
GENERAL—			
Married couple (where wife cooks for station hands)	73 0	—	—

*Except for harvesters and shearers. †Per hour. ‡Per one hundred sheep shorn.

The average rates quoted above cover considerable variations from district to district, and even from farm to farm, not only in money rates, but also in the value of allowances of various kinds, on whatever basis these are computed.

In Tables LI and LII the changes in agricultural and pastoral wages[18] are compared with the Dominion average for all industrial groups combined.

It will be seen that agricultural and pastoral wages are appreciably below the average for all groups throughout the whole period. Farm wages are about 82 per cent. of the average in 1914, and about 86 per cent. in 1920. By 1922 the percentage has fallen to about 73, and thereafter rises to about 80, where it approximately remains till 1927. The sharp rise in agricultural wages in 1928 is partly accounted for by an increase in the wages of shearers and shed hands, partly by an increase in the wages of permanent

18. Including an allowance to cover the value of board and lodging, where provided.

workers as revealed by the special enquiry. It is probable also that the competition of relief works on full award wages was an important factor. During the whole period 1922-1929, agricultural wages, as well as the

TABLE LI

Index Numbers Showing Relative Levels of Money Wages (Males) in Agriculture and in All Industrial Groups Combined, 1914 and 1920-1931 (Base of both series: Dominion weighted average wages for all industrial groups combined in 1909-1913 = 1000

Year	Agricultural and Pastoral	All Industrial Groups Combined
1914	883	1066
1920	1332	1550
1921	1237	1666
1922	1198	1636
1923	1297	1612
1924	1307	1634
1925	1305	1659
1926	1331	1683
1927	1378	1710
1928	1581	1765
1929	1584	1767
1930	1576	1772
1931	1379	1644

TABLE LII

Index Numbers Showing Relative Movements of Money Wages (Males) in Agriculture and in All Industrial Groups Combined, 1914 and 1920-1931 (Base of each series: Dominion weighted average for that series in 1914 = 1000)

Year	Agricultural and Pastoral	All Industrial Groups Combined
1914	1000	1000
1920	1508	1454
1921	1401	1563
1922	1357	1535
1923	1469	1512
1924	1480	1533
1925	1478	1556
1926	1507	1579
1927	1561	1604
1928	1790	1656
1929	1794	1658
1930	1785	1665
1931	1562	1542

average of all groups, showed some tendency to rise, farm wages rising in sympathy with general wages. In general, however, as is revealed by the fall in wages in 1921 and 1922, and especially in 1930, farm wages are more susceptible to conditions of depression than are wages in general. This is in accordance with what might be expected, since farming industries feel the influence of depression first and bear the main brunt of it, while

wage earners in other industries are protected by awards of the Arbitration Court. To some extent, therefore, the Arbitration Court is a factor increasing the disparity between agricultural and other wages during depressions through the protection it gives to other workers.

The movement in effective (real) wages is shown in Tables LIII and LIV.

The real wages of agricultural workers are appreciably below the average for all groups during the whole period; real wages were some 8 per cent. higher in 1931 than in 1914, the average of all groups being about 7 per cent. higher than in 1914.

The depression has brought about an appreciable fall in farm wages, and the disparity between agricultural wages and wages in general has been increased.

TABLE LIII

Index Numbers Showing Relative Levels of Real Wages (Males) in Agriculture and in All Industrial Groups Combined, 1914 and 1926-1931

(Base of both series: Purchasing power of Dominion weighted average wages for all industrial groups combined in 1914 = 1000)

Year	Agricultural and Pastoral	All Industrial Groups Combined
1914	828	1000
1926	777	982
1927	811	1007
1928	926	1034
1929	929	1037
1930	946	1066
1931	897	1069

TABLE LIV

Index Numbers Showing Relative Movements of Real Wages (Males) in Agriculture and in All Industrial Groups Combined, 1914 and 1920-1931

(Base of each series: Purchasing power of Dominion weighted average for that series in 1914 = 1000)

Year	Agricultural and Pastoral	All Industrial Groups Combined
1914	1000	1000
1920	849	819
1921	790	881
1922	850	961
1923	930	957
1924	923	956
1925	911	959
1926	926	970
1927	967	993
1928	1106	1023
1929	1121	1036
1930	1143	1066
1931	1082	1069

VI. ORGANIZATION OF AGRICULTURAL LABOURERS

As in most other countries, it has been found extremely difficult to organize farm labourers into industrial unions, and the number of trade unionists is small. This is shown by the following figures:—[19]

TABLE LV

Proportion of Organized Workers in Agriculture

All Wage Earners in Agriculture		Agricultural Workers on Roll of Registered Unions		
Date of Census	Number	Date	Number	Per Cent. of All Agricult. Workers
April, 1921 ..	55,549	Dec. 31, 1920 ..	1,798	3
April, 1926 ..	52,010	Dec. 31, 1925 ..	2,903	6
—	—	Dec. 31, 1931 ..	6,434	—

These figures show some improvement, but the progress has been very slow, pointing to the existence of serious hindrances. In April, 1931, there were nine unions comprising purely farm workers, and two general unions including farm workers but not limited to them. Membership is mainly composed of shearers, shed hands, harvest hands, threshing-mill and chaffcutter employees, shepherds, musterers and drovers. Ordinary farm hands are, in the main, unorganized. The two general unions referred to, the Waimate Workers' Industrial Union of Workers, and the New Zealand Workers' Union, include public works employees and other manual workers, as well as farm employees. The New Zealand Workers' Union is the only national organization which makes provision for agricultural workers, and includes the bulk of the trade union members.

The prime difficulties facing the organization of agricultural workers into unions has been the refusal of the Arbitration Court to make awards governing the conditions of work on farms, the scattered distribution of the workers, and the individual and personal nature of the relations between employer and employee. The physical difficulties involved in organizing scattered individuals who may be victimised if they form a union are enhanced by the fact that no substantial benefit can be pointed to, in the absence of Arbitration Court awards. In other occupations it has been possible in the past to organize small and scattered groups because substantial advantages could be shown to accrue from the operations of the Arbitration Court, but the Court has persistently refused to extend its protection to farm workers. It is significant that such classes of workers as shearers, shed hands, and threshing-mill employees, the nature of

19. The corresponding percentages for other industrial groups in 1926 were:—

Food and drink	61	Metal and engineering	37
Clothing and drapery	37	Other manufactures	16
Textile and weaving	39	Mining and quarrying	40
Building and construction	65	Hotels and restaurants	18
Sawmilling and forestry	43	Land transport	57
Paper manufacturing and printing	37	Shipping and cargo working	67

whose occupations brings them together in groups, and who have obtained some recognition by the Court, are the groups most susceptible to trade union organizations.

Application for an award to cover general farm labourers was first made in 1908. The Court refused the application, but recommended, though without much effect, that workers should have a weekly half-holiday, and at least one week per quarter on full pay. Subsequent applications met with a similar fate. Shearers, shed hands, musterers, packers, drovers and threshing-mill hands are, however, covered by awards of the Court.

The workers' case for inclusion under awards has been based (as for example in 1925) on the arguments that farm workers are underpaid; that the industry can afford to pay a higher wage; that workers are entitled to similar conditions as regards hours of work to those affecting other employees, and to proper holidays; that employment should be made as attractive in the country as in the towns; and that there are no means of enforcing collective agreements except through the Court. It is argued that, since awards cover many groups of farm workers, such as those referred to above, there is no reason why all farm workers should not be covered.

The 1925 application was objected to by the employers' representative on the grounds that previous investigations by the Court in 1908 and 1919 had revealed no grounds for the granting of an award, and that the conditions of agricultural workers were relatively as good as in previous years. It was further argued that existing relations between employers and workers were harmonious, and that there was no general demand for an award. In view of the scattered nature of the industry, and of variations in conditions of work and in allowances of different kinds, an award, even if granted, could not be enforced. The Court upheld the objections of the employers' representative, and concluded that it was not practicable to sustain awards fixing hours, wages and conditions under which farming is conducted. In consequence, farm workers still remain without the protection of the Court, and, in view of the prevailing depression in farming industries, there is little chance of their being covered. Indeed, of recent years, there has been strong pressure from farming interests, not only to exclude farming industries and associated industries, such as dairying manufacture, from the jurisdiction of the Court, but also to abolish *compulsory* arbitration altogether. In 1927 a Bill was introduced to exclude farm and associated interests, but this met with such strong opposition, including opposition from the larger co-operative dairy companies, that the Bill was dropped.[20] An amended Act was passed,

20. The dairy companies feared the loss which might result from the stoppage of work in factories, and preferred the peaceful settlement of differences by compulsory arbitration.

however, providing that no new award should be made covering such operations before September 1, 1928. These provisions were then re-enacted, but lapsed on September 1, 1929. In April, 1932, an amending Act was passed abolishing compulsory arbitration, and replacing it by a system of compulsory conciliation and voluntary arbitration. Thus, aided by the depression and the general demand for cost reductions, farmers and employers succeeded in their aim.

CHAPTER XII

TAXATION, GRANTS, AND SUBSIDIES IN RELATION TO FARMING

By H. R. RODWELL

I. Introductory. II. National Taxation—A. Land Taxation: 1. Historical; 2. Principles of Valuation; 3. Effects of Land Taxation—B. Income Taxation: 1. Historical; 2. Burden of Income Tax and Land Tax—C. Import Taxation: 1. Tariff Rates on Farm Requisites; 2. Tariff Protection of Farming—D. The Sales Tax. III. Local Taxation—A. System of Local Government—B. Local Body Finance: 1. Sources of Revenue; 2. Growth of Local Body Debt and Rates; 3. Local Body Expenditure—C. Road Construction and Maintenance: 1. General; 2. Main Highways Board. IV. Direct State Assistance—A. Agricultural Department and Agricultural Education—B. Railway Freight Reductions—C. Subsidies: 1. Wage Subsidies; 2. Miscellaneous Subsidies and Grants.

I. INTRODUCTORY

BROADLY speaking, the farmer is in the same position as other classes in the community in regard to taxation. He is now subject to both land and income taxation. Prior to 1915 incomes derived directly from the land were exempt from income tax, and in 1923 this principle was reaffirmed by legislation. In 1929, however, the farmer was required to pay either income tax or land tax, in the case of estates in excess of £14,000. Under the 1930 Act, both land and income tax were levied on farms of an unimproved value of £7,500 and over. In 1931, progressive land taxation was replaced by a flat rate of 1d. in the pound on the unimproved value of the land, certain exemptions being allowed, and incomes from farm lands of an unimproved value of £3,000 or over were made subject to income tax. Farmers are also liable for rates levied by the various Local Authorities.

Customs taxation is based on three main principles:—

(1) Free entry of essential raw material and equipment required by producers (including farmers);
(2) Preference to goods from British countries;
(3) Protection to local industries (including farming).

Where the first principle has come into conflict with the third, the protection tariff has usually been imposed, thus raising costs to the farmers. In very many cases this has proved a real burden, since it is not counterbalanced by effective protection to farmers' products. Although duties are levied on most agricultural and pastoral products produced in New Zealand, they do not confer any benefit since New Zealand has a very large net export of the commodities concerned. In some instances the retention of these non-effective duties has prejudiced New Zealand's trade

relations with other British and foreign countries. There is, however, one direction in which Customs tariffs have helped a section of the farming community. The sliding scale of duties upon wheat, first imposed in 1927, has been effective in maintaining the internal price of wheat at a level well above world parity.

II. NATIONAL TAXATION

A. Land Taxation

1. *Historical*

Taxation of land in New Zealand was not effectively introduced until 1891, although an abortive attempt had been made by Sir George Grey in 1879. The Land and Income Tax Act 1891 introduced the principle of progressive land taxation on the unimproved value of land, and had the double objective of bringing in revenue and breaking up the large estates. The failure of the tax as an instrument of closer settlement[1] led to a stiffening of the graduation and a checking of evasion under the Land and Income Assessment Act of 1907. Between 1907 and 1917 land tax consisted of a flat rate of a penny in the pound of unimproved value, and an additional graduated tax, ranging from 1/32d. on £5,000 value to 5-5/60d. on £200,000 or more. In 1917 a single progressive tax was substituted for these, rising from a penny to sevenpence in the pound plus a super-tax of 50 per cent. An additional tax of 50 per cent. of the whole of this amount was added in the case of absentees. In 1921 the maximum was raised to 7-17/20d. in the pound, but the super-tax was lowered to 33⅓d. per cent., with a rebate of 10 per cent. for prompt payment. The super-tax was finally abolished in 1924, while a reduction in the rate of taxation of 5 per cent. was made.

The main exemptions allowed since April, 1917, were:—

(1) Where the unimproved value of land does not exceed £1,500, an exemption of £500 is allowed, the exemption being reduced on values above £1,500 until it vanishes at £2,500;

(2) As an alternative to (1), where land is subject to a registered mortgage, an exemption was allowed of the whole of the mortgage where the unimproved value of the land is £10,000 or less, the exemption being reduced above £10,000 unimproved value until it vanished at £20,000. In 1929 this £10,000 was reduced to £7,500, above which the amount of the mortgage exemption diminishes until it vanishes at £15,000 of unimproved value. In 1931 the graduated scale of land tax was abolished and a flat rate of one penny in the pound of unimproved value of the land substituted, the above-mentioned exemptions being retained.

1. 'Before 1907 the scale of taxation in force had no very marked effect in breaking up the big estates.'—Le Rossignal and Stewart, *State Socialism in New Zealand*, p. 45.

In the case of private leases, the tax is payable by the owner. Some Crown lessees (e.g., those holding pastoral and small grazing-run leases) are totally exempt from land tax,[2] but in other cases the lessee must pay if his interest in the unimproved value of the lease exceeds £500. In valuing the lessee's interest, a true rent is computed at 5 per cent. of the value of the farm. If the actual rent paid by the lessee is less than the true rent the difference is capitalized at 5 per cent., and the resulting figure taken to be the value of the lessee's interest.

Joint owners are assessed jointly as regards land held in partnership and also severally in respect of each owner's interest in this and any other land. The same liability for joint assessment also applies to companies owning land if half of the paid-up capital or half (in nominal value) of the allotted shares of each company is held by or on behalf of shareholders in the other.

The Commissioner of Taxes has discretionary powers to grant remissions of taxation in special cases of hardship, but successful claims on these grounds are comparatively few. Where, however, a taxpayer's income does not exceed £300, and he is unable for any valid reason to earn further income, or where the payment of the tax would involve hardship on a widow with child dependents, exemptions may be granted.[3]

2. *Principles of Valuation*

The first attempt to value land and improvements separately was made in 1878, but until 1896 there was no uniform method of valuing land for taxation purposes. In 1893 ratepayers of local districts were given the option of rating on the unimproved value instead of the capital value of land. The resulting valuations arrived at by valuers employed by Local Authorities and by the different State Departments (i.e., for loan, taxation, etc., purposes) differed widely, the same property frequently having several values assigned to it. To overcome these obvious defects, a new department of State, known as the Valuation Department, was set up under the Government Valuation of Land Act 1896, and was charged with the duty of assessing the value of real estate for taxation and other purposes both of the general Government and of Local Authorities.

The department is directed by the Valuer-General, with a permanent staff of District Valuers who are responsible for the actual work of valuation. They appoint assistants who are not Government officials, but are employed as required for specific purposes. A valuation made by an Assistant Valuer is subject to endorsement by the District Valuer before being accepted by the Valuer-General.

There are three distinct 'values' assessed by the Valuers in regard

2. They were (and still are), however, subject to income tax.
3. D. W. Malloch: *Taxation Concerning the Farmer.*

to each property, namely: (1) unimproved value of the land; (2) value of 'improvements,' and (3) 'capital value.'

(a) *The 'Unimproved Value'* of land is defined as the value of the property less the value of improvements effected by the owner. But any increase in value due to the successful working of other lands in the district, or to State or Local Body expenditure on public works, or to the general prosperity and development of the country, forms part of the 'Unimproved Value' of the land. In this way the State taxes the community-created 'unearned increment' of land without actually absorbing it. The fact, however, that there has been no general revision of values since 1896, some values having actually stood since 1912 or earlier, indicates that this consideration has not been prominent as a principle of taxation in New Zealand. In any case, when prices are rising, valuations tend to lag behind selling prices of land.[4]

(b) *'Improvements'* consist of all value additions due to labour and capital expended by the owner or occupier of the land, and consist of buildings, fencing, planting, draining, private roads and water-races, clearing of timber, and permanent grassing. No work can, however, be considered an improvement if the benefit of it has been completely exhausted at the date of valuation. It is, in many cases, very difficult, if not impossible, to value improvements apart from the land itself. Much capital sunk in ploughing, cultivating, regrassing, etc., has become indistinguishable from the land itself, and consequently the attempt to arrive at an 'unimproved' value is somewhat arbitrary.

(c) *'Capital value'* is the fair selling-value in the open market, but not the auction value or value derivable at a forced sale.

Land containing or supposed to contain mineral deposits is valued as for the surface use only, and is of the same unimproved value as similar land in the neighbourhood until such time as the minerals are produced, when the profits (if any) are duly valued.

A valuation roll is prepared for each district, setting forth particulars of each property within the district. In the event of revision of valuations, the Valuer-General notifies each person on the roll of the values at which his property is entered. Property owners may then lodge objections to the values assessed. District Valuers are then instructed to reconsider the values in respect of which objections have been lodged. If they recommend reductions as claimed by owners then the necessary changes are made in the valuation roll. If they do not recommend any change, then objectors may have their cases heard in the Assessment Court, which consists of a President—who must be a barrister or solicitor of the Supreme Court of New Zealand—appointed by the Governor-General-in-

4. In 1909 this lag was estimated by Dr. (Sir) John Finlay at 25% cf. Le Rossignal and Stewart: *State Socialism in New Zealand*, p. 131.

Council, one member appointed in the same way, and one member appointed by the Local Authority or Authorities whose rolls have been revised, provided that the person is not a member or paid official of such Authority or Authorities. Any reductions allowed by the Assessment Court become effective only after the Valuer-General has endorsed them. If he does not do so, and the objector refuses to accept the former's assessment of a fair selling capital value, then the property may be acquired at this valuation for the Crown. On the other hand the owner of the property may require the Crown to take over his land at official valuation if the Valuer-General refuses to reduce his valuation to the level considered by the former as the fair selling value.

Appeal to the Supreme Court is provided for on questions of law, but on all other questions the decision of the Assessment Court is final.[5]

3. *Effects of Land Taxation*

(a) *Revenue*: Although when introduced the land tax was expected to produce a considerable volume of revenue, it has never been very important in practice. Thus in the years 1920-24, 1925-29, and 1930-32, land taxation provided 9·13 per cent., 7·12 per cent., and 5·58 per cent. respectively of the total tax revenue.

Only in the latter years of the war and during the few years following, when the super-tax was in operation, did revenue from land tax rise as high as 10 per cent. of total taxation revenue.[6]

(b) *Influence in Breaking Up Large Estates*:[7] The Land and Income Tax of 1891 introduced the principle of a graduated land tax on the unimproved value of the land, and had the double objective of bringing in revenue and breaking up the larger estates, while to some at least graduation promised a closer approach to equality of burden than did a flat tax. It is unlikely that the tax in its early years was of any importance in promoting closer settlement. The graduations were too modest to matter a great deal, and there were numerous opportunities for evasion. The formation of fictitious partnerships before partners were assessed separately, nominal subdivision between members of the family, false sales, false leases and nominal gifts were common until the 1907 legislation was designed to meet the situation; while defective land valuations helped considerably to frustrate the purpose of the Act.[8] The steady increase in prices which began in 1895 materially lightened the weight of the graduations and helped to mitigate their effect even when the tax became more severe and the opportunities for evasion were largely curtailed. The tax was nevertheless hated and feared by the great landowners,

5. For a good account of land valuation in New Zealand, see G. F. C. Campbell: *An Explanatory Memorandum of Valuation, cd.* 4,750 (1909).
6. In 1919 it was 10·96%, and in 1922 it was 10%.
7. This section was written by Mr. D. O. Williams.
8. Le Rossignal and Stewart, 45-6: Scheftel, *Taxation of Land Value,* 98-101.

as Reeves pointed out in 1902, not because of its actual burden, but because of its precedent and its potentialities.[9]

The amended laws to prevent evasion, the increased severity of graduations, the additional taxes on absentee owners and on owners who did not improve their lands, and the development of more efficient methods of land valuation, undoubtedly increased the impact of the tax. But there is no device which will separate the influence of the tax from that of other forces coincidentally making for closer settlement. The growth of population, the process of family subdivision on the death or retirement of the head of the family, the State repurchase laws, the growing demand for land during a long run of prosperous years, would be contributory factors to the final result. In 1916 Scheftel was able to remark: 'The experience with the tax for over two decades has both allayed the anxiety of its adversaries and dissipated the extravagant hopes of its most ardent adherents.'[10]

There are now fewer freehold estates ranging above 10,000 acres than there were in pre-war days, although directly comparable figures for the two periods do not exist to permit an accurate measurement of the differences. But no direct inference as to the force of the tax can be made from this fact, since many estates large in area carried a relatively small tax per acre. The graduations increased, of course, with value, not with area. From the point of view of tax burden mere extensity had no necessary significance. Land tax returns for 1929-30 show that the unimproved value of rural holdings of 50,000 acres and over was only 3/9 per acre. Consequently, the very largest estates of low-grade land paid less per acre, per taxpayer and per £100 of unimproved value than estates ranging from four to five thousand acres. The following table brings out this point clearly:—

TABLE LVI

Rural Lands—Tax Assessments for 1929-30

Area			Unimproved Value per Acre	Tax Assessment		
Acres		Acres		Per Acre	Per Taxpayer	Per £100 Unimproved Value
4,000 and under		5,000	£3 10 11	7d.	£173 3 2	£0 17 7
5,000	,, ,,	7,500	3 7 10	8d.	232 15 4	1 0 3
7,500	,, ,,	10,000	2 16 10	8d.	321 13 2	1 4 9
10,000	,, ,,	15,000	2 8 10	8d.	503 17 10	1 8 9
15,000	,, ,,	30,000	1 13 0	7d.	607 8 7	1 13 0
30,000	,, ,,	50,000	0 14 8	3d.	512 10 6	1 13 11
50,000	,, ,,	100,000	0 4 1	½d.	127 12 6	0 16 5
100,000	,, over		0 3 2	⅓d.	166 13 4	0 16 4

9. Reeves: *State Experiments in New Zealand*, I. 253.
10. Scheftel: *Taxation of Land Value*, p. 106.

It is obvious that the tax had no penal effect on assessments of 50,000 acres and over, and even in the range of 30,000 to 50,000 acres, where the tax was harsh, it affected only about twenty assessments. Nevertheless, if the two largest area categories are excluded, the tax burden measured per £100 of unimproved value shows a progression as the size of assessments increases, although there is obviously no appreciable difference between the burden on assessments averaging 20,000 acres and on those double the size. On the figures the maximum tax burden was reached on the average in the vicinity of 30,000 acres, and assessments larger in area than this were subjected to no additional tax pressure.

It is not possible to compare holdings on a value basis over a period of years, but the present distribution is interesting.

TABLE LVII

Rural Lands—Tax Assessments, 1929-1930

Amount	No. of Returns	Total Area	Average Area	Unimproved Value	Tax Assessment	
					Per Acre	Per £100 Unimproved Value
(1)	(2)	(3)	(4)	(5)	(6)	(7)
£ £		Acres Thousands	Acres	£ Thousands	£ s. d.	£ s. d.
15,000–19,999	603 (21)*	1,425	2,200	10,355	0 1 0	0 14 4
20,000–29,999	521 (32)	2,215	4,260	12,598	0 1 0	0 17 1
30,000–39,999	191 (6)	904	4,750	6,536	0 1 6	1 0 6
40,000–49,999	78 (4)	489	6,270	3,430	0 1 9	1 4 6
50,000 and over	113 (11)	1,238	11,000	7,879	0 2 0†	1 12 4†
100,000 ,, ,,	—	—	—	—	0 4 6	2 12 6
Totals ..	1,506 (74)	6,271,000 (acres)	4,200	£40,798,000	—	—

*The figures in parentheses give the numbers of companies included in the totals.
†On £50,000—£99,999.

The table shows only those rural estates which may be considered as large in value. The average area (col. 4) is not particularly large, but taken together these estates comprise an area equal approximately to one-third of the total freeholds of the country. Despite the severity of the graduations, holdings large in value are shown to be more numerous than might have been supposed. The difference between the light taxes on holdings of small value and the severe taxes on the holdings included in the table are striking. In the case of holdings ranging in value from £1,000 to £9,999 the average tax in the year 1929-30 varied from 2d. to 6d. per acre and from 2/6 to 6/- per £100 of unimproved value.

The relatively large number of estates of high value still surviving in 1929-30, and the lightness of the tax on holdings of smaller value, indicate that the graduated land tax was more important in its negative than in its

positive phases. The severity of the upper graduations has been less significant economically than the generosity of the exemptions provided for the smaller farmer, and it was probably the contemplation of the small farmer's immunity from all but a nominal tax that was the chief discomfort to the holder of a large and valuable estate in normal undepressed times. Almost any taxation is felt as a burden in bad times; but taking good years with bad it is difficult to believe that the tax has had much coercive influence. The tenacity of survival of so many valuable estates prior to the depression suggests that the tax was less penal than the abolitionists have urged. Doubtless the tax discouraged rural aggregation that would otherwise have taken place. Even so, it was less severe over the whole range than urban taxation which combined progressive land taxation with progressive income taxation.

The disparity between urban and rural taxation was most marked in the lower and medium reaches of the scale, since farmers falling into these classes received generous exemptions in their land tax and paid no income tax. In the higher reaches, the farmer lost his exemptions but still paid no income tax (except in the period 1915-23). In practice the exemptions granted to farmers in the lower and medium reaches of the scale were so generous as to make taxation for the bulk of our farmers a definitely negligible matter. It is certain that had all farmers been forced to pay income tax on the scale demanded from urban taxpayers, their total contribution would have been much greater than it was. One glance at the taxation returns for 1929-30 puts the matter beyond reasonable dispute. On 'Country and Farming' lands the total unimproved value was recorded as £167,000,000; total exemptions amounting to £69,000,000 were allowed, and the tax assessed on the balance of £98,000,000 amounted in all to £700,000. Whatever its distribution, a total tax of £700,000 on the farming lands of the Dominion cannot normally be called onerous.

The distribution of the tax reveals to what an extent the majority of farmers were free from any serious burden. For the year 1929-30 the Land and Income Tax Department received approximately 50,000 returns in respect of rural lands. The operation of exemptions whittled this number down to 30,000 taxpayers. The taxpayers carried the £700,000 tax in the following approximate manner:—

Some 25,000 were assessed at under £11 each for a total of about £100,000. The balance of £600,000 was placed on under 5,000 taxpayers. Only 1,500 taxpayers were assessed for more than £100, the tax ranging up to as much as £3,348 in eight instances. All but a few farmers escaped any taxation that could be considered burdensome, and the total amount paid into the Exchequer was under 4 per cent. of the total tax collections.[11]

11. Urban land tax added to rural land tax would raise the percentage to 6.7.

The graduated land tax may, perhaps, be fairly summed up by saying that it hindered the growth of land aggregation; contributed in an unassessable degree to the break-up of large estates while avoiding, through its exemptions, all tax obstacles to the development of small farms.[12] As a revenue device it has had little importance.

Now that the graduated land tax has been abolished and a flat rate of one penny in the pound of unimproved value substituted for it, the tax has lost its importance both as a producer of revenue and also as a means of breaking up large estates. In the year ended March 31, 1933, the percentage of total taxation revenue received from land taxation (urban and rural) was only 2·6.

B. Income Taxation

1. *Historical*

Until 1915 income derived from farming pursuits was entirely free from income taxation (land tax being levied instead), except in the case of lessees of Crown pastoral leases and small grazing runs who were liable for income tax. During the period 1915-1923, however, farmers paid income tax in addition to the graduated land tax. Income tax was then abolished in respect of income derived from the use of land for farming purposes, to be reintroduced in 1929, but as a substitute for land tax rather than as an addition to it. Income tax then became payable on profits from farm lands having an unimproved value exceeding £14,000. From the income tax assessed in such cases, assessed land tax was deductible and therefore income tax was only paid if it exceeded the land tax, land tax being paid where it proved to be the larger amount. In 1930, income tax was imposed on profits from farming lands having an unimproved value of £7,500 and over, the tax being an *addition* to the graduated land tax which was no longer deductible. In 1931, the graduated land tax was abolished, a flat rate of one penny in the pound of unimproved value being retained, the deficiencies in revenue being made good by modifying income tax rates, but the income tax was not extended to farmers with smaller incomes until April 1, 1932, when profits from farm lands with unimproved value of £3,000 and over became liable for income tax.[13]

In common with the rest of the community, farmers are liable for the general unemployment levy and for the special taxation for the relief of unemployment.

2. *Burden of Income Tax and Land Tax Compared*

The following tables compare the direct taxation paid by farmers with that paid by the community as a whole:—

12. See Condliffe: *New Zealand in the Making*, pp. 243-51, for a good discussion.
13. For an account of exemptions allowed, see Malloch: *Taxation Concerning the Farmer*.

TABLE LVIII

Amount of Direct Taxation Paid by Farmers (i.e., Income and Land Taxes)

Year	Income Tax (£)	Number Paying	Land Tax (£)	Number Paying	Total Direct Taxes (£)	Number Paying
1924–25	13,496	200	663,483	26,814	676,979	27,014
1925–26	27,265	400	622,682	25,684	649,947	26,084
1926–27	7,645	222	603,205	25,470	610,850	25,692
1927–28	9,606	269	(*)	(*)	—	—
1928–29	28,584	412	572,505	24,789	601,089	25,201

*Not available.

TABLE LIX

Total Amount of Direct Taxation Paid by the Whole Community (i.e., Income and Land Taxes)

Year	Total Taxation (£)	Number Paying	% of Taxation Paid by Farmers to Total Taxation (a)	% of Farmer Taxpayers to Total Taxpayers (b)	% Ratio (a) of—— (b)
1924–25	4,362,774	92,845	15·5	29·1	53·2
1925–26	4,331,920	93,885	15·0	27·9	53·8
1926–27	4,373,958	100,405	14·0	25·5	54·9
1927–28	—	—	—	—	—
1928–29	4,139,952	99,122	14·5	25·4	57·1

The years taken (i.e., 1924-25 to 1928-29) are the years in which farmers paid land tax and not income tax, with the exception of Crown lessees who paid income tax instead of land tax.

Although the figures in these tables are possibly subject to some small degree of error, it is quite clear from the last column in Table LIX that the amount of direct taxation paid by farmers as a whole was only a little more than half of what it would have been if they had paid at the same rate as the community as a whole. This means that the burden of direct taxation paid by farmers when they paid land tax and not income tax was light as compared with the whole community which paid mainly income tax. Since farmers are included in the figures for the whole community, the ratio as shown in the final column of Table LIX is higher than it should be to give a true indication of the actual relative position. The general conclusion to be drawn from these figures, therefore, is that land taxation was considerably less burdensome than income tax, a conclusion which is supported by the theoretical argument quoted by Dr. J. B. Condliffe.[14]

14. Condliffe: *New Zealand in the Making*, pp. 244-5.

C. Import Taxation

1. *Tariff Rates on Farm Requisites*

Approximately 38 per cent. of all farm requisites are free from customs tariffs, while an additional 30 per cent. are free if of British origin, the remaining 32 per cent. being dutiable whether of British or of foreign origin. Where British goods are dutiable the rate varies between 10 per cent. and 25 per cent., the bulk of the items bearing a duty of 20 per cent. *ad valorem,* with an additional 20 per cent. on foreign goods of the same classes. Where British goods are duty free and foreign goods of the same classes are dutiable, the latter carry a rate of from 15 per cent. to 25 per cent. But on a value basis, over 85 per cent. of the actual total imports of commodities used directly in farming enter New Zealand duty free while another 10 per cent. (approximately) are subject to duties varying between 10 per cent. and 15 per cent. *ad valorem.*[15] The fact that the customs tariff bears lightly upon the farming industry as compared with the whole community is revealed by a comparison of these figures with the total imports into New Zealand (again on a value basis). In the year 1929, 42·86 per cent. of total imports entered free and 57·14 per cent. were dutiable, while a much smaller proportion of those dutiable carried a duty as low as 10 per cent. to 15 per cent.

In some cases the interests of the farming industry have been subordinated to those of secondary industry in New Zealand by placing a tariff upon finished articles used directly in farming while allowing in free the partially manufactured article or the raw material for its manufacture. For example, carts, drays and waggons are subject to a British preferential duty of 20 per cent. and to a duty on foreign imports of 45 per cent., while carriage- and cart-makers' materials are admitted free; vacuum pumps for milking machines are subject to the same range of duties with the stated intention of encouraging their manufacture in New Zealand. The same considerations apply in the case of saddlery, harness, etc.

The primage duty of 3 per cent. *ad valorem* levied on goods otherwise duty free has, in some cases, borne heavily upon farmers where requisites were previously free of duty, but in many cases farm requisites are exempted from the payment of primage duty, exempted articles including live animals, bran and pollard, sheep-dip, traction engines and tractors, wire-netting, iron wire of all kinds, agricultural seeds, meat wraps, cheese bandages, etc., wool packs and manures.

2. *Tariff Protection of the Farming Industry*

Practically all farming products of New Zealand, with the exception of wool, hides and tallow, carry import duties ranging from 20 per cent.

15. Based on official figures for 1929.

to 25 per cent. (British preferential tariff) to 45 per cent. (foreign tariff), but as the imports are very few indeed and New Zealand exports large quantities of wool, butter, cheese, frozen meat, etc., which consequently have their prices fixed under world market conditions, these rates do not confer any protection on the New Zealand producers of these commodities. The method adopted in Australia of subsidizing butter exports is impracticable in New Zealand because of the much higher ratio of exports to total production than is the case in Australia. Only in the case of wheat is protection to farming really effective. Wheat duties are discussed in the chapter on the Marketing of Arable Products.

D. The Sales Tax

The sales tax introduced in February, 1933, exempted farming requisites and practically all farm products together with such processed products as butter and cheese, meat, bran, pollard, bread, hay, straw and chaff, oatmeal and rolled oats, sugar of milk, lard and margerine.

The exemption of farm requisites relieves the farmer directly of the sales tax, while the exemption of his products saves him from any diminution of his sales which would occur if he passed the tax on to buyers. This would in any case be very difficult since the bulk of his products are sold overseas.

III. LOCAL TAXATION

A. System of Local Government

Local Government in New Zealand is exercised by a number of local authorities constituted under various Acts of Parliament. Some of these perform a wide variety of functions, while others are in the nature of *ad hoc* bodies set up for a specific purpose as, for example, electric power boards, hospital boards, harbour boards, etc. Naturally the boundaries of these various local bodies frequently overlap so that a particular area may be within the jurisdiction of several authorities. The number of local authorities actively functioning in April, 1932, was 677, of which 125 were counties, 122 boroughs, and the remainder smaller local authorities and *ad hoc* bodies.

In addition, there are 18 District Councils of the Main Highways Board constituted under the Main Highways Act 1922. The main authorities which exercise control in rural areas include county councils, road boards, river boards, land drainage boards, water supply boards, electric power boards and rabbit boards, and the District Councils of the Main Highways Board.

B. Local Body Finance

1. *Sources of Finance*

The finances of local authorities are drawn from four main sources: (a) loans; (b) rates; (c) fees, licences, etc.; (d) Government grants and subsidies. In this section we shall be concerned mainly with local body rates though some reference must be made to grants from the central Government.

Rates are levied either for general or for particular purposes. 'General' rates are for general administrative and maintenance purposes, while 'separate' rates are levied in respect of such works as drainage, lighting, tramways, etc. 'Special' rates are levied to defray the costs of and to repay loans. General and separate rates are subject to a statutory limit while special rates are not so limited.

Rates are levied on the annual, capital or unimproved value of land. The valuation rolls prepared by the Valuation Department are used for local rating purposes. The system of rating is upon the basis that 1/- in the pound annual value is equivalent to ¾d. in the pound of capital value. Districts in which rates are levied on the annual or the capital value of the land, have the right to determine by poll that the system of rating on the unimproved value should be adopted, and may also reverse such a decision by poll after not less than three years' experience of the unimproved value system. At March 31, 1932, 44 per cent. of local authorities were rating on the unimproved value basis, but these districts contained 57 per cent. of the population of the Dominion. The following table gives the systems of rating in force during the year 1931-32:—

Table LX

Systems of Rating

	Unimproved Value	Capital Value	Annual Value	Acreage Basis	On Stock	Total
Counties	57	68	—	—	—	125
Boroughs	78	17	27	—	—	122
Town Districts	31	31	5	—	—	67
Road Districts	3	15	—	—	—	18
River Districts	15	24	—	4	—	43
Land Drainage Districts	33	28	—	—	—	61
Electric Power Districts	13	26	—	—	—	39
Water Supply Districts	1	2	—	—	—	3
Urban Drainage Districts	—	2	1	—	—	3
Local Railway Districts	—	1	—	—	—	1
Rabbit Districts ..	1	6	—	35	5	47

The Government makes annual grants to local authorities for special purposes and also subsidizes rates out of receipts from timber and flax royalties, goldfields revenue and gold duty, fees and fines, one-third of the proceeds of land sold on deferred payment and of perpetual leases, and one-fourth of rents from grazing runs. Additional contributions are also made from the Consolidated Fund. Subsidies and grants are also made from the Main Highways Revenue Fund for road construction and maintenance purposes.

The Public Works Department ascertains, as early in the financial year as possible, the approximate amount of Government money which will be available for that year's roading operations. This is then allocated to the several Public Works districts on the basis of each district's claim according to such factors as area, population, rating, loans available, mileage of roads in use, estimated amount to complete all roads, value of Crown and Native lands suitable for settlement. These district quotas are then in turn allotted, on the same basis, to the various local authorities, within each Public Works district. Each local body then allots its quota to individual roads in order of urgency after consultation with the Public Works District Engineer. This method of allotting on the advice of a Government Official tends to remove any parochialism that might arise. The allocations by the Public Works Department and by the local authorities are submitted to Parliament for final confirmation.

2. *Growth of Local Body Debt and Rates*

(a) *Debt.*—The gross indebtedness of local authorities has increased very rapidly during the past decade, having risen from £36·7 millions or £28/4/9 per head of population in 1921-22 to £72·5 millions or £47/3/1 per head of population in 1932-33, while the annual loan charge has risen from £2·1 millions or £1/12/9 per head of population in 1922 to £4·9 millions or £3/4/- per head of population in 1933.

The incidence of the debt is difficult to determine as between rural and urban districts for in many cases the same local authorities are found in both. For example, electric power boards whose indebtedness has shown the most marked increase of all local authorities,[16] operate in both rural and urban areas, while harbour boards' rating powers extend into rural areas. The following table shows the increase in the gross indebtedness (including loans from Government) of certain authorities which are almost entirely rural:—

16. Electric power, board's indebtedness: 1922—£1.5 millions; 1933—£13.0 millions.

TABLE LXI

Gross Indebtedness of Rural Authorities

	1924–25 £	1926–27 £	1928–29 £	1930–31 £	1931–32 £	1932–33 £
Counties ..	5,904,678	7,215,851	7,483,631	7,699,175	7,719,431	7,610,698
Road Districts	368,990	625,416	343,390	274,625	288,375	286,435
River Districts	196,623	·244,064	297,357	419,676	439,152	517,712
Land Drainage Districts ..	375,545	437,404	474,591	485,576	482,201	471,331
Water Supply Districts ..	20,470	20,431	20,389	11,109	*	*
Rabbit Districts	*	3,240	6,631	5,811	*	*
Totals ..	£6,866,306	£8,546,406	£8,625,989	£8,895,972	£8,929,159	£8,886,176

*No statistics available.

Indebtedness in respect of these enumerated local authorities has thus increased by 29 per cent. (approximately) in the period 1924-25 to 1932-33, while the total local body indebtedness has increased by 36 per cent. (approximately) in the same period.[17] But this apparent lag in the increase in rural local debt must be qualified by the fact that the heavy increase in the indebtedness of electric power boards, which operate partly in rural areas, accounts in large measure for the increase in total local body indebtedness. It is probably true to say that the burden of debt on rural areas has increased at about the same rate as upon urban areas.

(b) *Rates.*—The following table illustrates the growth of total local authority revenue during the last decade:—

TABLE LXII

Revenue of Local Authorities[18]

(£000's Omitted)

Year ending March 31	From Rates	Licences, Tolls, Rents, etc.	Government Subsidies	Total
1921	£3,550	£5,032	£304	£8,886
1922	3,780	5,757	318	9,855
1923	4,278	5,943	301	10,522
1924	4,446	6,403	301	11,150
1925	4,669	7,213	299	12,181
1926	5,040	8,015	319	13,374
1927	5,311	8,622	333	14,266
1928	5,616	9,454	332	15,402
1929	5,844	9,191	393	15,428
1930	6,011	10,310	437	16,758
1931	5,637	10,201	426	16,265
1932	5,512	9,054	628	15,194
1933	5,238	8,463	451	14,152

Total revenue increased by about 60 per cent. during the period while revenue from rates increased by about 47 per cent., but revenue from rates and total revenue have fallen sharply since 1930.

17. In 1924-25, total local body indebtedness was £53,353,466.

18. Excludes Government loan money, grants for unemployment relief and other "receipts not revenue."

The following table gives the revenue from rates collected by authorities which are mainly rural:—

TABLE LXIII

Rate Revenue of Certain (Mainly) Rural Authorities

	1924–25	1926–27	1928–29	1930–31	1932–33
Counties	£1,797,095	£1,894,770	£2,016,878	£1,665,200	£1,293,498
Road Districts	69,428	89,712	73,359	48,906	49,681
River Districts	55,186	61,262	67,626	58,393	59,976
Land Drainage Districts	43,557	50,210	62,452	53,456	53,525
Water Supply Districts ..	3,649	3,668	4,368	2,887	3,248
Rabbit Districts	*	15,484	18,022	14,046	13,864
	£1,968,915	£2,115,106	£2,242,705	£1,842,888	£1,473,792

*Not available.

Revenue collected from rates by these rural local authorities increased by about 13 per cent. as compared with an increase of about 12 per cent. for all local authorities between 1924-25 and 1928-29, after which it declined by about 34 per cent. by 1932-33, the figure in this year being well below that for 1924-25. This fall is not due to any lightening of the rates levied but rather to the fact that in many rural districts farmers have been unable to pay rates owing to the serious fall in primary produce prices.

3. *Local Body Expenditure*

The following table gives the total expenditure of various rural local bodies compared with expenditure of all local authorities (including moneys from revenue, grants, subsidies and loans):—

TABLE LXIV

Expenditure of Local Authorities

	1924–25	1926–27	1928–29	1930–31	1932–33
Counties	£3,299,169	£4,069,271	£3,989,885	£4,298,027	£3,807,643
Road Districts ..	320,958	262,916	103,602	151,464	95,142
River Districts ..	81,887	125,303	123,375	164,321	155,118
Land Drainage Districts	92,988	96,327	92,229	99,315	107,444
Water Supply Districts	3,954	4,110	6,571	3,517	4,578
Rabbit Districts ..	*	35,134	36,034	32,216	29,250
Totals	£3,708,956	£4,593,061	£4,351,696	£4,748,860	£4,199,175
Total Local Body Expenditure ..	£19,422,833	£21,747,557	£21,300,024	£22,174,524	£18,885,173
Per cent. of Rural Local Body Expenditure to total Local Body Expenditure ..	19·1	21·1	20·4	21·4	22·2

*Not available.

The increase in expenditure by rural local authorities was 28 per cent. between 1924-25 and 1930-31, while the increase in total local body expenditure was 14 per cent. The fall in revenue from rates described in the previous section was more than made good by increased Government grants and subsidies, and by further loans. Since 1930-31, however, expenditure shows a substantial decline.

Expenditure is divided between road, bridge and plant construction and maintenance, charitable aid and hospitals, administration, interest on loans and overdrafts, payments into sinking funds and repayment of loan money. The proportions devoted to each class of expenditure vary as between different local authorities according to their special functions and the size of their available funds. They also vary from year to year. The distribution and fluctuations in the different classes of expenditure are shown in the following percentage table:—

TABLE LXV

Percentage Distribution of Rural Local Authority Expenditure[19]

		Construction and Maintenance	Hospital and Charitable Aid	Administration	Interest on Loans and Overdrafts	Sinking Fund and Debt Repayment
Counties	1924–25	71	9	8	9	3
	1926–27	73	8	7	9	3
	1928–29	69	9	7	10	5
	1932–33	71	7	7	11	4
Road Districts	1924–25	82	2	5	8	3
	1926–27	69	3	8	12	8
	1928–29	56	7	10	20	7
	1932–33	67	2	8	18	5
River Districts	1924–25	66		15	11	8
	1925–26	74	Nil	13	10	3
	1928–29	72		11	13	4
	1932–33	72		8	16	4
Land Drainage Districts	1924–25	67		9	20	4
	1926–27	55	Nil	10	23	12
	1928–29	57		10	26	7
	1932–33	65		7	23	5
Water Supply Districts	1924–25	64		13	18	1
	1926–27	63	Nil	15	17	5
	1928–29	91		3	5	14
	1932–33	67		13	15	5
Rabbit Districts	1924–25	*		*	*	*
	1926–27	71	Nil	26	1	2
	1928–29	66		28	2	4
	1932–33	79		18	2	1

*Not available.

19. Excluding minor miscellaneous payments.

In all cases expenditure on construction and maintenance of plant is by far the most important item of expenditure while only counties and road districts contribute towards hospitals and charitable aid. The proportions of expenditure on construction and maintenance vary considerably since much of such expenditure comes from loan moneys and loans are raised irregularly. Administrative charges appear high in some cases, e.g., in the case of river districts, and rabbit districts, but in both these cases a large amount of the work consists of regular inspections while the areas covered are very large in proportion to the scale of the finances.

C. Road Construction and Maintenance

1. *General*

There are approximately 50,300 miles of formed roads in New Zealand and in addition there are 22,200 miles of unformed legal roads and bridle-tracks. About 44,800 miles of formed roads are under the control of counties, 1,450 miles under the control of road districts, 3,500 miles under boroughs and 560 miles under town districts. 21,200 miles of unformed roads and bridle-tracks are under the control of counties, while the bulk of the rest are under road districts. Great advances have been made in recent years in the surfacing of roads, concrete surfacing having increased from 59 miles in 1924 to 340 miles in 1932, bitumen or tar surfacing from 640 miles in 1925 to 2,200 miles in 1932, metal surfacing from 28,240 miles in 1924 to 33,600 miles in 1932. On the other hand, formed but unsurfaced roads have decreased from 16,750 miles in 1925 to 14,000 miles in 1932.[20]

Bridge construction has also proceeded rapidly, bridges of 25 feet and over in length having increased from 4,114 in 1925 to 5,804 in 1932, and there has been a marked tendency also towards the construction of better class bridges.

All loan money raised by local authorities must be used in construction while maintenance and general repairs must be financed from general revenue. The Government also provides grants for roading purposes (a) from the Public Works Fund (which consists mainly of loan money) for construction, and (b) from the Consolidated Fund for maintenance and repairs. Moneys are also granted from the Main Highways Account for construction and maintenance of roads other than main highways.

2. *The Main Highways Board*

Until about ten years ago the bulk of the roading outside boroughs was very inadequately surfaced. In counties where population was sparse and rate revenue therefore low, lengths of road had long been maintained partly or wholly by Government grants, but there was a very marked lack

20. Figures are approximate only.

of uniformity in road surfacing. With the rapid increase in the use of motor vehicles the demand for a type of road which would withstand heavy and rapid traffic became insistent. To meet the situation the Main Highways system was set up by the Main Highways Act 1922, which has been subject to several amendments.

(a) *Constitution.*—Under the Act a Main Highways Board was set up consisting of the Engineer-in-Chief and the Under-Secretary of the Public Works Department, the Assistant Engineer-in-Chief and the Accountant of the Public Works Department, two representatives of County Councils, and one representative of motor vehicle owners. There are, in addition, District Councils in each of the eighteen Highway Districts set up under the Act, the Councils consisting of one representative from each constituent county, together with the District Engineer of the Public Works Department.

(b) *Functions.*—The Main Highways Board controls all main highways and Government roads and provides part of the cost of construction and maintenance of such roads, as well as of other roads which have not been declared main highways if the circumstances warrant such assistance being given. Under the amendment now in force the Board may pay one-half the cost of construction or reconstruction of roads and three-fourths of the cost of maintenance, while in the case of bridge construction the Board may pay subsidies amounting to £2 for £1 on expenditure up to £10,000 and £3 for £1 on expenditure above £10,000. In all cases the local authorities in whose area the work is being carried out provide the remainder of the cost of construction and maintenance. The Board may also make loans to local authorities, and sell to them on the hire-purchase system modern road-making machinery, etc.

The functions of the District Highway Councils are to make recommendations to the Board each year as to which roads within their several districts should be declared main highways. In making their recommendations the Councils are guided by the following considerations:—

(a) Whether roads may be regarded as arterial in that they carry an appreciable volume of through as well as local traffic.

(b) Whether the roads connect large centres of population within the highway district.

(c) Whether the roads carry appreciable traffic to and from seaports or railway centres within or without the highway districts.

The Councils make estimates of the amounts required for construction and maintenance of roads and bridges and after these are reviewed by the Board, they are incorporated in the estimates which in turn are submitted to Parliament for approval.

(c) *Finance.*—(1) *Receipts*: The Main Highways Account consists of (i) the *Revenue Fund,* into which are paid the proceeds of customs duties on tyres and tubes, 92 per cent. of customs duty of 6d. per gallon on petrol[21] and registration and licence fees of motor vehicles but not heavy traffic fees. The receipts for the year ended March 31, 1933, were as follows:—

Tyre tax	£63,253
Petrol tax*	644,126
Motor licences, fees, fines, etc.	375,332
Total	£1,082,711

*A Petrol Tax of 4d. per gallon was first imposed towards the end of 1927 and was raised to 6d. per gallon in 1930. It is now 10d. per gallon but the extra 4d. goes direct to the Consolidated Fund for general purposes. The figure given is exclusive of the £500,000 transferred to the Consolidated Fund.

(ii) the *Construction Fund,* into which are paid loan moneys required for construction and reconstruction purposes. The Act of 1922 laid it down that such loans should not exceed £3 millions over a period of ten years. Sums may also be transferred to the Construction Fund from the Revenue Fund.

Until 1930, £35,000 per annum was paid from the Consolidated Fund into the Highways Revenue Fund and £200,000 was paid from the Public Works Fund into the Highways Construction Fund, but these payments have now been discontinued. Total payments under these heads up to the time of their discontinuance were £1,226,000 from the Public Works Fund and £210,000 from the Consolidated Fund.

(2) *Payments.*—The construction and maintenance of roads is, of course, the main function of the Highways Board, and this it may undertake itself, collecting from local authorities their share of the cost, or it may pay out its share of the cost to local authorities who undertake authorized work. In addition, the Board is empowered to pay out of the Revenue Fund to county councils and road boards a subsidy at the rate of 2/6 in the pound on the average annual amount of rates collected during the previous three years. This subsidy was intended to enable the local authorities to grant rebates of 12½ per cent. of the rates levied.

The following list gives the chief items of expenditure for the year ended March 31, 1933:—

Construction	£141,889
Maintenance	687,918
Subsidies to Local Authorities	181,287
Advances to Local Authorities	38,518
Interest, Amortization, etc.	268,955
Total	£1,318,567

(d) *General Considerations.*—Every proposed work is examined by the Board as to whether (1) it is sound from an engineering point of

21. Since April, 1933, £500,000 has been paid into the Consolidated Fund from proceeds of the petrol tax, otherwise payable to the Highways Revenue Account.

view; (2) it is justified as to cost, having regard to existing surfaces; (3) it is economically sound, having regard to the value to the district concerned, and the capacity of the district to pay its share of the cost; (4) it fits into and forms part of a comprehensive plan. The Board encourages the adoption of the simplest construction suitable for the present or early prospective traffic, but it has adopted the principle that bridges should be constructed of the most permanent materials available and should be designed to meet traffic requirements for a long period ahead.

In the case of all construction works the Board requires provisions to be made for continuous and up-to-date maintenance. The patrol system is encouraged. By dividing the highways into suitable patrol sections, by selection of suitable patrolmen, and by the provision of satisfactory supplies of material and efficient plant, it is considered that a very much improved standard of maintenance can, in most cases, be obtained, thus avoiding the necessity of expensive reconstruction.

IV. DIRECT STATE ASSISTANCE

The Government assists the farming industry by direct expenditure in various ways.

A. Agricultural Department and Agricultural Education

The cost of the Department of Agriculture and of agricultural education and research is met almost entirely out of general taxation. To the extent that this cost exceeds specific contributions made by some farming industries towards research, it may be regarded as a direct grant to the farming community. It should be noted, of course, that other sections of the community derive similar benefits in various ways.

The cost of maintaining the Agricultural Department falls upon the Consolidated Fund and amounts to approximately £400,000 per annum.

B. Railway Freight Reductions

Many of the freights charged on the railways upon goods required by the farmer are unremunerative, while in some cases goods are carried free of charge. Thus lime is carried free up to a distance of 100 miles, the Railway Department being partly reimbursed by the Agricultural Department for this service. The freights on much farm produce en route to ports are also unremunerative, while the farmer tends to avail himself of road transport when buying goods for which, in an attempt to compensate itself for the loss involved in carrying farm products, the Department charges relatively high freights. This tendency is an important contributing factor in the loss annually shown by the Railway Department.

In addition to low freights, there are thirty-two unprofitable branch

lines which are operated mainly in the interests of the farming community. The continued operation of these unprofitable lines is a disguised subsidy to the farming industry, though not, of course, to the extent of the actual loss.

C. Subsidies

1. *Wage Subsidies from the Unemployment Fund*[22]

Since 1930 the Unemployment Board has subsidized agricultural wages under two schemes known as 4A and 4B. 4A scheme provides for farmers who wish to employ additional labour on a wage basis. The rate of pay is mutually arranged between farmer and worker and the Board subsidizes actual wages up to 15/- per week for a single man and £1/5/- per week for a married man, a condition being that the farmer finds the man in board and lodging or housing. The period of subsidized employment varies between four and twenty-six weeks. 4B scheme provides for developmental worked on a contract basis. The Board grants a subsidy of 33⅓ per cent. of labour cost only and the maximum subsidy payable on any individual contract is £75, but a farmer can apply for one or more subsidies.

At September 30, 1932, there were 12,200 employed under these schemes and up to that date £305,200 had been paid in subsidies.

2. *Miscellaneous Subsidies and Grants*

The following table gives in summary form the chief items of direct State assistance to farmers:—

Table LXVI

State Subsidies and Grants

	Expended 1932-33	Provided in Estimates for 1933-34
	£	£
Agricultural Lime and Fertilizers: Rebate of Railage ..	167,576	148,000
Blackberry: Bonus for Extermination	—	10,000
Compensation for Pigs, etc., Destroyed	—	5,000
Compensation on Account of Condemned Stock	6,780	7,000
Compensation on Account of Stock Destroyed	10,582	10,750
Cow-testing Organizations: Subsidies	7,108	6,000
Deer-herds: Bonus for Destruction	4,317	4,000
Fruit-production: Guarantee for Exports	3,017	4,000
Manufacture of Superphosphate: Subsidy	141,456	91,000
Portion of Freights on Farm Produce	—	165,000
Rabbit-destruction: Subsidies to Boards	11,599	11,750

22. J. P. Belshaw: 'Post-war Unemployment and Unemployment Policy in New Zealand,' *Economic Record*, June, 1933.

CHAPTER XIII

SCIENTIFIC DEVELOPMENTS

BY F. R. CALLAGHAN AND G. S. PEREN[1]

I. Decennial Review of Scientific Advances and Their Application in New Zealand Farm Practice, 1870-1930—A. Mechanical Inventions—B. Breeding of Stock —C. Soil Knowledge—D. Fertilizers—E. Plant Breeding and Selection. II. The Development of Organized Investigations During the Decade 1920-1930—A. General Description—B. The Main Organizations and Activities Established: 1. Dairy Research; 2. Noxious Weeds Research; 3. Mineral Content of Pastures; 4. Phormium Research; 5. Wheat Research; 6. Pig, Pork and Bacon Research; 7. Fruit Research; 8. Seed and Plant Research; 9. Meat and Meat Products Research; 10. Soil Reconnaissance. III. Wool Research—A. Grading of Wool—B. Origin of Romney Cross-bred Sheep—C. Causes of Change in Character of Wool Clip—D. Synopsis of Research: 1. Department of Agriculture; 2. Massey Agricultural College; 3. Canterbury Agricultural College. IV. Co-ordination with Overseas Activities, e.g., Imperial Agricultural Research Bureaux Scheme. V. The Relation Between Discoveries and Their Application and Adoption by Farmers. VI. A Review of the Part Played by Science in Modifying the Nature or Degree of Land Utilization in New Zealand.

I. DECENNIAL REVIEW OF SCIENTIFIC ADVANCES, AND THEIR APPLICATION IN NEW ZEALAND FARM PRACTICE, 1870-1930

THE conditions of agricultural production since 1870 have changed remarkably. In this period the whole aspect of New Zealand agriculture has been changed, and with this change there have come about radical alterations in the characteristics of farming.

A. MECHANICAL INVENTIONS

Bearing in mind that wheat production in 1870 was considered one of the most important phases of New Zealand farming, and that the chronic shortage of labour common to all systems of colonial development existed, attention was constantly being devoted to devising mechanical means of preparing the large available virgin tracts of soil for crops and for handling and harvesting these crops. At this time, also, similar problems of large-scale production were being faced, particularly in the United States of America, and Australia. The constant influx of immigrants from overseas ensured that the attention of the New Zealand farmer was diverted in the direction of these two overseas countries, where problems, similar to those confronting him, were being grappled by agriculturists.

1. *Ploughs*

Wooden ploughs and single-furrow iron ploughs were the first implements used in New Zealand for the extensive cultivation of the soil and crops. Such was the fertility of much of the virgin soil that to plough

1. Sections I, II, IV, V and VI by F. R. Callaghan; Section III by G. S. Peren.

over the original sod and scatter seed thereon, followed by light harrowing, was all that was necessary to produce a wheat crop giving a very satisfactory yield. Nevertheless, the capacity of these ploughs placed serious limits upon the area which could be devoted to crop, and during the 'seventies multiple-furrowed ploughs appeared, the double-furrow being in favour at first, as soon as farmers could provide the necessary horse-power to utilize these to the best advantage. The development of the multiple-furrowed plough marked a distinct advance in New Zealand arable farming, as well as in the conversion of the pastures from indigenous grasses into those of English species. The multiple plough continued to increase its numbers of furrows with the passage of years, but especially was this marked during the second and third decades of the present century, where, in those districts characterized by extensive arable farming, three- or four-furrow ploughs became very much more common than the double-furrow plough, which continued to be used in districts where cultivation was not an important feature of the year's work.

In the 1920's, urged by the pronounced shortage and costliness of labour, which arose in the War and after-War years, the tendency was for horse-drawn ploughs to give way to the tractor type, and there was a further increase in the number of furrows utilized per man. Furthermore, the design of the plough was radically changed, and ploughs were redesigned so that they could be controlled from the tractor to which they were attached by special hitches of an entirely different nature from what had been employed in the case of the horse-drawn implement. In consequence, the acreage ploughed daily was greatly increased, some 8 to 10 acres being covered per day of 8 hours.

Another result was a great improvement in the tillage of soils, particularly those of a stiff clay nature, which normally possessed, only for a very short period, a desirable physical condition for the best cultivation. The rapidity with which the ploughing was done, the additional power which allowed of greater depth of cultivation, permitted better cultivation of the soil. This enabled more attention to be devoted to the subsequent operations, such as harrowing, rolling, scuffling, etc., so that normally soil could be prepared and put into much better order for the purposes of a seed bed.

2. *Harrows*

Some recent developments in regard to harrows, which have taken place during the last ten or 15 years, and contemporaneous with the attention that has been given to pasture as a crop, are worthy of note. The benefit of maintaining a satisfactory physical condition of the soil whereon the pasture is established, is well recognized, but is difficult to achieve in

the case of a permanent crop such as pasture. Several types of harrows have, however, been devised which do aerate the surface soil sufficiently to greatly assist the growth of the grass. Nevertheless, the designs already giving good results in practice are regarded only as a prelude to much greater advances which the future will see in the matter of implements which will provide pasture with adequate cultivation.

3. *Reapers and Binders*

As soon as means had been devised for dealing with larger areas of land and the growing of crops, similar advances had naturally to be made in the methods of handling these crops at harvest time. Bearing in mind that labour was always in short supply in the early farming days of the Dominion, this was a very real problem, as the climate was often capricious at harvest time, serious heavy winds sometimes tending to shake the seed from the crop if left too long at the ripe stage, while occasional epidemics of insect pests made serious inroads upon the yield.

The first crops in the Dominion were harvested with sickle and scythe. In the 'seventies various types of mowing machines were slowly coming into use. In all of these the crop was cut, and left to be bound up into sheaves by the harvesters. The use of these machines marked a distinct advance, and further improvements set in fairly rapidly. The mower was followed by the tilter, the side delivery, and a machine known as the Samuelson.

In 1878 the first reaper and binder trial was carried out in Otago, the sheaves in this case being bound with wire. During the 'eighties the use of the reaper and binder steadily progressed, and by the end of this period the design of the machine became fairly stabilized, and remained so for probably a decade, when, in addition, a sheaf carrier was added. In the early days of the reaper and binder the capacity of the machine was somewhat limited by the effects of careless cultivation, and by the occurrence of large quantities of weeds, which, to-day, are seldom seen in grain crops. Therefore, it was not possible to increase the width of the swathe beyond 5 to 6 feet. Early in the present century a tendency to increase the width of the swathe was marked, and most reapers and binders were designed to cut widths of from 6 or 7 feet. This has again been increased following upon the introduction of the tractor.

The next development was the alteration in the design of the reaper and binder, to allow of its attachment to, and, above all, its being driven from a tractor instead of from the central big wheel, which had been the normal method of driving in the days of horse traction. Where reapers and binders are used at the present time horse and tractor draft are both still common.

4. *Harvesters*

From time to time in the early years of the present century, attempts had been made to utilize in New Zealand, implements of the harvester type, but owing to the length of the straw, unevenness of ripening, and other difficulties, it was not found possible to introduce these on a general scale for widespread use.

However, in 1925 or 1926, renewed attention was devoted to the harvester, and a number of types which had been successful in the United States of America and Australia were imported, and were found to function very satisfactorily. At this time, however, the users of these implements were favoured by exceptionally good harvesting seasons, and were guided in their work by the Wheat Research Institute, a factor which enabled them to deal with the crop at the best stage of ripeness. The effect of the introduction of the header-harvester has been to allow of the growing of wheat, and its harvesting on areas of comparatively light soil. The fact that these machines are capable of effecting a reduction of at least 30 per cent. in harvesting costs, have enabled farmers to continue in the growing of cereals at a price which can withstand successfully the competition of cheaper grain imported from overseas countries. Header-harvesters have shown in Canterbury their capacity to thresh and bag in in one day the wheat growing on from 8 to 12 acres of average land. Both the direct heading and the windrowing types of harvesters are in regular use to-day.

5. *Tractors*

Agricultural tractors have been in use to a slight extent, and with variable success, from about 1910 onwards. Their general adoption, however, was given a fillip by the War, and in the years succeeding the War their use became very general. Their advantages in improving the utilization of land have already been referred to, and these can be more or less attributed to the single factor of their being able to provide a greater tractive power than was possible with horses, unless the latter were coupled together in numbers, which made the size of the team somewhat difficult to control.

The advantages accruing to the use of tractors were principally shown up in the operations of ploughing and harvesting. In ploughing, it was possible to break up soil pans which had been formed by long years of ploughing to certain comparatively shallow depths, the tractor giving the additional power which was necessary for this operation. Furthermore, the speed with which the operation was done was a distinct advantage in almost all classes of soil, in that it allowed of a long exposure to the weathering influences of the atmosphere. This was marked in the case of

the stiffish clay soils where rapidity of action was essential to gain the advantages which endure for a brief period when the moisture content of these soils was at an optimum for ready cultivation.

In many cases tractors were worked in double shifts during the stress of the season. Tractors of the caterpillar type also served a very useful purpose for the considerable reclamation of swamp soils which has proceeded during the present century. The caterpillar tractor could be utilised on land of a boggy nature, and the power which such implements could develop enabled the turning of furrows of such a size as very rapidly smothered the weed growth. The successful reclamation of large swamp areas was due, in great part, to the advent of caterpillar tractors. Though oil tractors have been used for harrowing, drilling, and other operations where the simultaneous use of several implements was feasible, in general their use in this respect has not been extensive, and reliance is still largely put on the horse team for this class of farm work.

6. Miscellaneous

The handling of such crops as hay and ensilage has also been greatly facilitated by the use of sweeps and hoists. These have enabled a considerable saving of labour, and the extension of their use during the present century has enabled farmers, in general, to increase their conservation of fodder, thereby reducing fluctuations in stock population. Machinery has assisted in the intensive utilization of land in which conservation of fodder has replaced reliance upon the uncertain sources of feed to be secured on waste lands during off seasons of the year.

7. Shearing Machines

The wool industry, which was of such great importance in the 'seventies, and has maintained its importance, has not been greatly assisted by the use of mechanical inventions. Probably the only marked advance that has been made is in the designing of the shearing machine, which has largely, but not completely, replaced the blade system. The use of the shearing machine is again largely dependent upon the availability of a convenient source of power. Originally the driving power was provided by small portable steam engines, but the internal combustion engine has almost entirely replaced steam power, and in those districts where electrical reticulation has been established electricity is now the main source of power for the driving of shearing machines.

Shearing machines came into use in the first decade of the present century, and their extension was fairly rapid. The use of the machine became particularly general in those districts where there were small flocks and where farmers were catering for the mutton trade. On the

larger sheep stations located in the higher parts of the country, the adoption of the machine was less general, because it was found that the closeness with which the wool was removed left the animal in a condition liable to be seriously affected by storms or by heat and cold.

8. *Separators*

Mechanical progress brought generous assistance to the rapidly-developing dairy industry during the period under review. In the 'seventies and the 'eighties, it can hardly be said that dairying constituted an industry in New Zealand. At most it could be regarded as a side line of arable farming. Butter was produced on the farm and marketed locally, a small amount being placed in kegs and exported to Australia. Cheese was made almost solely for local consumption, and to supply the needs of shipping.

In the manufacture both of butter and of cheese, time-honoured methods were followed, and it was not until the industry became definitely established in the late 'eighties and early 'nineties that mechanical progress paid any part in its advance.

The first advance was the development of the centrifugal separator, which replaced the former methods of pan setting for the separation of cream from the milk. The centrifugal separator was installed in creameries, steam being used as the motive power. To these creameries farmers from the neighbourhood conveyed their milk each morning for separation, the skim milk being returned to them, and the cream either churned into butter or else transported to a central butter factory, where the churning and butter-making operations were carried out.

9. *Milking Machines*

The first two decades of the present century saw the gradual perfection of the milking machine, and, in addition to designs and types of machines which were imported from overseas, New Zealand inventors were prolific in producing types which gave very satisfactory results.

Simultaneously with the perfection of milking machines, the steady improvement of the internal combustion oil engine enabled farmers to have available a ready supply of motive power. Many of these machines were originally driven by steam power, but the increasing reliability of the oil engine had the effect of replacing the steam engine, which, although its position in regard to reliability made it rank high, had obvious disadvantages on farms.

The second decade of the present century, therefore, saw the enfranchisement of the dairy industry from the handicap of hand milking. The size of herds on farms increased, many new herds were established,

and as the numbers of cows thereon increased beyond the capacity of the family labour supply, milking machines were installed. The movement still continues, and to-day it is considered proper to install machines whenever the herd increases to a size over 20 cows. Originally milking machines were of the 'bucket' type, that is, the milk from each cow was collected into separate vessels, which were emptied when the milking operation was completed. These plants have, to a large extent, been replaced by the releaser type of machine, which by means of a vacuum tank draws the milk from all the teat cups into a single receptacle prior to its being delivered into the separator.

10. *Home Separation*

The next marked change in the nature of the dairy industry took place in the second decade of the present century, when the creamery system gave way to the home-separation system. Now that power was available on farms for the milking machinery, it could also be used to separate the cream after the milking was completed, or during the milking process. Furthermore, a number of isolated dairy farms, at long distances from settlement and from creameries, found the greatest difficulty in transporting their whole milk to central points for separation, and in the carting back of the skim milk. At this period road facilities were extremely poor in many districts. The use of small hand-driven separators steadily increased, and consequently, if farmers could market cream, instead of conveying their whole milk for separation, it would be possible for them, even though living at a distance, to engage in dairying, and supply butter factories. At first there was considerable reluctance on the part of butter factories to accept cream from such sources, because they feared for its quality. The continued growth of the industry, however, forced a change in opinion on this point, with the result that home separation became general during the second and third decades of the present century, and many creameries were closed.

11. *Electric Power*

Another very important development was the provision of electric power from hydro-electric power stations during the second and third decades of this century. In nearly every hydro-electric power scheme much attention has been devoted to the reticulation of country districts. Twice a day for some ten months of the year there is a steady demand for electricity for driving milking machinery, separating, and the provision of hot washing water. Electric power has therefore tended, wherever it has been available, to replace that derived from oil, and the introduction of electricity to farms has, at the same time, led to other amenities, such as

the provision of lighting, and power for pumping water, which have done much to improve the conditions of dairy farm life, and thereby facilitated the extension of dairying to farms and districts which otherwise would not have countenanced it.

12. *Pasteurisation and Refrigeration*

The pasteuriser and the ammonia refrigerating plant in factories enabled the raw products utilized in the manufacture of butter and cheese to be so dealt with that inherent defects could be rendered of less importance. In the absence of these devices, it would be necessary often to reject milk or cream as unsuitable for butter or cheese manufacture. Control of temperature and of organisms present in milk has been a very valuable aid both to the butter-maker and to the cheese-maker.

The outstanding achievement of the period under review was the elaboration of mechanical refrigeration. Originating in some obscure experiments conducted by Michael Faraday, subsequently elaborated by Harrison, of Geelong, and finally brought to a stage of practical satisfactoriness by Bell, Coleman, Mort, Lind and others, mechanical refrigeration saw its inception in New Zealand in the year 1882, when the first shipment of frozen mutton left Port Chalmers in the *Duncdin,* and was landed in a sound condition in London.

During the 'eighties and 'nineties, improvements in the process continued, and this period saw the definite establishment of a number of freezing works throughout the Dominion. Prior to the development of refrigeration, the New Zealand farmer was continually made aware of the restricted scope of his markets. The price of sheep was exceptionally low, because the mutton and lamb could not be marketed beyond the colony. The same restrictions applied equally severely to butter and cheese. It would seem that the New Zealand farmer was doomed in so far as the marketing of perishable products was concerned, and that he would have to limit his attentions to developing an export trade in non-perishable products, such as wool, wheat, and other grain stuffs.

The advent of refrigeration changed the outlook completely, although its great importance became realized only gradually. Nevertheless, it may be said that this realization took place in the 'eighties and the 'nineties, in a period of extraordinary economic depression. With the beginning of the century the value of the new markets, due to the development of refrigeration, began to exert a marked influence upon the prosperity of the colony.

It would be well, now, to review what influences were exerted upon land utilization by the development of refrigeration. In the arable districts, a complete change in crop rotation was possible. Hitherto, cereal crops were grown until the inherent fertility of the soil was exhausted. The land was then left fallow or sown in grass to maintain

sheep mostly for wool production. Fodder crops, such as rape and turnips, were grown to a very slight extent. The demand of the freezing works for fat sheep and lambs gradually made itself felt in altering this exhaustive type of rotation. Attention was devoted to the growing of rape, swedes and turnips, either before or after the cereal crop, and this rotation had the effect of maintaining and increasing the fertility of the soil for the subsequent cereal crop, which would be grown upon it. It was now both possible and payable to alternate cropping with stock farming.

By-products of the freezing works became available as manures, and the practice gradually developed of always sowing with the rape or turnip crops a certain amount of fertilizer. This, in addition to the effect of the grazing, improved the fertility of the soil, while the additional cultivation had a beneficial effect in the same direction. The result was the maintenance and increase in the yield of wheat and oat crops grown. The two cereal crops showed the benefits of the cleaning crop by the marked absence of serious weed growths which were previously characteristic of them.

The whole aspect of the utilization of arable land was therefore completely changed between 1880 and 1900, and enabled the land to be utilized to a much fuller extent, and for a wider range of crops than previously, while, at the same time, its degree of fertility was maintained.

In the non-arable areas the position was also changed. Sheep graziers on hill country were now provided with an outlet for their surplus store stock, and, in consequence, were enabled to maintain and increase their wool clip and dispose of this surplus of store stock to arable farmers, who would fatten them on the richer pastures, or on the rape and turnip crops grown on these areas.

The changes also induced changes in the type of sheep grazed. The original sheep of New Zealand were Merinos, imported from Australia, and made use of largely for the production of wool. The Lincoln and the Leicester were also introduced largely for mutton purposes. In many areas, however, the acclimatization of the Merino was not very satisfactory and an improvement was effected by crossing this breed with the long-woolled breeds available, and the half-breeds which resulted therefrom figured largely throughout the low hill country of the South Island. On account of the darkness of the flesh, the Merino breed was not found satisfactory for the export trade in mutton and lamb, and, in consequence, in an endeavour to produce a better-quality carcass, much attention was devoted to breeding, in the hope of evolving a type which would serve the dual purpose of production of a good fleece and of a good carcass. The results of these endeavours produced the Corriedale breed, which is now very widespread throughout the Dominion.

In order to get new stock for crossing purposes, importation of other breeds was continued, and among those which were imported, the Romney Marsh breed showed qualities which rendered it highly satisfactory for much of the heavier soils and damper climates of the colony. The Merino breed receded everywhere throughout New Zealand, and the hill-country estates, in order to dispose of their surplus store stock, altered their breeding programmes, so as to produce lambs containing less Merino blood. Nevertheless, the contest between the use of sheep which produce wool and those which produce meat still continues, and shows no sign of ever being finalized.

However, the effect of refrigeration was to diminish the importance of the Merino breed, and increase the predominance particularly of the Romney Marsh. Refrigeration was soon extended to dairy produce, and the growth of the dairy industry, which was helped by other causes, was also greatly facilitated by the use of cold storage aboard the transporting vessels, and by the erection of refrigerating stores, which enabled the output of the factories to be held in sound condition until put aboard the overseas vessels.

Insofar as the dairy industry was concerned, the advantages of refrigeration did not rest entirely in the assistance it rendered to transport. Refrigeration plants have been installed in butter factories, and have enabled a temperature control to be maintained over the manufacturing processes to an extent that previously was not possible. In this way, it became possible to manufacture a high-grade butter from cream which, without such temperature treatment, would probably, at best, have yielded a butter of doubtful quality.

Undoubtedly, no mechanical invention has exerted an influence upon the utilization of land in the Dominion to be compared with that arising from the development of refrigeration. If, suddenly, all knowledge of refrigeration were to be lost overnight, the whole character of New Zealand farming would alter; it would suffer a disaster of an unparalleled kind, and much of the land now used for the production of dairy produce and meat would become derelict.

B. Breeding of Stock

Among the personnel of the early settlers in New Zealand were a considerable number who had experience in the breeding and management of first-class stock, and who were appreciative of the value of quality in the animals with which they were concerned. This was a direct result of their earlier contacts and experience in Great Britain. In New Zealand the scope for the breeding of good animals was at first restricted because then the large overseas demands for animal products were non-existent.

The presence of good foundation stock, the fact that climate and food conditions were most suitable for all classes of stock, that many Old World diseases were absent, and that there was a good sprinkling of men versed in the art of stock breeding, resulted in the quality of New Zealand's horses, cattle, sheep and pigs being maintained at a high level. Most attention was devoted to horses, and many first-class animals, both draught and thoroughbred, have been bred in New Zealand, and a considerable export of both classes has at times existed.

The most conspicuous achievement on stock breeding during this period was the evolution of the Corriedale breed by James Little on Dr. Webster's estate in North Otago. The aim at the time was to produce a dual-purpose sheep, more suitable for New Zealand conditions than the then predominant Merino or the long-woolled breeds which had been introduced. Mr. Little was successful in the cross made between Romney and Lincoln rams and Merino ewes in the late 'seventies, and following up his initial work by careful selection, the 'Corriedale' breed has been evolved, and has proved its suitability for a very large area of country in the eastern portions of both islands.

Regular importations of stud animals of all classes of stock have been made, New Zealand breeders seeking out high-quality animals in all parts of the world, but particularly from Great Britain, America and Australia.

With the advent of herd testing, which spread rapidly during the third decade of the present century, a new basis for dairy stock breeding appeared. Breeding for production rather than for show-ring standards became very general, a much greater number of farmers became active breeders, more animals were imported, so that the general level of the dairy animals of the Dominion has shown a very marked improvement.

Breed societies were formed in almost every class of stock early in New Zealand's farm history. These societies commenced the registration of stock and the recording of pedigrees in accordance with the best standards then known. There was therefore always available to farmers a basis of a good class of stock upon which to maintain their herds or flocks. The advent of herd testing of dairy cows, of pig recording, and of egg-laying competitions enabled performance figures to be obtained so that breeding practices could henceforth be directed into lines based upon production figures.

C. Soil Knowledge[2]

During the period under review more attention was devoted to the bringing in of virgin land to agricultural and pastoral use, by practical methods, than to any close scientific examination of the different soil characteristics found in New Zealand. In the South Island, reclamation

2. See Chapter VI.

of land from the virgin state presented very little difficulty. In the North, on the other hand, difficulties were much greater, owing to the fact that most of the desirable areas were clothed in dense forest, and the extent of swamp soils was also large.

With the growing population, and the consequent scarcity in available virgin lands, settlement began to spread on to soil types which were peculiarly difficult to reclaim. In the North Island there were two types which presented serious problems: Firstly, what were known as the 'gum' lands of North Auckland Peninsula, occupying large areas which, for the most part, were clothed in bracken fern, short scrubby manuka, *Leptospermum* sp., and other small shrubs, growing on a humus-deficient soil, presented great difficulties in regard to drainage, pasture establishment and cropping. Experimental farms were established to test out the possibility of this type of soil. A wide range of pasture plants, crops, grasses and fruit trees were grown under control conditions. These trials enabled the possibilities of the gum lands to be thoroughly explored, and with the advent of chemical fertilizers it became possible to farm these successfully, particularly during the second and third decades of the present century. Fortunately, these lands were situated in an area where a great deal of advantage could be derived from the favourable climatic conditions, and gradually the methods of reclamation of this type of land became better known, so that to-day much of it is in use, principally for dairy farming and for fruit growing.

In the southern part of the Auckland Province there are considerable areas comprised of soil which owes its origin to the acidic volcanic rocks common all over the centre of the North Island. These soils are generally known as pumice soils, although a wide range of types exist under this term. To those who settled there first, and who were generally firm believers in the value of cultivation, this type of soil presented very baffling problems. However, their settlement coincided with the general adoption of chemical fertilizers, and with the development of the dairy industry. Pumice soils are generally low in humus, open in texture, and well drained. Applications of chemical fertilizers therefore produce remarkable results in a climate which is both moist and mild, so that the knowledge which was gained at experimental stations and field trials located on this class of soil soon bore fruits in the farm practices which were adopted generally by those who were settled on pumice land. It so happened, however, that there were forms of pumice soil which presented remarkable problems.

Bush-sickness, a form of stock anæmia, prohibited the successful utilization of large areas, which grew luxuriant pastures, but as the result of a long and careful investigation it was ascertained by Mr. B. C. Aston,

of the Department of Agriculture, that this trouble could be overcome by the use of iron compounds, given to the stock in the form of drenches or licks. The result of this since 1930 has been to render farming possible where hitherto it could not be successfully carried on because of severe stock losses.

Other parts of the pumice lands likewise show similar tendencies to be conducive to animal anæmic diseases. Mairoa 'dopiness' is an example in point, but this has now been successfully coped with, following upon investigations which have revealed the necessity for top-dressing of affected soils regularly with a mixture of limestone and superphosphate.

It was characteristic of the North Island soils that the bush covering of so much of the land obscured the different soil characteristics which appear in different districts. At first, farmers with experience of bush lands in the southern portion of the island were inclined to assume that the good soils which they had found after removal of the bush further south did exist in the Auckland Province. It was found, however, that the volcanic soils of the Auckland Province presented new and difficult problems, and these have only been solved as the result of patient investigation and research work.

In the South Island the soil problems did not arise to the same extent. In the Nelson district, however, the character of the soils was given close attention by Cawthron Institute. Soil surveys were made of the principal arable areas, and farmers in that district have received considerable guidance in the utilization of their lands as a consequence of the surveys and field experimental work undertaken by the Institute.

D. Fertilizers[3]

The successful utilization of much of the pastoral land of New Zealand is centred upon the application of chemical fertilizers. Top-dressing of pastures with chemical fertilizers has become very general in all the dairying districts of the North Island, and with the passage of time the use of fertilizers is steadily extending over a wider area in both Islands. Bone-dust, largely imported from India, and blood-and-bone manure, were perhaps the first fertilizers to be used in New Zealand on an extensive scale. On account of their cost their use was restricted. Furthermore, lack of appreciation of their disease-carrying characteristics resulted in there being left in parts of the Auckland Province an unfortunate legacy, in the disease known as Black-leg, so that calf-rearing has been rendered somewhat difficult in those districts which were infected by the importation of diseased and unsterilized bone-dust from India.

Although superphosphate, basic slag, and rock phosphate had long

3 See Chapter XIX.

been known as farm fertilizers, they had almost always been applied in conjunction with some cultivated crop. Top-dressing of grass pastures constituted an unusual use for these materials.

In the Auckland Province there was an absence of organic farmyard manure, and a general recognition of the poverty of the soil, insofar as humus material was concerned. In consequence, in the first decade of the century some small quantities of superphosphate and phosphate were imported and applied in the Waikato district by Messrs. J. Barugh and R. Reynolds. The results were promising, but the development came only slowly, and for a long time farmers remained unconvinced. However, very divergent opinions were held as to what were the most suitable materials for the purpose. Superphosphate, basic slag, rock phosphate, blood and bone-dust manures had their rival claims supported and contested, while there was an increase each year in the area top-dressed. Simultaneously, there was a growing recognition of the value of lime.

From the Waikato, however, the use of top-dressing fertilizers gradually extended to other parts of the North Island, the spread being naturally slower on the heavier classes of soil, where response came very slowly, and was often arrested by the characteristics of the soils to which it was applied. Numerous trials with these fertilizers were arranged in different districts, and an educative programme was instituted. At the same time fertilizer manufacturing works were established, often in association with existing freezing works, and in more recent years the demand for fertilizers increased to such an extent that individual superphosphate factories were founded in Auckland, Canterbury and Otago. These followed particularly with the acquisition of Nauru Island immediately after the Great War. This ensured a ready supply of rock phosphate at a very reasonable rate, and relieved local manufacturers of the task of securing supplies of rock phosphate from the more distant sources of the African Continent.

In consequence of the experience gained by farmers, and the results accruing to field trials, the value of superphosphate has been demonstrated to an extent that it has now become the predominant fertilizer used in top-dressing. There are certain areas, however, where basic slag and rock phosphate are favoured, but a remarkable characteristic has been the steady advance to a predominating position which has been made by superphosphate. In districts where this fertilizer made intensive farming possible, there has been a marked tendency in recent years to incorporate a nitrogenous fertilizer also, and, in consequence, since 1930 ammoniated superphosphate is used to an increasing extent as a top-dressing for pastures. The use of nitrogenous fertilizers has extended in New Zealand, firstly on account of the cheapening in the cost of sulphate of ammonia,

following the acquisition of the Haber Bosch process by Imperial Chemical Industries Ltd. in the after-War years; secondly, owing to the higher standard of pasture farming which has followed the general adoption of superphosphate, and the increased utilization of newer strains of grasses and clovers.

In the South Island, and in the drier districts of the North Island, the use of chemical fertilizers, particularly on pastures, has spread only slowly, and then only in those localities where the soil is moist and the pastures good.

With arable crops, however, there has been a marked expansion in the use of artificial manures. By 1920 most of the wheat crops of Canterbury were sown with applications of 1 cwt. of superphosphate or other manures per acre. Previous to this, such crops as rape, turnips and mangolds were almost invariably sown in association with these manures. In more recent years, as the result of further field trials, the economic value of spring top-dressings and nitrogenous manures has been demonstrated.

E. Plant Breeding and Selection

New Zealand has received practically all its economic crops by importation from overseas. The great seeds firms of England have always conducted an active trade with New Zealand. Within the country there has been an active interest in trying out new strains of all pasture and agricultural crops, and there has always existed among New Zealand farmers the feeling that there are still crops to be imported which will possess much better qualities than those already being grown. An active plant acclimatization desire, therefore, has always existed, and has been the means for bringing to the country a very numerous array of plants, some of which have survived and proved their fitness, and many of which have completely disappeared. While this reliance has been placed on overseas resources, little has been done within New Zealand itself, either in plant breeding or in plant selection. A few instances, however, should be mentioned where some work of this class has been successfully accomplished.

In 1908 Mr. A. W. Green, working at Ruakura, selected and improved a variety of Algerian oats, which showed a high degree of resistance to rust, the main disease affecting oats grown in the northern parts of New Zealand. Ruakura oats, for a number of years, had a wide demand throughout New Zealand and Australia.

About the same time a South Canterbury potato grower, Mr. H. E. McGowan, working on potatoes, produced two selections, known as Northern Star and Gamekeeper, which, because of their high resistance to the severe epidemics of Irish Blight, which was then very prevalent in

New Zealand, their yield and table qualities, became almost the principal varieties of potatoes grown in the Dominion.

In more recent years the question of plant breeding and selection was taken up more earnestly at Lincoln College, wheat being the principal crop worked with, and in consequence Dr. Hilgendorf has, as the result of scientific selection, coupled with field and quality trials, produced a strain of Hunters wheat, known as College Hunters, which is now grown very widely in Canterbury.

Since 1925 there has been an intensification of activity in connection with plant breeding and selection. At Lincoln College, following on the establishment of the Wheat Research Institute, the whole of the then grown varieties came under review, the numbers were considerably reduced, definite breeding work was launched, and the outcome has been the release, in 1934, of Cross 7, a White Fife X. Tuscan variety, possessing high yield, short straw, good strength, high-milling yield, and improved baking quality.

At Lincoln College, also, as the result of work on Cocksfoot, a superior strain of Akaroa Cocksfoot C23 has been produced, and is now being commercialized.

At the Plant Research Station, under the direction of Mr. Bruce Levy, a great deal of pasture selection work has been done.[4] Recognizing that the pastures of New Zealand contain material of undoubted value, these have been carefully scrutinized, plants of ryegrass, cocksfoot, brown top, white clover, etc., have been selected and grown on a massed scale, and subjected to further close tests in experimental areas. The result has been the development about 1929 of an excellent strain of ryegrass, Hawke's Bay strain, and of a high-yielding white clover, known as New Zealand No. 1 White Clover. These strains are now being used to an increasing extent in all pasture mixtures, and their productivity is being reflected in the carrying capacity of pastures established therewith.

A certain amount of selection has been done with almost every agricultural crop in New Zealand, but difficulty has been experienced in many cases, through those who have produced these supplies being unable to multiply them on a scale satisfactory for commercial purposes.

II. THE DEVELOPMENT OF ORGANIZED INVESTIGATIONS DURING THE DECADE 1920-1930

A. General Description

With the end of the War in 1918 came a period of rapid agricultural development and reconstruction, in which the spirit of scientific organization which prevailed during the latter years of the War was much in the

4. See Chapter XVIII.

air, a great endeavour was made to retain, for times of peace, the scientific organization which had been established during the War. Every industry had been affected by this impetus, and, further, there was available a large number of scientists whose attention in recent years had been directed particularly to the industrial obligations of their own sphere. Everything seemed set for a distinct advance, which was likely to have a profound influence on all industries, including the farming industry. In New Zealand there were difficulties in regard to organization, because, unlike Great Britain and other overseas countries, the War had called for no establishment of any scientific organization in New Zealand. The matter, however, was being given a considerable amount of thought from, at any rate, as early as the middle of the previous decade. From 1915 onwards there appeared a number of suggestions made by the New Zealand Institute, by prominent scientists and by various committees, who were giving thought to an organization which would make scientific assistance available to all industries. Many ideas and plans were put forward, but there was difficulty in establishing an organization which would function satisfactorily for the Dominion as a whole, and which would service its industries and fall in line with the already existing institutions.

In order to clarify ideas, the Government decided to ask Sir Frank Heath, Director of the Scientific and Industrial Research Department, England, to extend to New Zealand an already projected visit to Australia, for the purpose of reporting upon the best organization that should be established, whereby science and industry would be brought into contact.

Sir Frank Heath's report was presented to Parliament in May, 1926, and on it was based the Scientific and Industrial Research Act, which was passed by Parliament during the same session. This marked the beginning of a systematic attempt to provide scientific service to the industries of New Zealand, in the forefront of which stood agriculture.

Sir Frank Heath's report drew particular attention to the need for scientific assistance for primary industries, among the first of which was dairying, for which he prescribed the establishment of an Institute of Dairying, as being the first and most urgent need. Elaborating his general ideas of this Institute, and its relation to the existing dairy organization of the Dominion, Sir Frank Heath suggested that it be the model for others which would subsequently be formed to deal with such matters as grain and grass crops, fruit, cattle, sheep and meat industry and transport, and, indeed, to supply all requirements for agricultural research. Accordingly, when the Council of Scientific and Industrial Research was established, it directed its first attention to the provision of research services for dairying, and the newly-constituted Department of of Scientific and Industrial Research was asked to make the fullest enquiries

and prepare a scheme of organization which would be suitable for that industry.

B. Main Organizations

1. *Dairy Research*

None of New Zealand's primary industries showed themselves more plainly in need of the assistance which scientific progress could render than the dairying industry. Prices for dairy products had remained at a high level since the termination of the War. Markets appeared to be expanding, and there was an unlimited demand for all the butter, cheese and dried milk which could be produced in the Dominion.

The leaders of this industry, which, it must be remembered, was strongly organized on a co-operative basis, were far-seeing men, many of whom had made recent contacts overseas. It was apparent to them that in New Zealand's main competitor—Denmark—very close attention was being devoted to the scientific aspects of the industry, and with results which reflected markedly in the success which attended it. In Denmark, as the result of the development of the dairy industry, and its ramifications, land was being utilized on a more intensive scale than in almost any other pastoral country in the world. Again, in the United States of America, which, in past decades has already inspired much of the dairy advance made in New Zealand, there were to be found numbers of laboratories engaged very actively upon all problems affecting dairy produce.

While, perhaps, the general level of the industry of the United States of America was not up to the same standard as that of New Zealand, its scientific equipment was infinitely superior, and it was in a position to give the Dominion a lead on many points which it could put into practice with advantage. Indeed, up till 1920, the development of the New Zealand dairy industry was almost entirely in the hands of the practical men. The standard achieved was an excellent tribute to the soundness of the practice they adopted. The industry possessed little or no scientific equipment. A kindly Nature, together with a degree of alertness on the part of the practical farmer, butter-maker, cheese-maker, who gathered in a store of information from abroad, who was alive to the advantages of the adoption of practices devised in overseas laboratories —these were the circumstances in which New Zealand's dairy industry had attained a status which was, in many respects, the envy of the world. Nevertheless, there was a growing feeling that the limit of inspiration from overseas sources was being reached. Difficulties were appearing. which could not be solved by the adoption of overseas recommendations. There was a growing appreciation of the importance of the local problem. There was a growing feeling, too, that a greater degree of scientific guidance and assistance was required in the ordinary technique of the industry. The

rapidity of its growth during the previous decades, a growth which was still proceeding rapidly, was tending to reveal a scarcity of highly-trained factory managers of mature experience. Promotion in the dairy industry had been rapid, and the seasonal nature of the employment had had the effect of turning away from it many of the better type of employees who might, ultimately, have made excellent factory managers. There was undoubtedly a feeling that this, and the attractions which other industrial avenues were providing, had done something to reduce the efficiency of the average factory manager. It therefore was considered an opportune time to remedy some of this lack of efficiency by utilizing to a greater extent some degree of scientific assistance and guidance. It was felt, too, that probably problems and defects which arose could be solved more rapidly by a scientific than by a practical approach. The result was that when a considerable number of the smaller co-operative companies, operating in one of the main dairying districts of the Waikato, amalgamated to form the N.Z. Co-operative Dairy Company, the largest dairying unit in New Zealand, it then became possible to establish, in 1921, a laboratory at Hamilton. As an industrial laboratory, its purpose was, firstly, to deal with the large amount of routine testing which was necessary in such a large organization in order to turn out standardized high-quality produce. This was necessary at a time when the markets of the world were demanding large supplies of evenly-graded butter and cheese. In addition, such a laboratory would be able to investigate the new and local problems which the rapidly-changing conditions of the industry demanded. This company, through its amalgamation, found itself manufacturing a large range of dairy products, which included butter, cheese, casein, dried milk, and dried skim milk, and in addition there were hopes that even this wide range of products would extend to others.

The amalgamation brought about by the establishment of this company enabled the findings of the laboratory, and its guidance, to be implemented throughout a wide area by means of an instructional controlled scheme which brought to every farmer sounder knowledge of how to produce better-quality raw material and a higher degree of utilization of his soil and pasture resources.

In Taranaki, a province in which dairying had been longer established than in the Waikato, the organization of the dairy industry was much on similar lines to that prevailing elsewhere in New Zealand, namely, a large number of small co-operative factories working more or less on independent and competitive lines. This province was also concerned more with the manufacture of cheese than with the production of butter. Probably the fact that the various co-operative units had been longer established, and had rather prided themselves on their individual capacities, made

them loath to reorganize by amalgamation on the same lines as that which had taken place in the Waikato. They had, however, reached a degree of mutual understanding, and had formed the Federation of Taranaki Co-operative Dairy Factories, within with each company maintained its identity. The leaders of the Federation, realizing that the move made in the Waikato, in the direction of establishing a laboratory, was also highly desirable in Taranaki, in 1925, with the assistance of a grant of £1,000 per annum for three years from the Department of Agriculture, set up a laboratory at Hawera, and appointed a chemist to undertake the routine testing, and as far as possible engage in the investigation of local problems.

The Dairy Division of the Department of Agriculture was largely controlled by men possessed of sound practical knowledge, who were guided by the work of overseas investigators. A certain amount of investigation was done through the Chemistry Division of the Department of Agriculture. The Chemistry Division, however, was required to undertake the work of its whole Department, and was unable to specialize on dairy problems. Consequently, it could give only a limited amount of time and attention to the requirements of this growing industry.

At the time of Sir Frank Heath's visit in 1925 it was apparent that an industry which was exporting some £16,000,000 worth of produce, and which was essentially dependent upon scientific knowledge in all its processes, was not very well provided with scientific assistance. Negotiations were therefore commenced with a view to bringing all interested parties together for the foundation of a central Institute, which would be adequately provided with staff and facilities to undertake work for the industry.

The Dairy Division of the Department of Agriculture already had in view the establishment of a special factory and laboratory at Wallaceville, near Wellington. At the same time there was being considered the foundation of the Massey Agricultural College, in the vicinity of Palmerston North, the intention of the Government being that this College should interest itself largely in dairy matters. As a result of conferences between those interested, it was finally decided to establish, in the proximity of Massey College, a Dairy Research Institute for New Zealand, and in order that this Institute should not be in any way isolated it was decided, with the consent of the controlling bodies concerned, to affiliate the Hamilton and Hawera Laboratories with the main Institute. It was agreed that the Dairy Research Institute at Palmerston North should primarily carry out research in connection with a number of long-range problems which already had cropped up within the industry, and that at Hamilton and Hawera portions of these major problems and other local ones should also

be attacked insofar as the staff and opportunities permitted. Grants were made both to Hamilton and to Hawera for the furtherance of the research portions of their work.

The Dairy Division, in order to deal with the routine matters, agreed to establish a laboratory for this purpose in the proximity of the Dairy Research Institute, at Palmerston North, but later events have led to the location of this activity at Wallaceville.

The experimental factory which the Department of Agriculture proposed to erect at Wallaceville, was then erected on the Massey College property, and in its vicinity, temporary laboratories were established, pending the erection of the main College block, which was designed to provide the necessary permanent accommodation. The Dean of the Dairy faculty, at Massey College, Professor William Riddet, was appointed Director of the Dairy Research Institute. The dairy land, buildings, and herds of the Massey College were made available to provide the necessary raw material for experimentation. The factory was arranged to house both butter- and cheese-making machinery, and the whole of the plant was so arranged to facilitate, in particular, research activities.

In the establishment of the Dairy Research organization, an important part was played by the New Zealand Dairy Produce Board. This Board had been formed in 1923 in order to deal with the transport and marketing of New Zealand dairy produce overseas. Its members were alive to the advantages which a proper scientific guidance could provide to the industry, and the Board, from the funds which it raised through a levy on the produce of the industry, made a generous grant amounting in the first year to over £3,000, for the purpose of promoting dairy research. This grant has since been increased, and the annual payments of up to £4,400 have subsequently been made for research purposes. The Board itself, in addition to financial grants made, maintained the closest interest in the work in hand, and has been the means of facilitating many of the detailed activities of the research programme in a number of directions.

In order that the work of the Institute should be conducted in as close a contact as possible with industry, the Council of Scientific and Industrial Research, which had been the active body in promoting the establishment of the new scheme of dairy research, set up a Dairy Research Management Committee, on which were representatives of the Dairy Produce Board, the Department of Agriculture, Massey College, and the New Zealand Factory Managers' Association, to guide and control the work of the Institute. This Committee has taken its duties seriously, and played an active part both in the promotion of the work of dairy research, and towards interesting dairy farmers and co-operative factories generally in the results emanating from the investigations, with a view to bringing them into rapid practical use.

2. Noxious Weeds Research

Noxious weeds research was one of the first investigations undertaken by the Department of Scientific and Industrial Research, and its establishment actually preceded that of dairy research.

The inception of the Department of Scientific and Industrial Research followed the establishment of the Empire Marketing Board, and among the early grants made by this Board was one for the purpose of investigating means for the control of noxious weeds throughout the Empire. About this time entomologists possessed considerable hopes that noxious weed growth could, to a great measure, be checked if these weeds were exposed to the attacks of their natural insect parasites. The measure of success which had attended the efforts of entomologists who were endeavouring to combat the prickly pear in Australia, and lantana in the Sandwich Islands, was referred to as examples of what could be achieved by this means. Moreover, very impressive results had been secured in New Zealand by Dr. R. J. Tillyard, of the Cawthron Institute, whose importation of the insect *Aphelinus mali* had proved remarkably successful in the control of the serious orchard insect pest *Woolly aphis.*

At this time in all the farm areas of New Zealand where the rainfall was fairly high, the menace of blackberry had become very serious. This weed was regarded as one of the most serious pests which was detracting very largely from the value, especially of dairy lands. Its spread over much of the second-class hill country was rapid and marked. The provinces of Auckland, Hawke's Bay, Taranaki, Nelson and Westland were menaced by the rapid advance of this weed, which was readily spread by birds, and which, once it appeared, was exceedingly difficult to control, especially in hilly country where machinery could not be used in its suppression. Not only did it prevent areas being used for pasture, but the nature of its growth was responsible for the deaths of many sheep which became entangled through the thorns gripping their wool.

Another weed which was constituting formidable menace was ragwort (*Senecio jacobaeae*). The occurrence of ragwort in large portions of the Auckland, Taranaki and Wellington provinces made the grazing of cattle on land infested with this weed a risky process. Its spread, therefore, constituted a menace to the dairy industry. It could be kept in check, to a certain extent, by grazing with sheep; but its spread was so prolific that even the use of sheep as grazing animals was not sufficiently adequate to obviate the trouble which it caused.

Throughout large portions of New Zealand, especially where settlement had proceeded rapidly, land which originally carried bush growth became covered with bracken fern, *Pteris* sp. This growth was probably responsible for rendering useless more land in New Zealand than any

other single species. Its presence over such a large area could, in the main, probably be attributed to imperfect farm management, and to the use of poor species in pasture mixtures. An astonishingly large area of New Zealand had reverted to fern, and the area appeared to be rapidly on the increase, thereby seriously limiting the acreage of pasture.

Considerable use had been made in New Zealand of gorse—*Ulex Europaeus*—particularly for fences and subdivisions. These plants had seeded prolifically, and in many cases had spread over large areas where they formed thickets impenetrable to stock. The longevity of the seed in the soil rendered it difficult to clear any particular area completely of gorse, for once the original covering was removed the seeds buried in the ground continued to germinate over a long period of years, and, in many cases, successfully contested with grass and clover for the use of the soil.

These four weeds therefore constituted a serious menace to farming in New Zealand. Their annual spread was considerable. The amount of time, labour and expense already incurred by the farming industry annually in endeavouring to maintain these under check was large, and, further, they were providing shelter for a number of other obnoxious animals (rabbits) and providing breeding grounds for other pests which harassed the farmer.

The Empire Marketing Board, at the request of the Council of Scientific and Industrial Research, therefore made a grant of £2,000 per annum for five years to promote investigations into methods which would ensure some measure of control of these weeds. The amount was subsidized by the Government on a pound for pound basis, so that for the quinquennium period from 1926 the sum of £4,000 annually has been devoted to ascertaining what measure of control of these noxious weeds could be affected by the importation of their insect enemies.

The work was carried out at the Cawthorn Institute, where a further grant made by the Empire Marketing Board enabled the erection of well-equipped entomological laboratories and insectaries. The work originally was under the direction of Dr. R. J. Tillyard, and latterly of his successor, Dr. David Miller.

In view of the record of bitter experience which has befallen New Zealand through the uncontrolled importation of animals, insects and birds during the period since its colonization, it was determined at all costs to take the utmost precautions with the importation of insects which were likely to be of use in the control of noxious weeds. In order that the position should be safeguarded in this direction, and that the whole of the work should be under sound guidance, the Council of Scientific and Industrial Research established a Noxious Weeds Research Committee,

consisting of biologists and farmers, who would supervise all importations. All importations which were to be tried out for the control of noxious weeds were therefore required to pass drastic tests in the insectaries at the Cawthron Institute before liberation. The adoption of such a course in the interests of safety naturally slowed down the progress of the work to a considerable extent, as most of these species imported required to be brought from the Northern Hemisphere, and consequently acclimatization was found to be a formidable task, even before actual investigations on the behaviour of the insects in New Zealand were commenced. The conduct of such trials under insectary conditions was therefore difficult, and, furthermore, a great deal of exploratory work had to be done on a number of points, because the handling and treatment of insects along these lines was more or less a completely new field of entomology.

For each of the four weed species abovementioned, numbers of promising insect enemies were imported.

In the case of blackberry, no success has attended the efforts of the Institute. Apparently this plant is attacked effectively by very few insect species, and those which do so also show quite a partiality for other plants of the order Rosaceae, which, in New Zealand, constitutes a very important economic order in so far as horticulture is concerned.

Ragwort has been attacked severely by *Tyria jacobaeae*, an insect which has passed all the drastic tests, and which was liberated in 1929. Colonies of *Tyria* have been established throughout the ragwort-infested areas of the Dominion, and its acclimatization behaviour in much of these districts closely supervised. Reports to hand indicate that the insect became fairly well established in several areas but has not persisted. More recently a seed parasite of ragwort has been introduced with a view to checking the seeding of the weed rather than controlling its vegetative growth.

One insect has been imported to deal with gorse, a species of beetle termed *Apion ulicis*. Great difficulty was experienced in connection with its acclimatization, and the drastic conditions under which the tests were required to be made seemed extremely prejudicial to the life of the insect. Nevertheless, means have now been adopted to overcome this trouble to a fairly large extent, and the insect is being reared successfully in New Zealand. It is exceedingly selective in its range of feeding material, showing no desire to live on any plant other than gorse, so that in 1931 it qualified for a partial release permit to enable it to be tried out in specified localities under more natural conditions. A difficulty that has been experienced in connection with this insect arises through the flowering period of gorse in New Zealand. In the Dominion, as distinct from overseas, gorse comes into flower in the early winter months, and continues in bloom until late spring. This period of the year is not that at which *Apion*

thrives, and consequently a severe restriction is imposed upon the acclimatization of the insect, and upon its general activities.

No insect apparently shows a marked affinity for bracken, and work in connection with this weed has not progressed. There is, however, in New Zealand a serious rosaceous pest in the native piripiri—*Acaena* sp. This grows extensively on sheep pasturage, and flowering in spring sends up heads which are covered with sharp burrs, which readily cling to the fleece of sheep, and so impregnate the wool with masses of vegetable matter. These burrs are attached to the seed, and sheep from piripiri-infested country therefore readily spread the weed to new areas. In addition, the presence of a large amount of vegetation in the fleece renders it troublesome to handle at shearing time, and reduces its value from the manufacturers' standpoint. To combat this weed pest *Antholcus varinervis*, a Chilean species, was imported in 1932, but as only small supplies have been secured and its spread is slow, this insect has not made as yet great headway.

A far greater measure of control of noxious weeds has attended trials with chemicals in New Zealand during the past decade. Species of bracken and hard fern have been destroyed by the use of arsenic pentoxide spray, while sodium chlorate has been found most effective to combat a wide range of weeds, and especially ragwort. Nevertheless, the control of noxious weeds must always be a serious consideration to the farming industry, and it would seem necessary to pursue investigations of a biological, chemical and mechanical nature in association with farm management with a view to minimizing, as much as possible, the reversion of useful land to weed growth, with its consequent and growing threat to all land in its vicinity, and to lessen the large annual cost which confronts the industry in labour, machinery and time spent on checking a growth which tends to choke both pastoral and agricultural crops.

There is no doubt that were there ready means either of controlling or of utilizing the present weed-infested areas of the Dominion, its agricultural and pastoral production would be greatly increased.

3. *Mineral Content of Pastures Research*[5]

At the time when the biological control of noxious weeds was occupying a prominent place in scientific thought, the part played by minerals in animal nutrition was also receiving a good deal of attention. For over 30 years the Dominion recognized that a large area of its potentially valuable agricultural land, situated on the northern fringe of the volcanic plateau, despite the fact that it grew luxuriant grass and clover, was unhealthy for stock through the presence of a mysterious disease known

5. See Chapter VI.

as 'bush sickness.' Investigations had been conducted by the Department of Agriculture over a long period in the search for the cause of this trouble, and finally it was attributed by Mr. B. C. Aston, Chief Chemist to the Department, to the deficiency of iron present in the pastures occurring on this class of soil which, on analysis, was proved itself to be low in iron content. It should be mentioned in passing that the soils over a vast area of the North Island of New Zealand have been formed in a unique manner. Their underlying strata consists of material ejected from a number of volcanic vents in past ages. These outbursts have spread what may be termed 'volcanic ash' over the central plateau. Variation occurs in the character of the ash which has been ejected at different times, and while in many parts it produces soil of exceptional fertility, there are certain areas which possess somewhat unique characteristics likely to deceive the practical farmer, and which, in their worst instances, actually prevent successful farming altogether. In this latter class belong the 'bush-sick' areas. The work on these areas in New Zealand was original, and the attribution of stock sickness to deficiency in minerals was a novel suggestion. With the passage of time it was found that other portions of the volcanic plateau, which had, for a time, at any rate, been successfully farmed, gave evidence that they were no longer able to maintain stock in a thrifty condition. In some cases the position gradually grew so bad that these areas could not be farmed profitably. Sheep and cattle, in the midst of a plentiful supply of feed, gradually wasted away, and unless moved on to a different class of country, became exceedingly emaciated and died.

It was recognized throughout the Dominion that there were a number of areas, even on land not located on volcanic soil, where stock were more or less unthrifty. Where analyses of the soils and pastures were made, it would appear that the results indicated somewhat abnormal contents of minerals at various periods of the year. These abnormal contents applied particularly to lime, phosphate and iron. With the knowledge of these conditions which prevailed in New Zealand, the Council for Scientific and Industrial Research secured from the Empire Marketing Board a grant of £2,000 per annum for five years for the purpose of extending the investigations, which were already proceeding in New Zealand, into a mineral content of pastures research and widening their scope. This grant was supplemented on a pound for pound basis by the Department of Agriculture, which had already long been engaged on these investigations, and by the Department of Scientific and Industrial Research. The work was carried out by the Chemistry Division of the Department of Agriculture, under the direction of Mr. B. C. Aston, and by the Cawthron Institute, under the direction of Mr. T. Rigg. The whole of the work was placed under the general supervision of an Advisory Committee of the Council

of Scientific and Industrial Research, and on this Committee were representatives of scientific and farming interests.

The work undertaken as a result of these steps, involved investigations of the volcanic soils of Mamaku, Mairoa and Kopaki, these being selected as typical, while a few other areas scattered throughout the Taranaki and Wairarapa districts were also included as possibly having some relation to the main problem.

The work of the Cawthron Institute was limited to the soil types occurring on the Moutere Hills and at Glenhope, on which grazing stock had exhibited signs of unthriftiness.

These investigations have now proceeded for a period of some five years. Their general nature has been the systematic and detailed examinations of both soils and pastures during each month of the year, while, in addition, a certain number of top-dressing trials and animal feeding trials have been inaugurated. It will be realized that in order to get an adequate picture of the changes occurring in pasture composition, a vast number of analyses of very carefully selected samples required to be made. The result has been the throwing of a great deal of light upon the changing nature of the pasture throughout the year. The results of the investigations have almost reached a stage when the definite feed value of pasture at any time of the year, and under ordinary manurial treatment, can actually be gauged.

In regard to the particular problems of direct interest to the farming community, it has been found that the stock anaemia known as 'bush sickness' may be effectively cured in the case of cattle, sheep and pigs by the administration of iron. Originally, an attempt was made to secure the ingestion in the form of organic iron, the pastures being top-dressed with iron manurial compounds, but, unfortunately, the open nature of the soil and the costliness of suitable iron salts rendered benefits from top-dressing of an exceedingly temporary nature. This practice has in consequence been abandoned in favour of the administration of iron directly either by direct dosings or by providing stock with licks or pellets containing iron. A marked success has attended even the administration of forms of insoluble iron (carbonates and oxides) to stock, and as these iron compounds are comparatively cheap, there is provided for farmers on bush-sick areas a fairly ready means of maintaining the thriftiness of their cattle and sheep. The position to-day reveals how complete is the success which has attended these investigations. Over the area where bush sickness occurred in its acute forms the use of a limonite-salt lick has become almost a universal farm practice, with the result that sheep and cattle can now be maintained in good health during the whole year, that the mortality due to anaemic diseases is reduced to a minimum, and

that there now is no need to arrange periodical changes for stock grazing on bush-sick country. The milk production of dairy cows has shown marked increase while high percentages of fat sheep are secured in flocks where previously it was exceptional to get any fat stock at all. In consequence it will now be possible to economically utilize some 2,000,000 acres which have been liable to this disease, and much of which is admirably adapted for farming purposes. The cost of the treatment is very small, £25 being adequate to provide adequate limonite-salt mixture for a year for a flock of 7,000 sheep.

In the areas on the western side of the Volcanic Plateau, in the vicinity of Te Kuiti, it has been found, as the result of feeding trials, that top-dressing of the pastures with a manurial mixture, where lime and superphosphate are used at the rate of 5 cwt. of the former plus 2 cwt. of the latter, can successfully combat stock unthriftiness, which is similar to bush sickness in many respects, and which is known locally as 'dopiness.'

These two results stand out as those most successful from the North Island investigations.

In Nelson, on the Moutere Hills type of soil, sheep were found to become very unhealthy owing to the presence in their kidneys of large calculi, which, on analysis, were found to consist mostly of the organic compound Xanthin. The analyses of the pastures in this case showed that the lime and phosphate content were low, the latter abnormally so, and, in consequence, the application of lime and phosphate top-dressing to this type of soil suffices to overcome this stock malnutrition ailment.

On the Glenhope area, detailed investigations of soils and pastures showed that although the origin of these soils was entirely different from that of the North Island volcanic types, their analyses showed a striking similarity in iron content to those of the North Island type, while the symptoms of the malnutrition as it occurred in the sheep also bore a strong resemblance to the malady known as 'bush sickness.' These comparisons naturally led to the assumption that the diseases were identical, and further work indicated that although the iron content of the Moutere Hills and the Glenhope soils was in both instances low, that on the Moutere soils possessed a higher degree of solubility, and consequently was more likely to become available in the alimentary canal of the animals.

Viewing the mineral content of pastures investigations as a whole, it would appear that the progress made with the researches has thrown a great deal of light on methods for overcoming stock diseases which can be attributed to faulty nutrition. New Zealand is a comparatively young country, and, as yet, farmed on extensive lines in very many districts. The rapid change which has taken place between the bush-covered soils

of less than 50 years ago to pasture and arable lands naturally brings such problems as those connected with stock health and disease.

Investigations have thrown completely new light upon the influences that may affect stock health, and the important part which defective nutrition may play in this connection has now been fully realized. It would therefore appear that the lesson learned on the acutely-affected districts of the North Island Volcanic Plateau and in Nelson could be applied quite satisfactorily over those other portions of the farm lands of the Dominion where stock health is not all that it should be, and where the production of milk, meat and wool is now restricted in consequence. With the rapidly approaching and more intensive use of the Dominion's farm lands, this knowledge will enable the rapid progress of stock-carrying intensification, which has proceeded uninterruptedly since the inception of the colony, to continue, and the present extensive system to be converted successfully into a more intensive one. It may here be pointed out that provided stock had a sufficient range covering different varieties of soils, the maintenance of health and thrift was possible. When, however, subdivision of large estates into smaller, and fencing restricted the range of animals, there immediately came into prominence such problems of sickness and unthriftiness.

4. *Phormium*[6]

New Zealand's phormium industry may be regarded almost in the light of an extractive one, insofar that natural resources of this plant were being worked in much the same way as were the indigenous forests of the country. Considerable areas of this plant occurred in swamps and provided sufficient material for milling purposes, without any particular attention being given to its culture or treatment along the lines usually accorded to any crop. In most cases the flaxmiller either possessed freehold or leasehold or licensed rights over his production area, and he viewed his position as miller much in the same way as did the sawmiller insofar as he gave no great attention to taking steps towards insuring a continuation of supplies. A few of the millers did interest themselves in the actual growing of the phormium plants, but these exerted no appreciable effect upon the growing of the commercial crop as a whole.

It is well to appreciate that an ordinary phormium swamp consists of an aggregate of different types of strains of plants, and in the manufacturing process an attempt was made to bring all these to a common denominator for hemp production by passing them through stripping machinery. This, however, did not suffice to obliterate variations in length, strength and colour found among the plants in such a swamp.

6. See Chapter XXVI.

If flax were to be regarded as a crop, then it was only natural that there should be selections of different types of plant, and that these should be grown in aggregations, so that the machinery would require to deal only with an even range of raw material. This move in the direction of securing a uniformity has been characteristic of all plants which are grown as crops.

No farmer consistently attempts to grow a mixture of wheat, oats or potatoes in any one area, mainly because the individual strains required differential treatment at some stage during their life. With the mills working on the native swamps, these were among the worst troubles which they were encountering, through the normal variations which occurred between the individual plants comprising the swamp population; but it was not this fact so much as the fact that competition with other cultivated fibres was making the marketing of New Zealand hemp increasingly difficult, coupled with the fact that a number of the swamps were showing signs of exhaustion and of the inroads of disease, particularly that known as Yellow Leaf, that stimulated those concerned with the industry to promote investigations and research.

The Council of Scientific and Industrial Research was sympathetic to the proposals put forward by the industry, and accordingly constituted an Advisory Committee, the Phormium Research Committee, and successfully impressed the Government with the importance of the position, so that it was decided to place a levy of 2d. a bale on all phormium fibre submitted for grading, and 1d. per bale upon tow. This provided funds to embark on a limited amount of investigation. It was decided that botanical investigations should be commenced with a view to selecting, gauging and propagating strains of flax which had been proved as possessing desirable qualities. In addition, it was proposed to extend the hybridization work which had been originated by Mr. A. Seifert, one of the leading flaxmillers of the Manawatu, with the same object in view, namely, the development of high quality strains of phormium tenax. Associated with this work, a definite attack was to be made upon the cause of and the remedy for Yellow Leaf disease. This biological work was placed under the direction of Dr. J. S. Yeates, Lecturer in Botany at the Massey Agricultural College, Palmerston North.

At the same time investigations were inaugurated with a view to ascertaining whether less expensive methods of handling stripped flax than the present method of paddocking and stacking could be developed by the use of chemical bleaching, mechanical washing, and dehydration; and, lastly, steps were taken to send trial shipments of selected fibres overseas with a view to ascertaining what modifications were necessary for it to occupy a wider part in manufactures, and whether the utilization

of this fibre could be extended to other spheres than those for which it was then being used.

It so happened that about the time the research scheme was being launched, a wave of rapid development in the industry was apparent. Proposals were afoot for the establishment of plantations of flax over a number of swamp areas, particularly in the Auckland and Wellington provinces. It was, therefore, important that the large expenditure proposed on plantation purposes should be judiciously made, and that the best types of flax plants should be used. Unfortunately, the best knowledge for this purpose was not then available, and, consequently, a large area of phormium was actually established without making use of the help that scientific investigations might have rendered. Had the knowledge been available to the promoters of these enterprises, there is no doubt that greater success would have attended their efforts.

At the present time the progress of the botanical investigations has provided information upon desirable strains of flax. One of the hybrids developed—13K x SS—has shown distinct promise, and is now being propagated to a sufficient extent in nurseries to enable supplies to be available for new areas. There are a number of other hybrid selections which are showing promise on account of their yield and for specialized uses which are also being multiplied. Investigations of the type of soil most suitable for flax growing have indicated that the plant requires good, rich soil, such as would be capable of maintaining a good dairying pasture. Wherever plantations upon peaty swamp areas have been made, the results have largely been failures, the plant failing to produce the multitude of fans which it normally does on better types of soil.

The investigations designed to counteract Yellow Leaf were fruitless, and the belief now exists that the cause of this disease is attributable to the presence of certain viruses, and a good deal of advance will have to be made by those who are dealing with the fundamental characteristics of these agents before any practical measures of control can be attempted in the case of phormium.

Chemical investigations showed that by the use of cheap bleaching agents, such as potassium permanganate, and certain of the sulphur sodium compounds, satisfactory colour could be obtained, but owing to the fact that this work really required to be done in association with the whole of the milling and bleaching processes its economic significance has never really been fully decided.

The trials arranged overseas with such bodies as the British Admiralty, the Imperial Institute and the Bureau of Standards, Washington, threw considerable light upon the purposes for which phormium fibre was suitable. The British Admiralty has now decided to use phormium for certain

A good deal of private investigation is proceeding in connection with phormium, especially upon the lines of making use of it for fabric manufacture, and there is no doubt that any manufacturing process which will extend the sphere of the uses of the phormium fibre will be of considerable assistance to the industry, and will probably hasten the development of flax along the lines of a crop, and an extension of plantations on individual farms.

There seems a distinct promise that once flax is regarded in full sense as a crop, then there will be an extension both of its growth and of its utilization in various manufactures.

5. *Wheat Research*

Wheat has been grown in New Zealand since its foundation, and in the earlier years of the colony the distribution of wheat was much wider than it is at the present time. Almost every province then grew some wheat, but with the passage of time, the growth of this crop became restricted to the drier portions of the Dominion and mainly to the eastern provinces of the South Island. In general these grew sufficient wheat to provide for local requirements, and, at times, a small surplus was available for export. In the first and second decades of the present century, however, the local production of wheat was insufficient to meet requirements, imports had to be resorted to, and a number of factors conjointly tended to discourage the producion of this grain. Among these factors were the better returns which farmers were securing from the production of wool and mutton, and butterfat. For a considerable time the wheat industry appeared in jeopardy, and various means were taken to assist it by means of tariffs, payment of fixed prices and other devices. These, however, gave little general satisfaction, and their effect in stabilizing the industry was not entirely successful.

With the establishment of the Council for Scientific and Industrial Research, attempt was therefore made to secure a better degree of stabilization through the provision of scientific information concerning all aspects of wheat growing and utilization. As a consequence of various negotiations which proceeded, representatives of the wheatgrowers and the flourmillers, and the master-bakers, who were all regarded as interested parties, were brought into conference, and the outcome was the decision to form a Wheat Research Institute under the general direction of an Advisory Committee of the Council of Scientific and Industrial Research. The general outline of the Institute organization was on a plan developed by Mr. G. H. Holford, B.Agric. The Committee was accordingly established, and representatives of wheatgrowers, flourmillers and bakers, together with others from the Department of Agriculture, Canterbury Agricultural Col-

lege, and other interested bodies, were nominated thereon. Funds for the prosecution of research were to be secured by the imposition of a small levy of 1½d. per 50 bushels on all wheat sold by growers, 1½d. per ton of flour milled, and 1½d. per ton of flour purchased by bakers. Moneys raised by means of the levy were to carry subsidy on a pound for pound basis by the Department of Scientific and Industrial Research, and were to be utilized for such purposes as the Committee deemed most appropriate.

The activities of the Wheat Research Institute commenced in 1928, a laboratory being established at Canterbury College, Christchurch, and field experimental work commenced at Canterbury Agricultural College, Lincoln. The whole of the work of the Institute was placed under the direction of Dr. F. W. Hilgendorf, of Canterbury Agricultural College.

One of the first problems confronting the wheat industry of New Zealand was the fact that the flour from locally-grown crops was weak in quality, and therefore presented difficulties in baking. This defect could only be remedied by the mixing of flour from overseas hard wheats —Canadian or Australian—with the New Zealand flour, and there was a tendency, in some quarters, for bakers to use exclusively imported flour. Were this practice to grow, it was plainly seen that the future of the New Zealand wheatgrower was in jeopardy. The farmer therefore required some variety of wheat which would at once give a high yield and produce strong flour.

In New Zealand wheatgrowing areas, the dominant crop consisted of solid straw Tuscan, a long-berried wheat, producing a weak flour, but whose yield and adaptability to soil and climate rendered it particularly suitable for farmers' requirements. The other varieties of wheat grown ranged themselves into two types—Hunters and Pearl. Pearl wheat was regarded as possessing the highest quality, and Hunters occupied an intermediary place between Pearl and Tuscan. The area upon which Pearl wheat could be grown successfully was very limited, and the price advantage which it maintained over Tuscan was not sufficient to exceed the lead that the latter gave on account of the greater yield. Both Pearl and Hunters wheat were also loose-chaffed wheats and very liable to wind damage when nearing the mature stage. The problem therefore before the plant breeder was a complicated one, as the prominent position which Tuscan had gained made it difficult to displace it.

In order to make a determined attack upon the involved problem of improvement of New Zealand wheat varieties, the services of a highly qualified geneticist, Dr. O. H. Frankel, were enlisted and the work which had previously been carried out by Dr. Hilgendorf at Lincoln College was extended in scope. A large number of varieties of wheat were imported from all parts of the world, work was continued upon the strains of wheat

already existing in New Zealand, the nomenclature of the large number of varieties grown was cleared up, and a very much larger number of hybrid strains were produced with a view to finding combined in one of them such qualities as would render the new wheat more suitable to local conditions than those at present widely grown.

Insofar as new varieties by hybridization were concerned, the work naturally proceeded slowly, and to date there has appeared only one cross-bred wheat which shows a promise which would warrant its extended growing. The cross has been formed from White Fife and Tuscan. This White Fife × Tuscan variety has now reached the stage when it will be reproduced in sufficient quantities to sow in a fairly considerable area. This Cross 7 gives a yield per acre equivalent to Tuscan, outdistances it as regards flour yield and possesses baking qualities markedly in advance of Tuscan.

The work of selection which has gone on in connection with the already established varieties has had a greater significance in that upon it there has been built up a system of seed certification which enables farmers to obtain genuine pure strains of any recommended variety.

Crop certification is carried out in association with officers of the Department of Agriculture, and has been the means of encouraging a greater attention to the maintenance of pure strains of disease-free wheats, in addition to helping in the maintenance of higher crop yields. While the influence of certification has not extended throughout the wheat-producing districts of New Zealand, it has spread sufficiently far to effect very considerable improvements in yield, and to introduce a greater degree of systematization into the production of good wheat.

In association also with the Department of Agriculture, the Institute has been concerned with the wheat manurial programme. This has shown definitely the advantages of using phosphatic manures when sowing wheat, and, later, the advantages of top-dressing the same crops in spring with nitrogenous manures. An extensive series of field trials has proved that it is quite possible to secure an economic return of some 5 bushels per acre on the average, from a top-dressing of 1 cwt. to 1½ cwt. per acre of nitrate of soda or sulphate of ammonia in spring. This spring top-dressing of nitrogenous manure has not been adopted as generally as might be expected, as it would be the exception rather than the rule for a farmer to receive an uneconomical return from the use of nitrogenous manure applied some time during the months of September or October.

The work of the geneticist, and the field trials, have been greatly assisted by the fact that the chemical laboratory made available facilities for ready analysis of new strains and varieties of wheat, and of wheats treated to different methods of manuring, cultivation, harvesting, storage, etc.

The laboratory has served the important purpose of speeding up the genetical investigations, because methods were elaborated of ascertaining in advance the possibilities of any new strain of wheat which the plant breeder had devised, but of which there was insufficient to provide for a full milling sample. The small-scale laboratory tests were quite satisfactory as a means of giving indications as to those strains which were worthy of being followed up.

One of the marked changes made in the wheat industry since the establishment of the Institute was the extension of the use of the header harvester. Generally speaking, the opinion was widely held that these machines would not function satisfactorily under the climatic conditions prevalent in New Zealand. A series of harvests, in which the climatic conditions were somewhat better than the average in New Zealand, enabled these implements to be tested out, and it was proved that they were capable of handling the wheat crop in a satisfactory manner. Concern was expressed, however, with their influence upon the quality of the grain they handled. The Wheat Research Institute undertook an investigation both of the economics of the header harvester, and of its effect upon the quality of the grain. The economic investigation showed that there were many cases in the wheatgrowing areas where the use of the header harvester was likely to prove entirely satisfactory. Investigations showed that it was possible to reduce the cost of harvesting wheat which, with the reaper and binder, amounted to approximately 1/1 per bushel, to about 9d. a bushel.

On technical points, the services of the Institute were called on by users of these machines to give specific advice regarding the best time for dealing with the grain. In consequence, a moisture content determination scheme was established, and very considerable use of the laboratory has been made in this connection, not only by those using header harvesters, but also by those using reapers and binders.

It has now become a well-established practice for farmers, before commencing harvesting, to ascertain from the laboratory whether the moisture content of the particular crop to be dealt with is satisfactory for the purpose. As a result of investigations connected with the moisture testing of wheats, the general advice to farmers now is to allow their crops to reach a greater stage of maturity than has previously been the custom, the effect of this modification being to provide a grain capable of producing a higher quality flour.

The question of whether wheat should be threshed direct from the stook or from the stack has long been a vexed question with farmers and millers, the general impression being that the latter course of action was the most desirable. A comprehensive series of investigations was carried

out by the Institute, the general result of which showed that no difference occurred between stook threshed grain, provided that the wheat in both cases was in good condition.

A similar question, with a distinct bearing upon grain quality, was whether autumn sown or spring sown crops gave the best results. The general practice in New Zealand has been to sow most of the wheat in autumn or early winter, if at all possible, and only in the case of unavoidable circumstances and in certain districts was it customary to sow wheat in the spring. As the aim has always been to secure a high per acre yield, the practice of autumn sowing possessed distinct advantages. Analyses of the grain from spring and autumn sown crops has shown that spring sown grain shows slight advantages from the point of view of flour extraction, protein content and baking score.

These examples will suffice to indicate the direction in which the chemical laboratory of the Institute has solved some of the outstanding problems affecting wheatgrowers.

In addition to these, it has, however, many problems which are of vital and direct interest to the miller and the baker. The total of the Institute's achievements in its service to these two sections of the wheat industry, has, in the aggregate, been very considerable. Methods have been demonstrated whereby New Zealand wheat may be employed to supply satisfactorily the whole of the Dominion's requirements. Methods of overcoming defects of local flour, largely owing to its weak quality, have been devised.

Assistance has been rendered to the millers in the direction of standardizing the quality of their output, and this assistance has greatly helped the bakers to maintain the quality of their bread, and to avoid the losses which were normally entailed through having to deal from week to week with flour of varying quality.

In the aggregate, the influence of the Institute has been to re-establish the reputation of New Zealand grown wheat and the flour therefrom on the local markets. Whether this has had any marked effect upon the consumption of New Zealand wheat products cannot be determined. Nevertheless, from the wheatgrowers' point of view, the influence of the Institute in this direction cannot be but wholly good, and has provided a method of stabilization in the industry which it badly required.

6. *Pig, Pork and Bacon Research*[7]

For a country possessed of the natural advantages of food supplies rendering it suitable for pig production, New Zealand has been remarkably backward in the development of the pig industry, which would serve as a very useful corollary either to the dairy or to the grain industry. Over a

7. See Chapter XXII.

period of 50 years, while the population of the Dominion had more than trebled, the pig population scarcely doubled, and in 1928 New Zealand had 40 pigs per 100 of its population compared with 85 in the case of Denmark.

These figures are all the more remarkable when viewed in relation to the very considerable expansion which had occurred during this same period, in the dairy industry. The time had therefore arrived to review the whole situation, and to ascertain whether scientific assistance could be forthcoming which would enable this industry to be put on a better basis, and encouraged to expand. At this time, it would appear that the main handicaps to the industry were:—

(1) The absence of an assured profitable overseas market for pig products either as pork or bacon.
(2) The costliness of providing proper balanced rations in New Zealand owing to the fact that the by-products of the dairy and grain industries were produced in widely separated districts, and
(3) The generally poor production of pig meat per breeding animal, and per unit of feed.

The knowledge available regarding the actual conditions existing in this industry, was somewhat meagre. In all cases pig farming was regarded as a side line of either grain or dairy farming. There were in the Dominion extremely few who made their livelihood wholly from pigs, because in the past, owing to the absence of a good market, the price of pig products had fluctuated to an extraordinary degree, and the advantages of high prices were generally quickly wiped out by the glut which followed. In general, the interest in pigs among farmers in New Zealand was small and intermittent, and, in many cases, the pig was simply regarded as a useful means of disposing of the noxious products of the dairy industry, the skim milk, buttermilk, and whey which could not be allowed to pollute streams, and by the wheat farmer as a means of disposing of his low grade grains and potatoes.

It was felt that probably a large part of the failure of this industry was due to the fact that the quality of the pigs in general use in New Zealand was low. Certainly, little attention had ever been given to pig breeding, so that the existing strains of Berkshire, Tamworth and Yorkshire were not of the highest quality. Nevertheless, cargoes of pork and bacon which had been exported were generally favourably commented on by those who purchased them.

In order to ascertain what was the position, the Department of Scientific and Industrial Research in 1928 inaugurated three pig recording groups, centred at Canterbury Agricultural College, Lincoln, Massey Agricultural College, Palmerston North, and with the Waikato

Group Herd Testing Association in Hamilton, Waikato. These three centres provided a good indication of what was actually proceeding in the pig industry in the differing conditions that existed in New Zealand. In each district a Recording Officer was appointed to visit a limited number of farms each month, make weighings of sows and litters, notes of the feeding and general management conditions, and generally acquire such information as would give a true picture of the conditions existing on the farms which he visited. The first important piece of information indicated that the influence of management was a factor which predominated over all other considerations. The greatest variation in management from farm to farm occurred, and in this variation there was seen to be one of the main reasons why the industry was not advancing. Ample evidence was collected, which indicated that in too many cases pigs were slow to increase in weight, due to defective management and defective feeding.

In the three districts under examination, it was found that the average weight of piglets of eight weeks of age, was barely 30 lbs., a figure too low to be profitable, and in most cases this low weight was due to the absence of proper feeding both of the sows during the winter months, and of the piglets themselves in the younger stages of growth. In most cases the pigs were left to fend for themselves during the winter months, with the result that the mortality was high, and the sows themselves were in poor condition for maintaining the young piglets in the spring.

At the same time that this investigation was proceeding, others were being conducted at the Otago Medical School, under the direction of Dr. J. Malcolm, at Lincoln and Massey Colleges, which would indicate that much of the difficulty of winter feeding could be overcome by the use of such concentrates as meat and grain meals, and whey paste. Furthermore, these concentrates could be used under economical conditions, and without any detriment to the quality of the pork or bacon produced.

In consequence, in the second year of the recording work, stress was laid upon the importance of proper feeding methods, and the use of concentrates strongly advocated, with the result that in the third season it was found possible to raise the average weight of all piglets recorded to 40 lbs. at eight weeks of age. This was achieved largely owing to the proper use of concentrates, together with certain minor modifications in management, such as the provision of a 'creep' system, enabling the young piglets to feed apart from the sow, and the use of fresh pasturage, and a more open field style for pig grazing.

In order to indicate the wide variation in actual cash returns received from pigs, some investigations carried out in the Waikato indicated that farmers were making returns of from £1/16/- to £5/18/- per sow from

their pigs, where skim milk was used, and from £1/10/7 to £2/12/- where whey was fed. In some of these cases, a small amount of concentrates was fed, but even in a number of cases where concentrates were fed they were used in a wasteful manner.

The continuation of the recording system in all three districts was not found possible. The main feature of the work still is concerned with feeding, but on those farms where recording has been in progress for a number of years, it is now becoming possible to make some investigations regarding the influence of breed, and strain within breed. Strong attempts are being made to bring the Large White breed, which has given such good results in Great Britain, Canada and Denmark, into greater prominence in New Zealand. It is considered that this breed and its crosses is likely to produce a carcass more fitting for the London market than that of the predominant Berkshire and Tamworth, which are at present used. Accordingly, there have been a large number of shipments of pork carcasses made from the Waikato district, and particularly inspected and reported upon by London experts. These reports have been given wide prominence in the district concerned, and throughout New Zealand generally, with a view to bringing before farmers the need for improvements in feeding, and in the types of pigs, if the establishment of an export industry on a sound basis is desired.

The pig recording work has exercised a very marked influence on the pig industry, especially in the Auckland province. Improved practices in pig management have been widely adopted, and a completely new interest has arisen in the potentialities of the pig for export, so that during the 1933 season a new record in the export of pork carcasses was established. This increase in the number of pigs reveals the fact that more intensive use is being made of the dairying land of the Dominion, and now that a sound export trade has been established indications point in the direction of this movement becoming more pronounced with the progress of years.

7. Fruit Research

With the making available of a grant from the Empire Marketing Board in 1930, an organized Fruit Research Scheme was brought into operation. Under a Fruit Research Committee of the Council of Scientific and Industrial Research a measure of co-ordinated effort between the Horticulture Division of the Department of Agriculture, the Cawthron Institute, the Plant Research Station and the Department of Scientific and Industrial Research was brought about. A research orchard was purchased at Appleby, Nelson, for the conduct of field experiments and very carefully planned manurial, spraying and cultural investigations have

been set out in this orchard. Experiments which had been commenced in the orchards of the Cawthron Institute some years previously afforded useful guidance in a number of directions, and these were supplemented by a number of others located in the chief fruitgrowing areas of the Dominion.

To date, the work done comprises a root stock survey of the Dominion, and this has shown that Northern Spy stock has been almost universally used, but has given a different type of root system if raised from stools or from cuttings. The most hopeful vigorous growing East Malling stocks have been imported, and on to these have been budded various varieties for comparison of their development with that of similar varieties established on Northern Spy.

In the manurial trials the best authenticated results show the value of 'complete' manures for apples. Nitrogen dressings have produced growth responses and improved yields accompanied by some loss of quality as regards colour. The influence of nitrogen has shown that much depends upon variety, Delicious, for example, responding well and with no adverse effects, while Statesman and Cox's show signs of suffering in keeping quality. Potash response has been small, but where dieback was apparent potash dressings have proved effective in arresting the disease. No direct results have been secured from phosphate dressings, but examination of soils has shown that a great part of the fertilizer applied becomes rapidly locked up in strong chemical combinations in the surface layers of the soil, and so may not be actually available to the roots, the main results to the trees being secured indirectly through cover crops.

Fruit tree sprays have been very carefully examined, with the result that the actual toxic principles in each have been definitely ascertained, and these, in turn, have been tried out on various pests to ascertain their respective degrees of tolerance. In consequence the general character of certain sprays, especially sulphurs and oils, has been radically altered, and their effectiveness greatly enhanced in consequence. Simultaneously with this work investigations of both insects and fungi have proceeded with the result that it has been ascertained, for example, that the defective control of some pests has been due to there being several species very similar in appearance attacking the trees, and one of these possessed a degree of resistance which rendered the generally-accepted spray treatment ineffective. Such was found to be the case with red mite. A wide range of insect and fungous pests have been subjected to close study done in association with control measures, through sprays and parasites.

Cold storage and transport trials have been a feature of the fruit research programme, and in this active and most useful co-operation has been possible with investigators in the United Kingdom. This has enabled a thorough evaluation of the efficacy of various measures adopted

to reduce wastage, to be made at the end of the voyage. In consequence, the fruitgrower has received much guidance in regard to the handling and packing of his crop in such a manner as will reduce wastage to a minimum. Modifications have been made in storage and transport temperatures and conditions, which have meant the saving of shipping space and the out-turn of better quality fruit in overseas markets.

8. *Seed and Plant Research*

In 1928 the Plant Research Station was established at Palmerston North following the receipt of grants from the Empire Marketing Board. The Station was a joint activity of the Department of Agriculture and the Department of Scientific and Industrial Research, scientific officers of the former Department being definitely allocated to the Station, and new appointments were made by the Department of Scientific and Industrial Research. Mr. A. H. Cockayne, Director of the Fields Division, was also Director of the Plant Research Station, an arrangement which ensured a close and most useful degree of co-operation between the two organizations. As its name indicated, the Plant Research Station undertook investigations into all aspects of plant life, insofar as this was related to the farm crops of the Dominion. Pasture problems were of outstanding importance, and soon after its inauguration attention was particularly directed towards the importance of strain in pasture plants. Perennial rye grass and white clover were recognized as the plants best suited for yielding high returns on the best classes of pasture lands, and these were shown to possess a wide degree of variation. Types were collected from all parts of New Zealand, grown under trial conditions, which were of a particularly searching character, and, as a result, perennial rye grass was divided into six group selections, the best of which was named temporarily 'Hawke's Bay,' and later on New Zealand Perennial No. 1. This rye grass possessed qualities of yield, capacity to respond to top-dressing, and true perennial characteristics, which placed it in the forefront of pasture grasses. After its development by the Station it has been eagerly sought after by farmers sowing down permanent pastures. The case of white clover is very similar, and to-day New Zealand No. 1 white clover features in all the best-sown pastures of recent establishment. This strain was found in consequence of selective studies of plants collected from all parts of New Zealand, which were submitted to very searching tests both in single plots and also in grazing and mowing trials.

The use of the N.Z. Pernenial No. 1 strain of rye grass, and of No. 1 white clover in the pastures, on the best soils of the Dominion, mean a great deal in the intensity of the use to which such land may be put. These strains, too, have been known to give the readiest response of all grasses and clovers to fertilizers and to be best adapted for the close grazing

system of pasture management which has been evolved to derive the maximum feed advantage which accrues to the ultilization of young grass. In addition, an outcome of this investigation work has been to provide for a lucrative industry in grass and closer seed production, the demand for seed of good strains of rye grass and clover being good both locally and overseas.

Similar work is proceeding with most of the other economic pasture grasses and clovers, for recognition of the value of strains is equally important there also. Lincoln College, incidentally, made good headway in the production of a strain of cocksfoot, known as C.23, which gives a very good supply of feed over a long season of the year. Thus it may be said that the work of the Station has done much to assist in the better utilization, particularly of the heavier class of pasture lands, by providing improved strains of grasses and clovers capable of rendering higher yields than those they replaced.

In non-pasture plants the Station has followed a similar policy, designed to eliminate types and replace them by others of proved worth, the standard being maintained through a system of certification. Potatoes, peas, and rape and turnips have been given particular attention, and in each case the result has been a clarification of nomenclature, a determination of real worth, and the demarcation of the best types suitable for New Zealand conditions.

Plant pathological problems have received much attention at the Station. Loose smut of barley and wheat has been conquered by means of the hot water treatment of mother seed. The careful technique necessary for the proper employment of this method of sterilization required much careful research before it was perfected. Dry rot of swedes and turnips has also been successfully combated, following hot water treatment of seed, and the elimination of sources of reinfection. The clubroot organism has also been dealt with so that by the use of adequate supplies of lime and the growing of resistant varieties, serious losses need no longer be feared. The Station has also been active in exploring the use of mercury compounds for seed dressing purposes and in the preparation of ensilage made under the newer methods which have been devised in recent years.

Shortly after the establishment of the Station the White Cabbage Butterfly was introduced accidentally to New Zealand, and, commencing in Hawke's Bay, it played havoc in the turnip and rape crops of that district. Two parasites were imported, acclimatized and liberated by the Station with most successful results, particularly *Pteromalus* which has spread very rapidly, and now has the butterfly in check.

As soon as the Station was inaugurated a much improved system of pasture manurial trials was introduced and a technique established which

placed trials on a proper footing where they were subject to the statistical examinations rendered possible in consequence of the replicated plot system. The investigations revealed the all-round superiority of superphosphate for pasture purposes, and at the same time showed up defects in the farm practices generally adopted in its application. The value of nitrogenous manures for producing out of season grass, and the precautions necessary to get the best results from this class of manures was demonstrated. The value of the pastures grown on the trial plots was further determined, both by chemical tests and by feeding trials, and these were invaluable in revealing the highly nutritive quality of young grass at a time when a move was being made in the direction of more intensive grazing and the more general use of fertilizers containing nitrogen.

It can safely be asserted that the findings of the Plant Research Station, since its inception, have been of a very marked value in increasing knowledge whereby a more intensive use may be made of the land resources of New Zealand.

9. *Meat and Meat Products Research*[8]

In 1929 a thorough survey of the freezing works and meat transport system both in New Zealand and overseas was conducted under the auspices of the Food Investigation Board and the Empire Marketing Board. This survey was intended to throw light on the loss of 'bloom' with which New Zealand lamb and mutton was at times affected, but though a number of valuable results were secured, and the nature of the 'bloom' explained, no measures designed to overcome the trouble were suggested.

In 1934 Messrs. Borthwick Ltd. decided to exploit the possibilities of a shipment of chilled beef from their Waingawa works. The works were sterilized under the direction of officers of the Department of Scientific and Industrial Research, and the details of the shipment watched from the works until disembarkation in London by means of instrumental records. This was the first occasion on which a shipment of chilled beef, using CO_2 gas storage, was successfully accomplished, as was revealed when the *Port Fairy* arrived in London and discharged her chilled beef in excellent condition.

This achievement reopened for New Zealand the beef market which had been lost in the post-war years, when frozen beef received a very serious setback when Argentine chilled beef came on to the English market in large quantities. The *Port Fairy* shipment demonstrated that there was still possibilities for beef-raising in New Zealand.

10. *Soil Reconnaissance*

Consequent on the finding of the association which existed between soil characteristics and such diseases as bush sickness, attention was

8. See Chapter XXIX.

devoted to soil problems elsewhere in New Zealand. Considerable settlement was projected in volcanic soils of the central plateau, and in view of the dangers which might arise most of these were subjected to soil survey, as a first step. These surveys proved of very real use to those vitally concerned, especially when arrangements were in train for subdivisions. The Native Land Settlement schemes were developed in areas only after the soil surveys had been completed.

Later on the work was extended to long-settled areas in the Taranaki and Waipa districts, with the object of ascertaining the connections existing between soil types on the one hand and pasture establishment, fertilizer practice, and general farm methods on the other. To date, this work has revealed certain important connections between soil type, manurial response, and dairy produce quality.

In Ashburton County an extensive survey has been carried out in preparation for the extension of irrigation in that district. The work has been done in sufficient detail to render the results useful for other purposes also. A similar but more detailed survey has been completed of the Levels County, a part of which will shortly be irrigated.

Several special purpose soil surveys have also been completed, such as that of the potential tobacco lands of the Dominion.

As yet the soil surveys have not been carried sufficiently far to reveal their important value in relation to land utilization.

The work is done by a Division of the Geological Survey Office, working in association with Cawthron Institute.

III. WOOL RESEARCH IN NEW ZEALAND[9]

A. Grading of New Zealand Wool

The major portion of the New Zealand wool clip is composed of crossbred wool, the product of long-woolled breeds of sheep. This class of wool is predominant in the North Island while merino and half-bred wool is almost entirely confined to the drier districts and the high country of the South Island.

For some time past various complaints of the character of the crossbred clip have been made by wool brokers in New Zealand and by British and Continental buyers. These complaints may be summarized as follows:

(1) A falling off in the proportion of super wools.
(2) A decrease in the number of large, even lines of wool.
(3) An increase in the amount of shabby and hairy wool.
(4) A scarcity of deep preparing wools showing considerable Lincoln or Leicester characters and too great a proportion of medium crossbred.

9. This Section was written by G. S. Peren early in 1934.

Much of the clip, however, is of an excellent character and meets with a strong demand. All long-wool breeds of sheep have, however, a tendency to produce medullated or partly medullated fibres in the fleece and the breeds in use in New Zealand are no exception to the rule. The presence of these fibres is undoubtedly a major defect of our crossbred wools, but if this account should seem to lay too much emphasis on faults it must be borne in mind that it is with these that applied research is mainly concerned.

The figures given in Table LXVII, which were obtained from an analysis of the 1917-1918 clip given in the Report of the Department of Imperial Government Supplies, 1921, are impressive and show that the necessity for improvement existed at that time. Unfortunately no other official analysis of the Dominion's clip has since been made, but judging by brokers' and buyers' comments it is doubtful if any marked alteration has taken place.

TABLE LXVII

All Fleece Wool of 36s to 48-50s quality Hoggets Inclusive (Pieces and Lambs' Wool Omitted): 1917-1918 Clip

Description (or Grade)	Percentage of Total
AA	·75
A	19·25
B	74·5
C	4·6
D	·9

B. ORIGIN OF ROMNEY CROSSBRED SHEEP

Before giving an account of the wool research which has been carried out or is in progress it is desirable to give a brief history of the origin of the so-called Romney crossbred sheep, on which the majority of the work has been conducted, and to consider in some detail the major factors responsible for the inferior wools, as this will facilitate an appreciation of the problems involved.

The Romney Marsh is to-day the predominant breed of sheep in the country as shown by the figures given in Table LXVIII.

The earliest flocks to be founded in the country were, however, composed of Merinos. In the heavy rainfall districts which are now stocked with crossbreds, Merinos very naturally did not thrive and crossbreeding with rams of long-wool breeds was commenced in an endeavour to evolve a sheep more suitable to these conditions. Lincoln, Leicester and Romney Marsh were the breeds most used, although the Cheviot was given a trial here and there. For various reasons the Leicester largely dropped out of use for this purpose and Lincoln rams were for a period almost entirely the order of the day. In due course, however, the increasing difficulty of wintering hoggets with a large proportion of Lincoln blood in them, due

probably to the natural decrease in the fertility of the hill pastures since their original sowing down to grass, and the poor demand for very strong wools during periods of low prices, resulted in a rapid decline in the use

TABLE LXVIII

Numbers of the Different Classes Composing the Flocks in April, 1934

Breed of Sheep	Stud Sheep Entered in Flock Book	Sheep of a Distinctive Breed not Entered in Flock Book	Total
Merino	22,408	1,029,563	1,051,971
Lincoln	3,396	24,018	27,414
Romney	181,641	2,917,402	3,099,043
Border Leicester	19,559	36,457	56,016
English Leicester	18,248	44,104	62,352
Shropshire	2,218	12,550	14,768
Southdown	109,124	181,035	290,159
Corriedale	46,221	1,230,035	1,276,256
Ryeland	4,124	3,646	7,770
Half-bred	3,536	2,196,006	2,199,542
Other Breeds	42	2,346	2,388
	410,517	7,677,162	8,087,679
Flock Sheep : Crossbreds and others not otherwise enumerated ..			20,561,359
Grand Total			28,649,038

of this breed. There are no data on the extent to which this cross is practised to-day, but the number of pure-bred Lincoln sheep in the country in April, 1934, is an indication:—

Pure-bred Lincoln	3,396
Pure-bred Romney Marsh	181,641

It will thus be seen that the so-called Romney crossbred sheep of New Zealand, that is, unregistered sheep, contain Romney, Lincoln, Leicester and Merino blood. The first-named is largely predominant, but strong traces of Lincoln and Leicester characters in the wool are quite common and very occasionally a trace of Merino comes to the surface. Naturally the clip from these sheep includes a wide range of counts or qualities ranging from fine (48s-50s) to medium (46s) and strong (44s) crossbred and even in stud sheep a considerable range of wool types is permitted.

C. CAUSE OF CHANGE IN CHARACTER OF WOOL CLIP

From the foregoing it will be readily apparent that a slow but continuous change must have taken place in the character of the clip since the early days. The Merino and half-bred foundation which was a considerable help to the character of the wool for many years, has been left far behind and now the length, lustre and handle of the Leicester and

Lincoln are not present, in many cases, in sufficient quantities for the production of a true lustre wool. There are no data to prove an increase in the proportion of plain and unattractive wools but it is commonly considered that this has taken place and the following factors are held responsible:—

(a) *Subdivision of Large Stations.*—The subdivision of large stations into smaller properties as a result of the necessity for closer settlement following the occupation of the greater portion of the virgin land suitable for farming under existing economic conditions.

It is contended by many that on the average the smaller men have not maintained the standards set up by the original stations. This may be due to several causes such as less expert knowledge, lack of money precluding the purchase of really good rams and in some cases the sale as 'fats' of ewe lambs which should have gone into the flock. The extent to which subdivision has taken place can be seen from Table LXIX.

Since a well-bred flock almost invariably exhibits certain subtle characteristics representing the owners' ideals and practices, subdivision and the multiplication of owners results in the reduction of big 'even' lines of wool into a number of small to medium lines each possessing individual characteristics. Buyers naturally regret this development.

(b) *Influence of Refrigeration.*—The advent of refrigeration and the rapid development of the fat lamb industry has had several repercussions on the quality of wool:—

(i) In the first place it is the practice in breeding flocks to dispose of the surplus 2-tooth ewes and the aged ewes and to replace the latter with an equivalent number of the best of the 2-tooth ewes. Prior to the advent of the fat lamb industry only the best of the surplus 2-tooth ewes were saleable for breeding purposes; the culls and the aged ewes were boiled down or canned. To-day the cull 2-tooths and the cast for age ewes are purchased by the producers of fat lambs who put them to rams of mutton breeds, especially the Southdown. The lives of the aged sheep are therefore prolonged for at least one year and, in a certain number of cases, two years. Either on account of age or, especially in the case of 2-tooths of hereditary faults, an unduly large proportion of the wool which these sheep produce is plain, unattractive and tender and in the case of the aged sheep the percentage of cotted fleeces is higher than normal. Naturally this contribution of inferior wool lowers the average quality of the Dominion's clip and, purely from the wool point of view, it would have been better if these sheep had been fattened off after being culled from

TABLE LXIX

Number of Flocks in New Zealand

Year	Under 500	500 and under 1,000	1,000 and under 2,000	2,000 and under 5,000	5,000 and under 10,000	10,000 and under 20,000	20,000 and upwards	Total
1883	5,039	970	609	467	244	200	149	7,678
1884	5,422	1,033	672	473	256	211	154	8,221
1885	5,622	1,146	718	505	270	213	157	8,631
1886	6,024	1,189	747	532	263	228	166	9,149
1887	6,247	1,139	723	531	289	221	166	9,316
1888	6,579	1,182	794	524	287	213	166	9,745
1889	7,063	1,381	826	597	279	239	152	10,537
1890	7,662	1,528	854	586	283	236	160	11,309
1891	8,272	1,691	969	666	287	239	169	12,293
1892	8,822	2,033	1,193	761	314	231	176	13,530
1893	9,629	2,239	1,315	836	341	241	178	14,779
1894	10,314	2,427	1,409	933	345	230	179	15,837
1895	11,336	2,497	1,405	904	341	232	183	16,898
1896	12,028	2,605	1,460	892	340	231	147	17,703
			1,000 and under 2,500	2,500 and under 5,000				
1897	12,706	2,623	1,806	615	347	226	145	18,468
1898	12,886	2,708	1,798	614	341	231	144	18,722
1899	12,719	2,656	1,880	639	363	204	138	18,599
1900	12,239	2,810	1,971	650	352	196	139	18,357
1901	11,700	3,059	2,189	688	397	189	138	18,360
1902	11,961	3,158	2,232	730	385	206	131	18,803
1903	12,428	2,923	2,081	670	342	207	110	18,761
1904	12,177	2,909	2,078	664	362	199	104	18,493
1905	11,545	3,120	2,350	734	374	203	97	18,423
1906	11,793	3,431	2,558	782	394	213	94	19,265
1907	12,014	3,661	2,733	811	441	230	87	19,977
1908	11,796	3,928	3,244	944	488	213	80	20,693
1909	12,389	4,219	3,391	1,044	510	227	78	21,858
1910	11,564	4,313	3,663	1,128	544	233	77	21,522
1911	11,463	4,366	3,703	1,130	540	216	75	21,493
1912	11,290	4,427	3,778	1,174	563	183	56	21,471
1913	11,053	4,459	3,946	1,286	536	188	59	21,527
1914	11,106	4,824	4,168	1,307	548	194	55	22,202
1915	11,539	4,728	4,339	1,287	558	191	38	22,680
1916	11,818	4,911	4,344	1,299	566	202	41	23,181
1917	11,812	5,071	4,279	1,375	629	176	38	23,380
1918	11,562	5,603	4,747	1,407	622	187	40	24,168
1919	11,719	5,466	4,637	1,440	611	162	30	24,065
1920	12,286	5,249	4,411	1,314	536	139	25	23,960
1921	13,045	5,167	4,236	1,276	505	140	24	24,393
1922	13,067	4,803	4,047	1,233	492	139	19	23,800
1923	12,118	5,017	4,233	1,335	515	130	25	23,373
1924	11,927	5,071	4,393	1,356	522	128	26	23,423
1925	11,953	5,461	4,637	1,399	536	138	22	24,146
1926	12,332	5,732	4,858	1,452	532	120	19	25,045
1927	12,613	5,884	4,960	1,461	541	128	22	25,609
1928	12,266	5,957	5,415	1,606	573	139	26	25,982
1929	11,915	6,313	5,975	1,724	613	146	26	26,712
1930	14,284	6,764	6,318	1,860	615	151	30	30,022
1931	15,438	6,692	6,157	1,759	571	146	26	30,789
1932	15,561	6,652	5,837	1,669	563	143	24	30,449
1933	16,009	6,252	5,474	1,607	554	141	26	30,063
1934	15,095	6,475	5,848	1,670	544	142	26	29,800

the breeding flocks as would have happened at one time. As the fat lamb industry has grown so has the amount of wool from old ewes increased in proportion to the rest of the clip.

(ii) On account of the relative values of meat and wool, the producer of fat lambs is not very particular about the quality of the wool on the draft ewes which he buys. His main concern is a deep, low-set sheep with a reasonably sound mouth. If he were more particular, the breeder on the hill country would have an additional incentive to breed good wool.

(iii) Again, the relative values of meat and wool have tended to concentrate attention on carcass at the expense of an interest in and knowledge of wool. A comparison between the average crossbred breeder and the average Merino breeder shows a very marked difference in their attitudes towards wool. Had refrigeration not come on the scene, there is little doubt but that the standard of our crossbred wool would have been very much higher.

(c) *Deterioration of Hill Pastures.*—The unavoidable deterioration of some of the hill country pastures has affected wool quality in several ways. In order to understand the part which this has played it should be remembered that a very large proportion of the hills now used for grazing crossbred sheep were originally covered with forest, much of which was rain forest. This was felled and burnt and grass seed was broadcasted immediately following the burn. The grasses used were largely the best of the English grasses and clovers such as perennial rye grass, cocksfoot, dogstail and white clover which, incidentally, are not found to any marked extent in hill pastures in Great Britain. The great majority of this pioneering work was carried out during the latter half of the last century. To commence with, an excellent sole of grass with a relatively high carrying capacity was obtained where the work was properly carried out, but in the course of time a slow but definite change in the botanical character and quality of the pastures has occurred in districts where the soil formation is not of the best quality. This passing of the first flush of virgin fertility is quite natural; to the drain on the land of continuous crops of meat and wool aggravated sometimes by too high a proportion of breeding ewes for the quality of the country, has been added in many cases an unusually high degree of surface washing of finer soil particles and plant nutrients due to the heavy rainfall and the steep character of the hills. Geologically speaking, New Zealand is extremely young and the topography of its hills is correspondingly immature. The high quality

of the earlier pastures made it possible to produce an excellent crossbred wool which earned a world-wide reputation. The deterioration of the poorer country that has slowly but surely taken place is, however, definitely reflected in the character of the wool produced on it.

In a number of cases sheep farmers have been confronted with a marked decrease in the weight of their clips combined with poorer body conformation. More particularly on the poorest country too high a proportion of the wool is ill-nourished, tender, too short for its style and lacking in character; hairy and partly hairy fibres are very much in evidence. In order to counteract loss of weight farmers in districts with a high rainfall are in the habit of using strong-woolled Romney rams or to a very much less extent Lincoln rams, and in the districts with a moderate rainfall dense-woolled sheep have been much tried. The strong-woolled rams usually show signs in their wool of Lincoln or Leicester blood. The use of such rams represents in the case of the finer-woolled ewes in a flock a very wide cross and results in a multiplication of the types of wool in the flock especially in the second and later generations. Unfortunately the unsoundness of this method of breeding is not always appreciated. Again, medullated fibres in strong wool are not easily detected by eye alone and it often happens that considerable damage is done quite unwittingly by the use of rams of this type.

It is true that the Lincoln ram increases the weight and length of the crossbred fleece although not to the extent that would occur under conditions of higher fertility but, as previously mentioned, it is not safe to go too deeply into this blood on account of loss of constitution. When the Romney is used in the subsequent crosses, the resulting wool loses length and in due course a number of the fleeces show strong traces of Lincoln character but are too short for the style of wool and therefore of distinct limited value.

The endeavour to keep up weight of fleece in the districts of lighter rainfall by the use of dense-woolled rams has not been altogther satisfactory. If density be increased beyond a certain point the wool would seem to take on the characteristics of the coarser of the Down breeds and the resulting harsh handling 'frizzy' type of wool combined in many cases with a hairy tip finds very little favour with the buyers.

The situation is admittedly very difficult: no other country has ever succeeded in utilizing one breed of sheep for such a wide variation of soil and climatic conditions and it is probable that the problem will have to be solved by the evolution of very distinct types of sheep to suit the different conditions which are appearing in certain districts as the country gets older.

While the foregoing remarks apply to sheep depastured on hill country

which has lost its virgin capacity for the production of pasture of high nutritive value, there are many districts in which soil fertility would appear to have stabilized at a high level and in which a correspondingly valuable pasture is found. On this class of country the Romney crossbred thrives, and grows a high-grade demi-lustre wool of pleasing appearance and handle.

To summarize the position: the Romney crossbred sheep of to-day contain a predominant amount of Romney Marsh blood, the remainder being Lincoln with perhaps small amounts here and there of Leicester and an odd dash of Merino. Subdivision and the fat lamb industry has resulted in the creation of a very large number of small flocks. On certain soil formations, the quality of the pasture has deteriorated and resulted in a definite loss of character and weight in the wool. Too great a proportion of the clip shows traces of hair and yet on account of the relative values of meat and wool the improvement of the latter is not receiving the attention it deserves.

D. Synopsis of the Research Carried Out or in Progress

Serious investigations may be said to date from the visit to this country in 1923 of Professor Cosser-Ewart, of Edinburgh, who raised the interest of Mr. A. H. Cockayne, Director of the Fields Division of the Department of Agriculture, in the subject of hairy and partly hairy fibres in long-woolled sheep, their undesirable characters and the importance of trying to eliminate them by selective breeding.

The various contributions which have been made to the subject of wool research can be conveniently grouped for the purpose of description under the headings of the institutions at which they were carried out.[10]

1. *Department of Agriculture*

In 1924 Cockayne (1) published an article on the internal structure of wool, in which the structural differences between hair, medullated fibres and wool are described and the objections to kemp and medullated fibres are stressed.

The investigations initiated by Cockayne were continued by Northcroft (2), who in 1929 published a bulletin which covers in very much greater detail than Cockayne's articles, the structural characteristics of a number of the fibre types to be found in New Zealand crossbred wool.

2. *Massey Agricultural College*

By far the greater portion of the work has been centred on the subject of medullated fibres with the object of determining the parts played by the factors responsible for their production. So far the research has been

10. The literature cited in the following account is referred to by figures enclosed in brackets. The Bibliography will be found in the Appendix.

very largely systematic in nature, the gradual expansion of the enquiry in a physiological direction being rendered impossible by a shortage of funds following the financial depression in New Zealand. It is very questionable, however, whether this has handicapped the work as it has become increasingly apparent that very little reliable work can be done on problems such as the effects of feed until the fibre type arrays and their relationship to one another and the relationship between the characters of the successive fleeces of a sheep have been worked out.

The investigations were commenced in 1928 when Dr. Dry, late Ackroyd Research Fellow, Leeds University, joined the staff of the Massey Agricultural College, and for the first two years were carried out in conformity with plans laid down by the Wool Research Committee of the recently-formed Department of Scientific and Industrial Research which assisted the work financially. With the onset of the financial depression, however, the latter assistance was perforce withdrawn and outside help has been limited to small grants from the Romney, Southdown and Ryeland Sheep Breeders' Associations.

(a) *The Fibre Types of the Romney Fleece.*—Dry, who for some years previously had been engaged on work with mammalian hairs, commenced a study of the fibre types of the Romney coat and their development, as it was necessary to possess a knowledge of the units of which the fleece is composed. From the point of view of hairiness this work is designed to supply a basis for selection and for research upon the genetic and non-genetic factors that determine hairiness. Breeding experiments have been in progress for several years. Some effects of nutrition and of the physical conditions affecting the skin have been discussed in a recent paper (9). This work has been concerned mainly with the first year's coat, fibres being classified very largely upon their original tips. The protection of the tips by covers has therefore been necessary (4). There are marked differences in the collections of fibres, of 'fibre type arrays' on the same part of different animals and on different parts of the same animal. One variant in terms of which these differences are logically expressed is the postulated 'pre-natal check.' This theory of the pre-natal check is an elaboration of an idea previously put forward by Professor J. E. Duerden and the principle occupies a leading place in the zoological theory of the fleece that is being built up in collaboration with Miss Nancy Galpin and Mr. K. M. Rudall.

Two main groups of hairy fibres are recognized, kemp and non-kemp. Birthcoat kemps, being shed, are followed by other fibres growing from the same root. There is great variation in hairiness amongst these successional fibres, but there is detailed evidence to support the commonsense

view that selection against birthcoat kemp should be as keen as practicable. This can be carried out quite easily at birth or at docking time.

Some information has been obtained about non-kemp hairiness which is also useful to the breeder. Here is involved a study of the relations between the first and later fleeces. Progress has been made in foretelling the non-kemp hairiness of the animal in future life from an examination at weaning time.

The first breeding experiments that may claim to have been carried out on an accurate basis have been concerned with the abundance of halo-hairs, or large birthcoat kemps. In genetic terms the results have to be interpreted in terms of multiple factors. In practical terms the statement may be made that selection for or against these birthcoat kemps is largely effective, even strikingly so.

In this research on fibre types a mass of detail has been accumulated. This is valued mainly because it is hoped that light will be thrown, directly or indirectly, upon the major realities underlying the intricacies of characterization.

Contributions to this kind of zoological work have been made by Miss Anthea Hefford and Miss Nancy Galpin working in Dry's laboratory. Acknowledgments for these have been made in published papers. Miss Galpin is now the holder of a Scholarship and is specializing in variations in fibre type array over the body of the lamb, and upon the pre-natal development of the fleece.

(b) *A Test for Medullation.*—The necessity for a qualitative and quantitative test for medullated fibres which would be both rapid and cheap was early apparent. It was quite clear that the sheep breeder required a more reliable guide than his eye in order to detect in every case small amounts of medullation especially in the stronger wools and therefore it seemed essential that some suitable test should be evolved if the results of research, the ultimate object of which was the elimination of hairiness in its various forms, were to be applied by the breeder. Further, it was clear that such a test would be of immense value to research workers confronted with the examination of large numbers of samples of wool. The observations of Wilson (12) attracted the attention of Sutton who was carrying out investigations connected with yolk. He initiated the work taken over at a later date by Elphick (13-19 inclusive) which eventually resulted in the production of what is now known in New Zealand as the Benzol Test and the Benzol Testing Outfit. This test is based on the fact that pure wool and benzol have very nearly the same refractive index so that wool immersed in benzol is practically invisible whereas medullated fibre which has a very much higher refractive index owing to the inclusion of air in the medulla shows up quite distinctively. Testing outfits have

been puchased by a large number of breeders who find it extremely valuable in cases where visual examination has left them in doubt. As has been pointed out to breeders this test could very well be adopted as a basis for the organized testing of rams by breed societies; it is analogous to the Babcock Test commonly used in official herd testing in this country. While it may be some time before such a development takes place, it seemed wise to be prepared for it and a considerable amount of work has therefore been carried out by Elphick on the sampling of the fleece on the live animal and on a suitable method of determining the amount of medullation in a sample of wool as revealed by the benzol test.

The evolution of a reliable system of sampling naturally involved a study of the distribution of medullated fibres over the body of the sheep. Elphick has published the results of this work and illustrated the spread of medullation over the body of the sheep by fleece maps representing progressive stages of hairiness.

Work on the perfection of a rapid but reliable method of expressing the amount of medullated fibre present in a sample as a single number is still in progress. Elphick having left the College to take up farming on his own, the work has been taken up by McMahon. Various methods based on visual estimation have been tried and checked against microscopic counts and density measurements. The most promising method is visual estimation with the aid of standard photographs of samples divided into narrow zones whose content of medullated fibres has been very carefully measured microscopically. Microscopic tests of the results of this method show that a trained eye, as in wool classing, can be relied upon to give a comparatively small margin of error. The entire elimination of the personal factor would, of course, be ideal, and it may yet be possible to achieve this aim. Reasonable speed and comparative cheapness would, however, be essential in any organized scheme of fleece testing on a large scale and these handicaps seriously limit the ingenuity of those working on the problem.

(c) *The Effect of Shearing on the Production of Medulla.*—In view of the opinions expressed by many woolgrowers, Waters (20) has investigated the effects of shearing upon the production of hairy tip in the fleeces of 2-tooth Romney. In some cases a definite increase in production occurred but in others no marked difference could be observed. Those animals whose wool made the most rapid rates of growth were the most susceptible to the effects of shearing. The flush of feed in the spring, the maximum rate of growth of the wool and the production of hairy or medullated tip would seem to be definitely associated in the case of vigorous animals with inherent tendencies to hairiness.

The results obtained from shearing with abnormally hot handpieces

were not significantly different from those obtained with handpieces at a normal temperature.

Rudall (21) has also investigated the effects of shearing. Working with Romney crossbred lambs he found that lambs with little or no hairiness at the tips of their fleeces did not produce medulla as a result of being shorn, that lambs with distinct hair at the tips of their fleeces all showed an increase in the amount of hairiness after shearing and that when shorn only on one side showed more hairiness on the shorn than on the unshorn side.

During the foregoing work Rudall obtained evidence that new fibres arising in the place of those which had been accidentally pulled out during the operation of shearing were medullated although the remainder of the fleece was not producing medulla at that time. This point has been followed up and it has been found (22) that the hairy tip arising as a result of pulling is as coarse or coarser than that of an animal's fleece when a lamb. It is noteworthy that in one or two cases pulling resulted in the production of hair although the lamb's fleece was pure wool, and it is suggested that this particular treatment thus unmasked an hereditary tendency to medulla production.

(d) *The Histology of the Follicle.*—Rudall working privately in Dry's laboratory has been making a study of the histology of the follicle. The difficulties of problems connected with fleece characters are aggravated by the lack of knowledge of the mechanism of follicle activity. Information on growth forces would assist considerably the interpretation of the complex structural variations to be found in the fleece.

Concerning the gross form of the follicles, the original division into two groups, those possessing and those without sweat glands has been bridged by the discovery of vestigial sweat glands. A series of observations on the degree of development of the follicle glands is in progress.

Particular attention is being paid to the structure of the papilla or growing point. Preliminary measurements of its form have been made, and the alterations which occur with seasonal changes and as a result of external influences such as shearing have been followed. Along with observations on the gross form, the detailed structure of the papilla is being studied with reference to the formation of medulla.

The evidence obtained suggests that the character of a given follicle may change, and that this change is related to a change in the character of the fibre produced.

The work is being continued with the aid of a Scholarship granted by the Department of Scientific and Industrial Research, and the results will be published in due course.

(e) *Microbiological Problems. Stains.*—As a result of numerous

enquiries received, Waters and his assistants have investigated the causes of a number of stains occurring in wool. Green and red stains have been found to be due to Bacillus pyocyanus, thus confirming the results of Seddon and McGrath (23) in New South Wales. A pinkish-white colouration, accompanied by a rotten condition of the fibre (24) has been traced to the action of an organism corresponding in most respects to Bacillus vulgatus. In this case the damage is serious; all other stains which have come under Waters' notice merely affect the use of the wool for undyed goods, the tensile strength of the fibres being apparently normal, but in the case of so-called 'Pink Rot' the fibres are reduced to their component cells or retted and are quite useless. Samples of blue and violet stains have been received, due apparently to bacterial action, possibly B. violaceous in the latter case, but no work on these colours has yet been carried out.

Although in some years numerous cases of stained wool are reported in some districts, due to a spell of particularly warm and humid conditions combined with weak fleeces which let in the rain, the economic importance of the defect is negligible except in the case of 'Pink Rot,' which on rare occasions may be responsible for the loss of several bales of wool.

Hursthouse (25), working in Waters' laboratory, succeeded in isolating several organisms other than that isolated by Waters which are capable of disintegrating or retting wool. These organisms were obtained from unaffected fleeces, soil, parings from the feet of sheep suffering from foot rot, and crumbly material from the soles of apparently healthy hoofs. The last two were able to ret sterilized hoof in broth cultures.

Gabriel (26), also working in Waters' laboratory, used the organism isolated by Waters in a study of the cellular characters of Merino, Romney and Lincoln wools of widely-different counts. He found that no great differences were to be observed in the cortical cells of even extremely fine Victorian Merino fibres of 100-120s count and of coarse Lincoln fibres of 36s count.

Mycotic Dermatatis.—This disease, which occurs in Australia (27) and South Africa (28), was recorded for the first time by Waters (29) as occurring in New Zealand. The disease would seem, however, to be very rare in this country.

(f) *Yolk.*—At the request of the Wool Research Committee of the Department of Scientific and Industrial Research, which provided a grant of money for the purpose, work was commenced in May, 1929, on the subject of yolk in relation to sheep management on the one hand, and to wool quality on the other hand.

Sutton (30, 31, 32), who carried out the investigations, found it necessary first of all to devise a suitable method of measuring the amount

of suint (water extract) and wax (ether extract) produced by the sheep's skin month by month throughout the year under natural conditions in the paddock. Having worked out a suitable quantitative method of estimating the production of yolk, it was necessary to determine whether animals under experiment could be covered with ordinary sheep covers in order to avoid the leaching of suint from the fleece by rain. Housing was out of the question, and would in any case have introduced too many disturbing factors. The possibility that the uses of covers might influence the production of yolk was checked by running an equal number of sheep without covers. The figures obtained from both treatments showed that the production of both water extract and ether extract was of the same order for the covered as for the uncovered sheep. If any influence was exerted by the covers, it was masked by the normal variations between individuals. The utilization of covers, rendering possible the use of the larger number of sheep necessary, seemed therefore quite permissible under local climatic conditions. Figures were then obtained from the monthly sampling of covered and uncovered sheep commenced three months after shearing, by which time there was a sufficient growth of wool, and continued throughout the year. These figures show that there is a distinct seasonal variation in the production of yolk, which is much more marked in the case of the water extract than the ether extract. The sheep used had been chosen to represent two types of Romney crossbred wool, fine and medium, and the results obtained suggest that there is a tendency for the fine-wool sheep to produce more yolk than the medium-woolled type. It was shown quite definitely that in the case of the uncovered sheep yolk was leached by rain and that the suint or water soluble fraction was removed to a greater extent than the wax or ether soluble fraction.

A study of the degree of individual variation shows very clearly that large numbers of animals are required for this work, and the data provides a useful guide to the degree of accuracy which may be obtained in such experiments. Unfortunately, this promising work had to be dropped at this stage owing to the unavoidable cessation of financial support from the Department of Scientific and Industrial Research.

Waters has investigated the yellow colouration of wool associated with the condition known as cakey yolk. This work points to the trouble being associated with a disorder of the skin similar to if not identical with 'cockle.' The stain can be removed by a special scour which is not injurious to the wool. The results of this work have not yet been published.

(g) *The Cotting of Fleeces.*—As the outcome of a study of the rate of growth of wool Waters (33) obtained data on cotting which confirms the findings of Roberts (34), and associates the defect with a drop in the

rate of growth of the fleece combined with a shedding of the finer fibres which occur in winter in the case of sheep of weak constitution, or as a result of hard conditions and a shortage of food. Under such conditions old ewes carrying twins are very liable to cotting.

(h) *The Effect of the Feeding of L-Cystine on the Production of Medullated Fibre.*—In view of the low cystine content of medullated fibre as compared with pure wool, Keys carried out an experiment in which sheep known to be capable of producing a small amount of medulla at the tips of their fibres were fed on a strictly-controlled cystine-deficient ration. The live-weight changes of the animals, and the growth rates of their wool when fed on this ration, and later when returned to pasture, were recorded. The cystine-deficient ration was not observed to increase the production of medullated fibres. On account, however, of the artificial nature of the diet, combined with the continuous yarding of the sheep which was essential in view of the cystine content of pasture, the sheep did not thrive normally and the rates of growth and cystine requirements of their fleeces were, therefore, correspondingly small.

A technique was devised for inducing sheep to consume a precise amount of cystine supplement daily for the purpose of comparing their wool with that of the control animals.

Analysis for the sulphur content of the wool, grown on cystine-deficient diet, and later, after returning to pasture, were partially carried out; the data, however, were insufficient to warrant drawing any conclusion.

This work was carried out with the aid of a scholarship, with the termination of which the work had to be dropped on account of financial stringency.

(i) *Fleece Weights.*—Three years ago data were obtained on the range of variation to be found at shearing time in the body weights and fleece weights of some 300 crossbred Romney hoggets which had received identical treatment since birth. The figures obtained showed no correlation between body weight and fleece weight, some of the heaviest animals, for example, having very light fleeces. Needless to say there was a very large range of fleece weights. One hundred animals which appeared to be perfectly normal as regards development and constitution were selected, and the fleece weights of these animals have been taken at shearing time during the past two years with the object of ascertaining the extent to which the weight of the hogget fleece may be taken as a guide to the weights of the successive fleeces in an animal's life, other things being equal. Since the work has not yet been completed no data have, therefore, been published.

(j) *Branding Fluids.*—At the request of the Department of Scientific

and Industrial Research the trial of a branding fluid produced by the Wool Industries Research Association of Great Britain has been carried out during the past year. The report on this work has not yet been made.

Trials of two other fluids will be carried out during the coming year in conjunction with trials at Canterbury Agricultural College, Lincoln.

(k) *Lincoln Cross Romney Sheep versus Romney Crossbred Sheep.*—At the request of New Zealand Lincoln Sheep Breeders' Association trials were instituted some three years ago on the comparative values of the Lincoln cross and the Romney crossbred sheep. The results obtained were definitely in favour of the latter as regards percentage of lambs, hogget mortality, and value of wool. It should be borne in mind, however, that the latter is dependent on the varying demands of the market for different styles of wool.

3. *Canterbury Agricultural College*

(a) *Fleece Weights.*—The chief line of investigation has been that of weighing fleeces from stud and crossbred sheep with a view to determining (a) the variations in quantity of wool produced, and (b) the possibility of improving the quantity produced by breeding from sheep selected for their heavy fleeces.

The work has shown that there are marked variations in the wool production of sheep of the same age and breed and reared under the same conditions and that certain strains or families within a breed may show a tendency to produce either heavy or light fleeces.

In order to ascertain if the heavy fleeces contained a higher percentage of grease and dirt than the lighter fleeces, a large number of fleeces were scoured. The results showed that there is a tendency for the heavy fleeces to contain a higher percentage of material other than wool.

Work has also been carried out in an endeavour to discover if it is possible to take a small sample which will give a true indication of the clean scoured yield of the whole fleece. It has been found that in the majority of cases a sample taken from the shoulder gives a clean yield which corresponds closely with that of the whole fleece; in a very few cases, however, the results were disappointing.

(b) *Effect of Winter Feeding.*—Winter feeding trials have been used to determine the effects of feeding on wool production. The results show that good feeding, as opposed to mediocre (not poor) feeding, gives an increase of ½ to 1 pound more wool, depending on the length of time the improved feeding is carried on. They illustrate also that there is a decided improvement in the quality of the wool, particularly as regards tenderness. Observations have shown that where a 'break' occurs in the wool it can, in many cases, be associated with a decided drop in

live weight. The results of wool-scouring tests indicate that the increase in weight is not represented by excessive increase in grease.

(c) *Hairiness.*—A small Romney flock was founded with very hairy ewes; it has been shown that by the use of rams with a minimum of hair in the fleece a marked improvement in respect to hairiness can be effected in the course of two or three generations.

(d) *Branding Fluids.*—Experiments are also being carried out, in co-operation with the Wool Industries Research Association of Great Britain, to determine the possibility of producing a branding fluid which will be satisfactory to both farmer and manufacturer. Trials with the more recent experimental fluids show that these are now nearing perfection for dry climates; the brands remain visible for twelve months, and yet give a minimum amount of trouble in the mills.

BIBLIOGRAPHY

The Bibliography will be found in the Appendix.

IV. CO-ORDINATION WITH OVERSEAS' ACTIVITIES

Until the development of the Imperial Agricultural Research Bureaux scheme, which arose out of the Imperial Conference of 1926, very little co-ordination in research activities existed between New Zealand and the remaining portions of the Empire. Prior to the formation of these Bureaux, however, a certain amount of co-ordination existed through the Imperial Institute, which devoted a considerable amount of attention to problems connected with fibres, e.g., phormium, skins, leather, and timber.

Two Bureaux, dealing respectively with Entomology and Mycology, had been established in Great Britain prior to 1926. New Zealand enrolled as a member of both of these Bureaux, and derived considerable advantage from so doing, as these were able to furnish valuable assistance to research workers in New Zealand engaged upon the problems of two very important economic branches of Biology.

In the second and third decades of the present century it had become painfully apparent to New Zealand farmers, and particularly to those engaged in fruit production, that the financial success or otherwise of their ventures depended in a large measure upon their ability to combat the ravages of insect and fungous pests. Those who were engaged in the investigation of such diseases as were causing serious concern in New Zealand, therefore, were glad to avail themselves of the assistance which such Bureaux could render, especially as regards these fundamental problems of these sciences which the New Zealand workers found that they required to utilize in an economic sense.

New Zealand's geographical isolation, and its comparatively short history, rendered it very difficult for workers located here to interpret

their problems speedily without such assistance as these Bureaux could provide. Therefore it is only fair to associate the activities of the two Bureaux with such measures of success as have attended the work of Entomologists and Mycologists towards combating plant pests in the Dominion, and it can be said, also, that what has been achieved in this respect has been of very real value.

The experience gained with the two above mentioned Bureaux, therefore, led to the suggestion that the scheme of Imperial co-operation should be widened to encompass eight others, all with a bearing on agricultural matters. To the establishment of these Bureaux New Zealand contributed her quota of financial assistance, and since 1927 has been participating in the scheme, local correspondents having been appointed in the Dominion for the eight Bureaux now in existence. The result has been a great stimulation in the attention devoted to various fundamental aspects of the sciences affecting farming. These eight Bureaux deal with:—

(1) Soil science.
(2) Animal nutrition.
(3) Animal health.
(4) Animal genetics.
(5) Agricultural parasitology.
(6) Plant genetics (herbage plants).
(7) Plant genetics (plants other than herbage).
(8) Fruit production.

The outlook of the investigators has, in consequence, been widened and directed into new channels, and while it is perhaps too early to point definitely to any outstanding example of where the Research Bureaux activities have been brought to fruition in New Zealand, there is no doubt that the general level of the standard of research and of its effectiveness has been raised, and is at the present time exerting a steady though profound influence upon the future of New Zealand agriculture.

As has previously been pointed out, one of the greatest dangers attaching to agricultural investigations in New Zealand lies in the isolation of its workers from contacts in other parts of the world. The Imperial Bureaux afford a most valuable means of overcoming this handicap. One of the features of the Bureaux scheme has been the encouragement of visits to New Zealand of those connected with researches in Great Britain. Recently a member of the staff of the Aberstwyth Plant Breeding Station spent some twelve months studying the strains of pasture grasses and clovers in the Dominion. As a consequence, this investigator (Mr. W. Davies) was able to isolate the type of perennial ryegrass, now generally known as the Hawke's Bay strain, and to give to the New Zealand farmers the knowledge that they could greatly improve the yield and quality of their pastures were they to pay due atttention to the inclusion in their seed mixtures of the best strains of the component plants. The result which

has followed this finding has been most marked, and has seen the rapid utilization of permanent strains of ryegrass over such areas of New Zealand farms as were being regrassed. At the same time a valuable export trade has been built up, particularly with Australia, with seed of this strain. This finding has stimulated the search for strains of other grasses and clovers, and, in consequence, improved strains of Cocksfoot, White Clover and Brown Top have already been isolated. The discussions and articles written in this connection have given wide publicity to the fact that New Zealand possesses very highly desirable strains of pasture plants, and there is no doubt that in the course of time this will reflect advantageously upon its overseas trade in grass and clover seeds.

There have, however, been other instances of benefits which have been derived from association with the Imperial Agricultural Research Bureaux scheme, but it will suffice for the present to give this one example of the value attaching to such Imperial co-operation, and to the interchange of ideas and of workers engaged upon various phases of agricultural research.

V. THE RELATION BETWEEN DISCOVERIES AND THEIR APPLICATION AND ADOPTION BY FARMERS

The monetary value of agricultural research is largely determined by the extent to which the findings of the workers are put into practice by the farmers of the country. In older countries it has been constantly noted that the gap between the research worker and the farmer soon widens once any prolonged stimulus is given to research. The scientist soon outstrips the practical farmer at the danger to himself of becoming theoretical. The farmer soon appreciates the position which arises once the scientist begins to emphasise matters which cannot be applied in ordinary farm routine. There is then a mutual loss of confidence on the part of both. To attain best results there would seem to be need for some method of keeping a brake on the theorizing of the scientist, and at the same time improving the general education of the farmer so that he can grasp the significance of new knowledge. The way that this has been achieved in New Zealand has been through an Agricultural Instruction Service attached to the Department of Agriculture. It is the business of this service to translate to the farmer the findings of the research worker, and to stress upon the research worker the practical difficulties confronting the farmer. The Instruction Service has also been the means of trying out on a semi-practical scale new methods before they are fully endorsed as being worthy of adoption by the general run of farmers. It would be difficult to express a correct opinion as to how successful this arrangement has been. Nevertheless, when one views the output per head of the New Zealand farmer the result cannot be said to be unsatisfactory.

In the first place the New Zealand farmers have sprung from an enterprising stock, with whom it has been a second nature to seek newer methods and newer ways of accomplishing their ends. In consequence, they are alert to adopt new machinery, keen to try out new systems of soil cultivation, stock treatment, and, in fact, anything of a novel nature in farming is considered as being at least worthy of a trial by them. Even though their attitude is innately conservative, this enterprising spirit generally prevails. There is no doubt that many will point out how deplorably slowly highly advantageous new methods are adopted in New Zealand, but by comparison with farmers in other parts of the world this is scarcely justified. Due weight is seldom given to the fact that farming is essentially an industry in which changes must necessarily move slowly, as the time lag in production exacts that any change of a radical nature on account of its far-reaching effects in all phases of farm activity, be made slowly and with due caution. In general it may be said, however, that farmers respond most quickly to advances of a mechanical nature. Therefore it has consequently been remarkable how rapidly the use of such machinery as reapers and binders, potato diggers, multiple ploughs, milking machinery, separators, oil engines, tractors, and shearing machines has spread. If enquiries were made into the extension of the use of any of these, it would be found that it took little more than a decade for the use of any proved machine to be generally adopted by the majority of farmers. The use of top-dressing fertilizers, such as superphosphate and basic slag, was first conclusively demonstrated at Rothamsted in the 1840's, about the time that New Zealand farming first became established. The use of phosphatic top-dressing manures in New Zealand, or, indeed of any artificial manures, was not extensive before the freezing industry became well established. Progress, however, was slow even then, till the first decade of the present century, when it was found that application of top-dressing fertilizers in the Waikato gave remarkable results insofar as pastures were concerned. The result was a steady expansion of the use of these fertilizers, particularly in the Auckland Province, and more slowly throughout the remaining portions of the North Island. Even as yet the use of top-dressing fertilizers in the South Island is not extensive, though artificial manures are now generally applied when crops are being sown. However, it can be said that at the present time, some 30 years after the first extensive use of top-dressing fertilizers, the practice is generally well established throughout all the lowland areas of the Dominion, and that all farmers have either used such manures or tested to some extent their efficacy for their own particular class of land.

In regard to crops, mention has been made in a previous paragraph regarding the rapid spread of the use of the Hawke's Bay strain of

Perennial Ryegrass. This rate of adoption by farmers has been on a more rapid scale than that which has occurred probably in the use of any other crop, as it has generally been found that new varieties of farm crops which have been produced, and given good results in an overseas country, acclimatize much more slowly in New Zealand, and very often do not give results which would justify their use in preference to what is already locally established.

In those portions of farming, such as the fruit industry, which have grown up under a constant threat of injury from the ravages of various diseases, there has been marked alertness to adopt all new methods for checking and controlling these pests. Unfortunately, there have been instances where such adoption has not borne good results because conditions in New Zealand orchards have varied considerably from district to district, so that specific treatments have, in many instances, only given partial control of pests. Nevertheless, the adoption of new methods in the fruit industry has probably been more rapid than in any other branch of farming. Recently a new standard of sulphur and lime-sulphur sprays, based on investigations at the Plant Research Station, has been adopted throughout the industry in less than two seasons.

Any opinion, therefore, regarding the adoption of research findings by New Zealand farmers would favour the fact that this adoption proceeds fairly rapidly, and that, provided new methods do not receive that initial setback which at times has confronted them through lack of caution in trying them out on a small scale first, then the influence of research should react fairly quickly throughout the whole farming industry.

VI. A REVIEW OF THE PART PLAYED BY SCIENCE IN MODIFYING THE NATURE OR DEGREE OF LAND UTILIZATION IN NEW ZEALAND

It may be said that the major part of the farming industry in New Zealand is based fundamentally upon science. In an earlier section of this article the part played by refrigeration in the welfare of New Zealand farming has already been emphasised. It is well to state again that upon refrigeration depends the whole welfare of our meat, dairy and fruit industries. It is refrigeration that puts these industries in a position in which they can market their produce overseas and can control its quality within New Zealand. Of the major farm industries of New Zealand, wool alone remains unaffected by this scientific discovery. The wool industry, however, has been markedly affected by the scientific breeding work carried out by James Little, the founder of the Corriedale. In the dairy industry the scientists play a dominant part almost in its every aspect. The introduction of the Babcock test at the beginning of the century has

had a far-reaching effect, extending even to the breeding and management of the stock itself. The activity of the chemist in the numerous operations of butter and cheese manufacture has been an all-important feature of the production of high-quality produce. Of all the main industries of New Zealand none depends upon scientific assistance to a greater extent, possibly, than the dairy industry.

Some reference has already been made to the part played by fertilizers in the production of good pastures, and in stimulating the growth of agricultural crops generally. Again, in this instance, the work of the chemist is all-important, and it can be stated that without doubt very much of the land at present in full utilization in New Zealand would not be so used were it not that supplies of fertilizers are readily obtainable.

Almost all the pasture and field crops in general use in New Zealand have been the result of careful plant-breeding work conducted, for the most part, overseas, and put into practice in the Dominion. The same characteristic extends to the fruit industry, and reference has already been made to the part played by science in providing controlling measures for the diseases affecting this industry.

In addition, biological investigations of the behaviour of fruit under cold storage conditions has made it possible to carry apples and pears in sound condition to overseas markets after a long sea voyage through the Tropics. Geological and chemical investigations, in association, have solved the problem of mineral-deficient pastures and soils in many districts of New Zealand, thus rendering useless land available for farm purposes. The solution of the bush-sickness problem of the volcanic lands in the central North Island region affords an excellent example of this.

The work of the veterinary surgeons has gone far towards reducing the incidence of stock disease and controlling and combating that which at times has shown a liability to secure a foothold in the Dominion, and as a result many of the most serious stock diseases of the world have never secured a permanent footing in New Zealand.

It is unnecessary to go into further detail to indicate how the New Zealand farm industry, and consequently the utilization of its land resources, really depends upon the assistance rendered by a wide range of sciences. It must, however, be admitted that, as yet, the resources of science and its services towards agriculture are but imperfectly understood and developed. There undoubtedly still exists remarkably wide scope for the utilization of science in the assistance of the farmer, and thereby bringing into production land which is at the present time barren, and in increasing the intensity with which our better-quality lands are farmed.

CHAPTER XIV

AGRICULTURAL EDUCATION

BY J. E. STRACHAN, DOUGLAS CAMPBELL AND F. W. HILGENDORF

I. Primary and Post-Primary—A. Introductory—B. Administration—C. Local Education Authorities: 1. District Education Boards; 2. Primary School Committees; 3. Post-Primary Boards—D. Policy in Regard to Agricultural Education: 1. History of Agricultural Education; 2. The Primary Schools; 3. Finance; 4. Training of Teachers; 5. Itinerant Instructors—E. Post-Primary Education in Agriculture: 1. Types of School and Organization; 2. Agriculture in General Courses; 3. Agriculture as a Specialized Course; 4. Statistics; 5. Training of Teachers; 6. Extra School Education. II. University Agricultural Education—A. Historical Review—B. Lincoln College—C. Massey College—D. Scholarships—E. Editorial Note.

I. PRIMARY AND POST-PRIMARY[1]

A. INTRODUCTORY

FOLLOWING the abolition of the Provincial Governments in 1876, the first Central Parliament passed the epoch-making Education Act (1877), providing a tentative scheme of national reorganization. This, however, could not be fully realised in practice owing to the strong political power of the Education Boards. Features of the Act were as follow:—

1. A triplex organization of control was instituted:
   - (a) A central authority, the Education Department, was installed under the direction of a Cabinet Minister, an Inspector-General, and a Secretary. Its chief duty was to allot to the Boards capitation grants (£3/15/- per child). The Governor-in-Council was empowered to make regulations within the Act covering the whole range of education. Control of the purse and power to make regulations later proved cogent weapons in subordinating the Education Boards to the Central Department.
   - (b) The Education Boards replaced the Provincial Boards, which had previously controlled education, and despite reduced power they dominated the Department. The Board practically had control of education in each province, appointed inspectors of schools, staff, etc.
   - (c) School Committees elected by the householders were responsible to the Board for general management of individual schools.

2. Free primary education was made general in New Zealand, and later the curriculum was nationalized.

1. This section was written by J. E. Strachan and Douglas Campbell.

The next step, which resulted in complete overhaul and reconstruction, was due to the energy and genius of Mr. Hogben after his appointment as Inspector-General in 1899. He made full use of the power of framing regulations, and thus accelerated progressive centralization. The new syllabus was probably the greatest milestone in New Zealand education. Primary Schools in general were established on a very satisfactory basis, largely under Departmental control.

Secondary Schools, however, were still under the control of local boards, and were not affected to any great extent. They were dominated by a rigid examination system, out of harmony with the needs of the community, and they refused to liberalize their courses even when free places were introduced and pressure was brought to bear on them by the Department.

Faced with these difficulties, the Department encouraged Education Boards to establish District High Schools by granting extra capitation. It was intended that these schools should develop into rural High Schools offering vocational courses. The District High Schools increased rapidly, but came under the same domination as Secondary Schools.

Finally, the Department resorted to power given in the Manual and Technical Instruction Acts of 1900 and 1902. It was not suggested that separate schools should be developed, but since Secondary Schools were reluctant to depart from their classical syllabus, the Department encouraged the establishment of Technical Schools entirely under its control. The development of these was phenomenal owing to their popular and useful courses.

Thus four types of schools developed separately without that co-ordination which would seem so essential to a true educational system.

The Education Act of 1914 consolidated the position of the already powerful Education Department, nationalized the Inspectorate, and instituted a Secondary School Inspectorate. Permission was given to Secondary Schools to provide vocational courses, and to Technical Schools to provide general courses, with consequent overlapping. The popular and rapid development of the latter enabled them to gain ascendancy over their rivals, practically forcing the former to provide vocational courses.

During the Hon. Mr. Hanan's Ministry a certain amount of reorganization took place, and greater stress was laid upon vocational training.

In Sir James Parr's Ministry, 1920-26, a period of financial stringency led to retrenchment in the whole service, Secondary School endowments were almost completely nationalized, the Department of Education became responsible for payment of teachers' salaries and incidental expenses (thus subordinating Post-Primary School Boards); a

compulsory grading scheme for teachers was introduced as a basis of appointment, and provision was made for the inauguration of Junior High Schools.

To the succeeding Minister, the Hon. R. A. Wright, retrenchment was the main consideration.

Reforms and reorganization recommended successively by the Cohen Commission, the Hon. Mr. Hanan, and the Tate and Reichell-Tate reports awaited institution. These were very vigorously pursued by the next Minister, the Hon. Mr. Atmore, who placed great emphasis on education with an 'agricultural bias.' The Report of the Parliamentary Recess Committee on Educational Reorganization in New Zealand during Mr. Atmore's Ministry was full of progressive ideas, but it met with a very mixed reception.

The next Minister, the Hon. Mr. Masters, had, unfortunately, to devote attention to a process of drastic retrenchment, but his successor in 1935, the Hon. Mr. Smith, seems disposed to be more liberal.

B. Administration

The Minister of Education is selected by the Leader of the Party in power, i.e., the Prime Minister. He is responsible to Cabinet for the administration of his Department. The Permanent Head of the Department is the Director of Education, who is appointed by the Public Service Commissioner. He is responsible to the Minister for the control of the Department and its officers, and for the general direction of educational affairs in the Dominion. Educational policy is laid down in Parliamentary Statutes, but power is taken in each Statute for the framing of regulations by the Governor-General-in-Council for the satisfactory working of the Statute. In practice these regulations emanate from the Department, which tends therefore to exercise a pronouncedly bureaucratic control of educational affairs.

Inspectorial supervision of all Primary and Post-Primary Schools is well organized, and thus the Department is effectively linked up with the teachers. There are 49 Primary School Inspectors, 3 Post-Primary Special Inspectors, and 5 Technical Inspectors.

C. Local Education Authorities

The proportion of the population directly concerned with and interested in education in New Zealand is very high. There are 2,734 Primary School Committees, 45 Post-Primary School Boards, 9 District Education Boards, and 6 University College Councils. One person in every 48 holds an official position in the service.

1. *The District Education Boards.*—The following nine Boards—

Southland, Otago, Canterbury, Nelson, Wellington, Hawke's Bay, Taranaki, Wanganui, Auckland—are composed of members chosen by ballot from each area. Each has a secretary and small office staff. The power of the Boards has been reduced by regulations until now they must act entirely with the approval of the department, forming a connecting link between the Department and the individual schools. They supervise Primary, Junior High, and District High Schools in their respective districts, appoint teachers on the approval of the Minister, maintain school buildings and grounds, etc. The Instructors in Agriculture are under the jurisdiction of the Boards.

2. *Primary School Committees.*—Each Primary School is under the direct supervision of a Committee of householders of the district, who are responsible for cleaning, fuelling, and maintaining the school buildings, the expense of which is borne by the Department out of capitation of 10/- per pupil of average attendance per annum. Until recently (1931) a £ for £ subsidy on all money raised locally for school improvement was paid by the Department, and this did much to stimulate progress and interest in schools.

3. *Post-Primary Boards.*—There are 43 Secondary Schools controlled by 26 Boards, and 20 Technical High Schools controlled by 20 Technical School Boards. Originally all Secondary Schools were endowed, but since the Department undertook the payment of all teachers' salaries, granted capitation for incidental expenses, and deducted the endowment from the amount due to each Board, they have been placed on a similar basis. The Boards consist of members representing the Government, Education Boards, University, and parents of scholars, and administer funds supplied, exercise general supervision over the school, appoint teachers, and organize local effort in raising money for improvements, which was, until recently, subsidized.

D. Policy in Regard to Agricultural Education

The appearance of this satellite in the firmament of New Zealand education has been surprisingly long delayed, and since first arresting attention has been conspicuously out of focus until quite recently.

1. *Summary History of Agricultural Education*

Agricultural instruction commenced in New Zealand when Canterbury Agricultural College was established in 1880 by the Canterbury College Council, and financed by the Canterbury Provincial Government.

Its introduction into Primary Schools, as part of the Manual Training scheme, promulgated in Mr. Hogben's reorganization of Primary School curricula, is probably the outstanding feature in its development. With the nationalization of curricula and free primary education, it was possible

immediately to organize a system of instruction supervized by itinerant instructors. This step certainly blazed the trail, providing a lead which Secondary Schools seemed loth to follow.

In 1901, the first organizing Technical Inspectors were appointed. Besides numerous other branches organized, Nature study was to be taught, leading, where possible, to gardening and agriculture. The teaching of agriculture was organized by a number of itinerant instructors stationed in various districts. School gardens, observational plots, and in many cases suitable laboratory practice, formed the special features of this branch of work.

By 1908 460 agricultural classes were established, 38 of which specialized in dairying.

By 1914 there were 1,199 classes in 400 schools, supervised by 19 instructors.

By 1928 agriculture was taught in 1,839 schools to 45,313 pupils.

In his report on Secondary Schools in 1901, Mr. Hogben stressed the importance of courses related to the life of pupils, with special reference to agricultural courses, and gave effect to these ideals by introducing free secondary education into District High Schools, in the hope that they would develop into Rural Schools.

In 1911, despite the fact that 59 out of 62 District High Schools were equipped sufficiently to give agricultural courses, 28 of them had no rural courses at all.

Later, free education was made possible at Secondary Schools, and the Education Act of 1904 encouraged and provided scope for the development of agricultural training in Primary, District High, High, and Technical High Schools. These ideals were thwarted in District High Schools, which showed a disposition to imitate academic Secondary Schools, while in Secondary Schools little support was accorded owing to the bias given to academic examination courses.

Owing to the partial failure of this scheme, the Department, bent on developing vocational education, provided enhanced capitation and liberal subsidies for such courses, with the result that Technical High Schools sprang up very quickly, becoming very popular.

Although agricultural vocational courses developed more slowly, favourable public impression created by vocational education was manifest, and paved the way to the ultimate development of the former.

In 1912 the Cohen Commission strongly stressed the importance of agricultural training in a country so dependent on primary resources, and advised that a rural bias should be given to teaching in all schools.

The factors operating against the popularity of agricultural courses were:—

(1) Lack of qualified teachers alive to rural problems.

(2) Uneducated outlook of the public, and its failure to realize that higher education in agriculture was necessary or beneficial: Boys intending to be farmers either found work on a farm, or proceeded to secondary education, the cultural or academic course being chosen as the most desirable.

(3) Lack of incentive, for there were few, if any, positions offering to the professional agriculturist in comparison with positions offering in the industrial, commercial and other professional spheres.

(4) Those in country families who could not find employment, or were not suited for employment, on the land were given secondary education to enable them to take up the more attractive positions in business houses.

During Mr. Hanan's reign as Minister a vigorous campaign was pursued in the furtherance of agriculture. Agricultural bursaries were instituted in 1916, and were available to students after matriculation who were desirous of continuing studies and specializing in agriculture. These were tenable at an experimental farm (e.g., Weraroa), but after the first year almost all bursars attended Lincoln College, and latterly, Lincoln and Massey Agricultural Colleges.

The introduction of agriculture into the matriculation (now University Entrance) syllabus provided an additional impetus, and now about 12% of the candidates take it as their science subject.

In 1904 the New Zealand University created the Degree of Bachelor of Agriculture, giving it a professional status.

The Field Club movement of 1922 was successfully launched in Taranaki, and has given decidedly important results, and its field is assuming big dimensions already.

In response to Departmental encouragement, slowly-changing public opinion, and its inclusion in the University Entrance examination, agricultural training has forged ahead in many Secondary Schools, while in others it has not been considered.

Mr. Tate, in his report on post primary education in New Zealand, said that, 'In regard to Post-Primary and Secondary Schools, I am strongly of the opinion that there should be an important place for agriculture in all rural schools. I would go so far as to say that I know of no subject of education which gives more abundant opportunities for educational training than it does, being readily linked up with all life which is going on round the school.' He recommended that District High Schools devote more effort to the introduction of suitable rural courses into secondary education, and that short courses for farm lads should be organized at suitable times in High Schools or District High Schools.

Recently, a great deal has been achieved in changing public opinion in favour of agricultural education by the vigorous and urgent appeal made by the late Minister of Education, the Hon. Mr. Atmore. Mr. Atmore was very much alive to the necessity of correlating the education of the schools with the normal life of the community, and vigorously advocated the policy of the 'agricultural bias.' During his term of office he gave much practical encouragement to rural schools developing along these lines, and left them much better equipped for their work. From the Parliamentary Recess Committee's Report on Educational Reorganization, 1930, popularly known as the 'Atmore Report,' the following is worth quoting:—

'What the Committee desires to see accomplished is a complete shifting of emphasis for the great bulk of our children from academic studies to those which relate to our primary industries. It is not for a moment suggested that there should be any neglect of or slackening of interest in cultural education as such, nor is it proposed that there should be instituted any narrow or too early specialization in this field. What is proposed is that in the elementary stage agriculture should be given a prominent and effective place in the curriculum, that in the intermediate stage it should be taught in every school with sufficient emphasis and opportunity for practical work to enable pupils to discover and reveal their own aptitude for, and attitude towards, farming as a vocation, and that in the higher secondary stage there should be a sufficient number of residential and other schools staffed and equipped so as to enable effective specialization to be undertaken either for immediate employment in agricultural pursuits or for admission to the agricultural colleges of University rank.'

Later, referring to pioneer work already accomplished, the report says:—

'What the Kowhai and Matamata Junior High Schools have done in the way of blazing the trail for the establishment of the change-over to the proposed new organization of our educational stages, the Taranaki Agricultural Club movement and the Feilding and Rangiora Agricultural High Schools have done for the new orientation of our whole educational system.'

2. The Primary Schools

The country Primary Schools occupy an important position in the community, since the education of 49% of their pupils terminates on leaving school.

In many country centres Junior High Schools[2] have come into existence, and the senior pupils from surrounding small schools are conveyed to these schools. Many advantages follow such a system, the chief being

2. Now called, since 1933, Intermediate Schools.

that the resulting larger classes can be taught more effectively and a preparation made for secondary education, while pre-vocational training is possible. The majority of these ex-pupils work in the community, finally becoming farmers. Hence the aptitudes and industry developed in the child have ample opportunity of expression, especially when closely related to his future career.

The main principles and objectives of the syllabus designed and put into operation by Mr. Hogben in 1900 dominate the curriculum of the present day. The scheme embraces a wide range of subjects, while natural science and agriculture are given a prominent place, and as far as possible all subjects are brought into harmony with the environment.

(a) *Subjects in the Curriculum related to Agriculture*

Geography, particularly physical geography, as taught in Primary Schools, has a very close correlation with agriculture.

Natural science is taught from the primary department upwards for two hours per week in the average school. It embraces studies in plants, insects, birds, and animal life, on a very extensive scale in some cases. From Standard III upwards it is more directly applied to agriculture, in country schools, but not in town schools.

Botany is a prominent feature of all courses, covering the structure and organs of the plant and the functions of these, emphasizing where possible their practical utility. Weeds, grasses, crops and forestry are also a part of this work.

Elementary experimental science, including chemistry, is taken, and leads to soil and fertilizer studies.

Gardening practice and experimental plot work is well developed in the great majority of schools, providing material for, and practical application of, the above courses. Insect pests are also studied.

Elementary dairy science is popular in many schools in dairying districts.

Field Clubs, Calf Clubs, and Home Garden Projects form a valuable adjunct to the work done in Primary Schools.

These subjects are taken, not as a vocational development, but almost entirely as a method of using the child's environment more directly as a means of education. The development of a real and live interest in living processes tends to bring the child into harmony with the environment.

Agricultural instruction is given at 2,003 out of 2,579 schools in New Zealand, to 50,267 out of a total of 210,396 pupils, and is supervised by 23 itinerant instructors. The above figures reveal the fact that agriculture is taught at practically all the country schools and to few urban schools, since it is taught in 74 per cent. of the schools, but to only 24 per cent. of the total pupils. The figures were almost the same in 1933.

(b) *Method of Teaching*

All the material studied can either be handled or examined closely (as in botany and insects), experimented with (in chemistry and dairy science), or dealt with in a practical way, e.g., nursery, garden and plot work of all kinds. Thus it is possible to make individual studies and observations, and later collate these. Individual projects in raising of certain crops or vegetables, and in experimental trials, are compared later and inferences drawn.

(c) *Statistics of Primary and Intermediate (State) Schools*

In 1933 there were 2,531 Public Primary and Intermediate Schools, 6,072 adult teachers, about 23 agricultural instructors, and 200,641 pupils, distributed as follows:—

TABLE LXX

Education District	Enrolment 1933	Adult Teachers 1933
Auckland	62,700	1,826
Taranaki	11,212	370
Wanganui	15,277	476
Hawke's Bay	14,870	445
Wellington	26,360	750
Nelson	6,328	238
Canterbury	33,858	995
Otago	18,957	605
Southland	11,079	367
Totals	200,641	6,072

In addition there were in 1933 309 registered Private Primary Schools, with a total enrolment of 26,428 pupils, employing 974 teachers.

The following table gives the pupils in attendance at Education Institutions in June, 1929, 1930, 1932 and 1933:—

TABLE LXXI

	1929	1930	1932	1933
Public Primary Schools	210,396	216,698	207,280*	200,641*
Native Schools	6,951†	7,616†	7,850†	7,892†
Junior High Schools	2,321	2,212	—	—
Secondary Departments of District High Schools	4,568	4,115	4,345	4,389
Secondary Schools	16,223‡	16,149‡	17,499‡	15,238‡
Technical Day and High Schools	7,536	6,953	7,106	7,149
Technical Classes (part time) ..	11,187	—	—	9,078
Private Primary Schools ..	26,556	26,451	26,410	26,428
Private Secondary Schools ..	3,877	3,825	4,053§	4,063§

*Including Junior High Schools.
†Native village and Native Mission Schools.
‡Including endowed schools.
§Excluding endowed schools.

The numerical importance of Public Primary Schools is in evidence.

TABLE LXXII

Destination of Pupils Leaving Public Primary Schools

Destination	1927 Per Cent.	1928 Per Cent.	1929 Per Cent.	1930 Per Cent.	1931 Per Cent.	1932 Per Cent.	1933 Per Cent.
Post Primary	50	51	51	53	53	53	54
Commercial Occupations—							
(a) Clerical	1	1	1	1	—	—	—
(b) Shop and Warehouse Assists.	4	4	4	2	2	3	3
Trades—							
(a) Engineering ..	1	2	1	1	1	1	1
(b) Building	2	1	2	1	1	—	—
(c) Other	4	4	4	2	1	1	2
Agricultural and Pastoral	20	20	20	22	24	24	24
Other Occupations ..	6	6	7	6	5	6	5
Home	8	8	7	9	10	10	10
Not known	4	3	3	3	3	2	1

3. *Finance*

The Education Department is the largest spending, non-revenue-producing Department.

The largest proportion of the cost is provided by Parliamentary votes, but endowment reserves provide a varying amount. The following summary gives the cost of the Dominion's educational service at March 31, 1934:—

Service	1929–1930 £	1933–1934 £
General Administration	40,897	29,647
Elementary Education	2,592,862	1,833,591
Secondary Education	472,539 }	529,802
Technical Instruction	254,487 }	
Training Colleges, etc.	180,642	34,323
Higher Education	179,598	56,722
Native Schools	87,043	79,700
Physical Instruction	9,150	1,155
Schools for Deaf	6,007	4,812
Education of Blind	1,377	168
Schools for Feebleminded	15,456	11,434
Industrial Schools and Probation ..	131,731	111,631
Material and Stores	Cr. 708	Cr. 495
Miscellaneous Services	87,141	48,055
Totals	4,058,222	2,740,545

In the last ten years expenditure on education has varied from a maximum of 55/1 per head of the mean population in 1927 to 35/7 in 1934. The approximate expenditure per head of the mean population on the main branches of education is (for 1934): Elementary, £1/5/-; Secondary and Technical, 7/6; Higher, 10d.

In addition to the payment of salaries, capitation grants for maintenance, and building grants, the Department has until recently provided a £ for £ subsidy on all voluntary contributions towards education.

4. *Training of Teachers*

Teachers, in order to enter upon primary teaching, must have passed the University Entrance Examination, and been admitted to a Teachers' Training College. If the course has been satisfactorily completed they become certified teachers.

It is necessary to take agricultural science as part of the course for 'C' Certificate. A lecturer in agriculture is in charge of this course. The time devoted is from 1½ to 2 hours per week for 2 years.

Nature study is a prominent feature, and may be said to form the basis of the course. Elementary chemistry is followed by soil studies, fertilizers, dairy science, etc.

Botany leads up to crops, weeds, fungus pests, and micro-organisms and forestry, farm operations and garden operations. Practical experimental work is given in connection with the above course. In addition, gardening and nursery work are taken thoroughly.

At best the average course can only be said to provide the teacher with sufficient acquaintance with the subject to take classes, but does not attempt much more.

5. *Itinerant Instructors*

These men are qualified agricultural instructors engaged by the Education Boards throughout New Zealand. They are in charge of agricultural education in Primary Schools, and circularize teachers with a syllabus of work, paying periodic visits to give assistance to teachers and take speccial lessons in the school. Twenty-three of these men are engaged by the various Education Boards in New Zealand.

E. Post-Primary Education in Agriculture

1. Types of School and Organization.—(a) *District High Schools*: Eighty-one of these small Secondary Schools are attached to some of the larger, and more central, rural Primary Schools. The Education Board controls them through the School Committee and Headmaster. They were established by the Department in an endeavour to meet the needs of the locality for rural secondary education, but many have failed to do otherwise than try to imitate urban Secondary Schools. Pupils are admitted free on becoming holders of a proficiency certificate. Primary and Secondary School Inspectors visit these schools. Great scope is

allowed by the Department, and encouragement is given for the development of rural vocational training, which is directly supervised by itinerant Agricultural Instructors.

(b) *Secondary Schools.*—Some 44 of these schools are found in the larger centres of New Zealand. A special Secondary Schools' Branch of the Education Department controls each of these through a local Board of Governors. Salaries are paid by the Department, and a special grant is made for incidental expenses and equipment on a capitation basis. Departmental Inspectors visit these schools at least annually. Staffing is according to grade of school. No restrictions are placed upon the syllabus of these schools, other than that certain time must be devoted to general subjects.

(c) *Technical High Schools.*—There are 21 of these schools in the larger rural and urban centres, controlled by the Technical Schools' Branch of the Department, through a Board of Governors and Director. There is essentially little difference between these and Secondary Schools now, but originally they were established to cater for vocational training, which Secondary Schools seemed loth to undertake. The facilities for manual training are well developed in Technical Schools, but in many respects their courses are similar to those in ordinary Secondary Schools. In rural centres there is usually a well-developed agricultural course, but of the four large urban centres one only has a well-developed course.

(d) *Private Secondary Schools.*—Many well-organized Secondary Schools are financed and controlled by private institutions or individuals. In some there is a distinct leaning to vocational training and agriculture. Of the 22 registered Private Boys' Secondary Schools in New Zealand special development is seen in the following:—

Wesley College, near Auckland, has its own farm and special vocational course in agriculture.

St. Patrick's College, near Dunedin, owns a very large farm in connection with the College, and a well-patronised vocational course is provided.

Flock House is a privately-endowed training farm near Marton, where boys learn the practical arts of farming, but have little theoretical tuition.

2. *Agriculture as a Subject in General Courses.*—The importance of agriculture in general courses may be gauged from the fact that 12 per cent. of the candidates for University Entrance take it as their science subject. This has been possible since 1916.

Most of the District High Schools take agriculture as a subject in

the school. There are 81 of these schools, and 71 per cent. of the boys take agriculture, while 23 per cent. take dairy science.

In Secondary, Technical, and Combined Schools, however, a very different state of affairs exists, owing largely to the fact that the majority of the pupils attend urban schools. In the majority of cases the course taken conforms very closely with the prescribed syllabus for University Entrance, which, though fairly wide, has definite limitations. Although it cannot be claimed as a satisfactory science subject, its importance seems to be lost sight of in most schools despite its direct effect on all other callings in after-school life.

From the tables below it is evident that Agricultural subjects (Dairy Science, Agriculture and Woolclassing), as distinct from an Agricultural Vocational Course, are taken by a large number of boys. Since more than one of these subjects may be taken simultaneously, their collective totals signify little, except that a trend towards the development of complete Agricultural Courses is indicated.

From figures available in 1930 4 per cent. of the boys in Secondary and Technical Schools took Agriculture as a subject, while 13·3 per cent. took it in 1933.

3. *Agriculture as a Specialized Course*

The number of Secondary and Technical Schools offering Agricultural Courses has increased from 12 to 16 in recent years, which accounts for the big increase in number of boys taking a full course in Agriculture (according to replies from two questionnaires it increased from 4 per cent. in 1930 to 8·2 per cent. in 1935).

A total of 50 Post-Primary Schools (including 21 District High Schools) now offer Agricultural Courses in varying degrees of completeness. As a climax to this development there are two Private Schools (St. Patrick's, Silverstream, 880 acres, and Wesley College, Paerota, 750 acres), four Secondary Schools (Rangiora 114 acres, Napier 40 acres, New Plymouth 42 acres, and Waitaki 8 acres), three Technical Schools (Feilding 240 acres, Stratford 12 acres, Christchurch 10 acres), and one District High School (Pleasant Point 30 acres) with farms attached to the school.

Many other schools have a well-developed system of practical contacts with farms, farmers, Agricultural Colleges, Agricultural Department, shows, sales, etc., e.g., Palmerston North, Hamilton, Pukekohe, etc.

In conjunction with these developments it is essential that a reorientation of the school curriculum should accompany the presentation of these courses to provide the most desirable harmony and atmosphere. Notable in this respect are Rangiora and Feilding, where education become closely integrated with the life of the community and of the world at large.

4. *Statistics of Agricultural Interest Relating to Secondary Schools*

The Education Department's Report E.2, 1934, gives figures showing the extent to which Agricultural Training was given in the Post-Primary Schools in 1933. A distinction is made between a full Pre-Vocational Course in Agriculture and Agricultural subjects not integrated in a full course. The following table summarizes the facts as they appeared in 1933:—

TABLE LXXIII

Agricultural Subjects in Post-Primary Schools

Type of School and Number	No. on Roll	Full Agricultural Course		Agricultural Subjects					
				Agriculture		Dairy Science		Woolclassing	
		No.	%	No.	%	No.	%	No.	%
Boys' Secondary (24)	7,836	578	7·3	1,036	13·2	474	6·0	1,790	22·8
Boys' Technical (21)	4,917	524	10·6	672	13·6	633	12·8	2,828	57·7
Boys' Combined (3)	1,221	119	9·7	125	10·2	79	6·5	642	52·6
District High Schools (81) ..	2,788	252	9·0	2,090	75·0	629	22·6	34	1·2
Private Schools (22)	2,077	74	3·5	71	3·4	65	3·1	29	1·4
Totals ..	18,839	1,547	8·2	3,994	21·2	1,880	10·0	5,323	28·3

TABLE LXXIV

Post-Primary Schools: Percentage of Pupils Taking Certain Subjects, 1935

Types of Schools	Number of Schools	Complete Ag. Course in		Boys taking Course	Boys taking			Hours devoted to Agricultural Course
		1931	1935		Dairy Science	Agriculture	Woolclassing	
Technical ..	21	7	11	9·6%	11·4%	10·8%	2·8%	7
Secondary and Combined ..	22	5	15	6·1%	5·0%	5·3%	2·0%	5
District High ..	81	—	21	12·9%	25·1%	52·7%	1·8%	3
Private ..	22	3	3	8·1%	7·1%	7·8%	3·1%	5
Totals ..	146	15	50	8·0%	9·5%	12·8%	2·3%	5

TABLE LXXV

Farming as Destination of Boys Leaving Schools in N.Z.
(Department Returns and Replies to Questionnaire)

Type of School	1933 Roll No.	No leaving in 1933 to go farming	Percentage of boys taking up farming*											
			1928		1929		1930		1931		1932		1933	
			A	B	A	B	A	B	A	B	A	B	A	B
Technical ..	4,917	423	18	—	18	—	22	26	27	32	22	32	19	26
Secondary ..	7,836	426	18	—	19	—	25	31	28	33	23	31	18	30
Combined ..	1,221	88	—		—		—	—	33	—	29	—	24	—
District High	2,788	418	34	—	33	—	43	44	46	50	46	59	39	42
Private ..	2,077	—	—		—		—		43	—	49	—	43	—
Private Primary ..	12,575	—	—		—		—		—		—		—	
Intermediate	2,081	88	—		—		8	—	8	—	8	—	7	—
Primary ..	100,019	2,678	—		—		22	—	24	—	24	—	24	—
Totals ..	133,514	4,114	—		—		27†	—	31†	—	27†	—	22†	—

* A = All schools in each type. B = Schools with well-developed Agricultural Courses.
† Dept. average for all schools.

The time devoted to the Agricultural Course has been considerably extended in recent years, but varies widely in the various schools, increasing considerably with senior pupils. In schools where the course is well developed it ranged from 6-10 hours per week, and, in addition, practical work, field and demonstration visits, etc., are an irregular item, while the time devoted by senior pupils is increased.

The fact that a fair percentage of boys in all schools take Agricultural subjects (10 per cent. Dairy Science, 16 per cent. Agriculture and 28 per cent. Woolclassing) is very apt to cloud the real issue, and be misleading when the destination of boys is considered, for only a well-developed vocational course in Agriculture can be considered as an adequate attempt to prepare the individual for modern farming. In Post-Primary Schools 8·2 per cent. of boys prepare in this way, while approximately 27 per cent. during the past four years took up farming as a career.

In Primary Schools 80 per cent. of the pupils (1929) have a mere introduction to Nature Study and Agriculture, and 24 per cent. of these boys go on to farms at the end of their primary education, with the result that 66 per cent. (approx.) of all boys leaving to go farming—our future farmers—receive nothing more than this elementary smattering of the science of Agriculture.

It will be noticed that in the Secondary and Technical Schools offering Agricultural Courses there is a close agreement between the numbers of those who take the course and those who ultimately take up farming. In District High Schools, more take 'Agriculture' than go farming, but it must be remembered that only one in four of these schools offer anything like an Agricultural Course.

The destination of ex-pupils in schools with highly-developed courses is interesting:—

From Feilding .. .. .. 69 per cent. of those leaving took up farming.
Wesley College .. 68 per cent. of those leaving took up farming.
Rangiora .. .. .. 60 per cent. of those leaving took up farming.

It will be realised that an unduly high proportion of boys must go farming that have had little or no pre-vocational training, which is a serious factor in a country so dependent on great improvement in its primary productive resources.

The trend and development of Agricultural Education in New Zealand has been accelerated in recent years, and has become more rational, approaching in some schools the demands of the community. This has been due to such factors as—(1) the success of particular schools in this field, (2) Atmore report, (3) unemployment in business, bringing to the surface the main wealth-creating industry, and consequent employment in it, (4) availability of qualified teachers from Lincoln and Massey, (5) demands of modern Agriculture in face of world competition. The backward state of Agricultural Vocational Courses is still very evident, and these could well be doubled or trebled, for the teaching of Agriculture, Dairy Science and Woolclassing as subjects in a general curriculum can only be regarded as necessary for the great majority of pupils, whatever their vocations, in a country so dependent on its Agricultural resources.

Courses are necessarily diverse in accordance with local conditions. Some are very thorough indeed, and compare favourably with courses taken at the Agricultural Colleges. Necessarily it depends largely on facilities, as number of pupils and staff, farm, finance, etc. The average course includes:

(a) Bookkeeping and farm accounts.
(b) General biology to lead up to botany, entomology and animal husbandry.
(c) Chemistry and physics to provide a basis for soil, fertilizer and plant chemistry reactions.
(d) Field husbandry, including botany of farm plants and weeds, grasses, and pasture management, crops and their management, farm forestry, orchard and garden practice, diseases affecting crops.
(e) Animal husbandry, anatomy and physiology, nutrition and

feeding, breeds of live stock, breeding, diseases and care and treatment of such animals, dairy science, wool and wool classing.

(f) Insect pests, identification and control.

(g) Practical work in ironwork, woodwork, implements and general farm work.

In some schools home project work is promoted, and this is evident in those schools which do not have access to land in connection with the school. Such work as top-dressing trials, crop manuring, lamb and calf feeding, poultry raising, farm records and bookkeeping, and stock feeding projects are carried out. There is room for considerable extension along these lines.

The general method of teaching is very diverse. As far as possible theoretical teaching is combined with observations, experimental and practical work. A background of science (chemistry, biology, and elementary physics) is built up progressively, and its application to the former stressed and made use of. Since the duration of the average pupil's course is short, the science subjects must be taken in conjunction with those which have a direct bearing on agriculture.

Most schools are provided with equipment sufficient to allow individual experimental work in the sciences. However, comparatively few are fortunate in having a school farm and livestock, etc., for agricultural instruction. The means at the disposal of the teacher are laboratory work, observations on all farm operations, experimental work, etc., either on school farm or neighbouring farms, practical work by pupils on farm or as home projects, and practical work in iron and wood and saddlery.

It is essential that a pupil should take part in or be capable of doing all kinds of farm work, and know the practical details; but it is also realized that this must not be done at the expense of scientific work, since the pupil will have ample opportunity of developing the former to perfection in later life. Routine work is minimised as far as possible, and purely manual work avoided.

5. *Training of Teachers*

Up till now there has been no satisfactory scheme in operation for the training of teachers, owing to the fact that teachers may enter the profession in two ways which are not related—

(a) By taking a Science Degree, and passing through a Teachers' Training College. By this means they are trained teachers, but not qualified agriculturally.

(b) By taking a degree at an Agricultural College, in which case they are qualified in agriculture, but not as teachers.

There has been a shortage of teachers qualified in agriculture up to the present. The output of Canterbury Agricultural College did not satisfy the demand, but now that Massey College is functioning there will be sufficient offering. It is also probable that some arrangement will be made for their training as teachers as well.

The course at an Agricultural College entails one year's work of pure science at one of the University Colleges, and three years' work at the Agricultural College. The latter consists of a study of all subjects related to agriculture, and considerable practical work of all kinds.

6. *Extra School Education*

The Department of Agriculture organized and largely financed a scheme of Boys' and Girls' Agricultural Clubs, which made its initial appearance in Taranaki, under the guidance of Mr. Deem, but has since been developed in many parts of New Zealand. It has been eminently successful in the country districts, and good work is being done. Competitions are arranged for pupils of Primary Schools in growing a small area of a crop of mangels, carrots, swedes, or potatoes, etc. A senior division for young people after leaving school has also been recently added. These field competitions have been extended to calf and pig raising competitions. The competitor must keep records throughout, and be present at inspections and judging. The work of organizing, inspecting and judging is carried out by officers of the Department of Agriculture, Education Department, Farmers' Unions, and individual farmers.

In 1923 Calf Clubs were formed in Taranaki.

In 1924 a Poultry Club was developed in New Plymouth.

In 1926 Senior Boys' and Girls' Clubs were established for those who had left school. A quarter-acre of crop was laid down as a manurial trial.

By 1927 practically all schools in Taranaki and Wanganui area competed, and extension of the organization began.

In 1928 clubs were established in Feilding, Wairarapa, Taihape, Marton and Hunterville areas.

In 1929 the movement had spread to Otago and Southland.

In 1930 the movement had spread to Hawke's Bay and Canterbury as well.

The movement has been one of progressive success in the number of competitors and the standard of work, particularly in the increasingly popular Calf Clubs. Valuable demonstration work is given at judging time.

In some rural and urban schools a vegetable garden plot competition has been organized, and is proving itself very popular and useful.

TABLE LXXVI

Calf Club Entries

	1926–7	1927–8	1928–9	1929–30	1930–1	1931–2	1932–3	1933–4
North Taranaki	117	154	215	291	251	288	309	350
South Taranki ..	282	344	311	360	403	524	418	449
Wanganui-Main Trunk ..	—	—	138	121	—	190	192	190
Manawatu ..	—	—	—	—	—	227	231	227
Horowhenua ..	—	—	—	—	—	59	114	107
S. Hawke's Bay	—	—	—	—	65	92	140	150
Wairarapa ..	—	—	126	76	43	101	203	251
Gisborne ..	—	—	—	—	—	—	—	36
Canterbury ..	—	—	—	—	—	20	31	—
Otago	—	—	—	—	75	98	100	—
Southland ..	—	—	—	38	120	122	140	—
Totals ..	399	498	790	886	957	1,721	1,898	1,760

TABLE LXXVII

Crop Competition Entries

	1926–7	1927–8	1928–9	1929–30	1930–1	1931–2	1932–3	1933–4
North Taranaki	—	—	—	131	66	36	58	84
South Taranaki	—	—	—	118	101	217	197	192
Wanganui-Main Trunk ..	—	—	—	221	177	148	192	143
Manawatu ..	—	—	—	179	211	241	154	148
S. Hawke's Bay	—	—	—	—	33	—	—	—
Canterbury ..	—	—	—	—	700	65	76	—
Otago	—	—	—	22	122	200	287	—
Southland ..	—	—	147	301	227	193	176	—
Total ..	—	—	147	972	1,637	1,100	1,140	56[1]

II. UNIVERSITY AGRICULTURAL EDUCATION IN NEW ZEALAND[3]

A. HISTORICAL REVIEW

In 1872 Wm. Rolleston, then Superintendent of the Province of Canterbury, in the South Island, set aside certain back-country runs, totalling 200,000 acres, as an endowment for a University College for the teaching of Arts and Sciences, and certain other runs totalling 100,950 acres, as an endowment for an Agricultural College. The University College, being established first, assumed the management of both endowments, and in 1879 established a School of Agriculture of Canterbury College. Some of the endowments were sold to buy land for a farm at Lincoln, 13 miles from Christchurch, and brick buildings were erected to serve as classrooms, laboratories and residences for 50 students and a teaching staff.

[1]. This section was written by F. W. Hilgendorf.

In 1896 the University College and the Agricultural College endowments were separated, and Canterbury Agricultural College, usually called Lincoln College, was given a separate existence.

For the first 11 years the course of instruction was purely for the Diploma of the College, Matriculation to the University not being required of any student.

In 1891 the University granted a Certificate in Agriculture to students who had matriculated and had thereafter passed certain examinations based on the College Diploma Course. In 1896 a Degree of Bachelor of Agriculture of the University of New Zealand was established. Candidates were required to be matriculated, to have attended a University College for one year, and to have then passed examinations in chemistry, physics and biology, and thereafter to have spent two years at Lincoln College, and passed examinations on agricultural subjects. This was the first University Degree in Agriculture in the Southern Hemisphere, but no one took advantage of it till 1913. A total of 39 students had graduated up to the time of the alteration of the course in 1928.

In about 1910 Sir John Logan Campbell made a bequest for a Chair of Agriculture at Auckland University College, but the bequest did not become operative until many years later. In 1923 Sir Walter Buchannan made a bequest for a similar purpose to Victoria College, and in 1924 Prof. Peren was appointed to the chair, the first established in New Zealand. In 1925 the Campbell bequest became available, and Prof. Riddet was appointed to the Chair of Agriculture at Auckland. Neither professorship was, however, supported by an adequate staff, laboratories or farm.

In 1926 a movement was started by the two colleges named to combine these two chairs, and found a complete College of Agriculture for the North Island at some intermediate point. Palmerston North was chosen, and a Bill was put through Parliament establishing the Massey Agricultural College, and providing it with ample finance for a complete staff, buildings and farm. Massey College started work in 1928, in temporary accommodation, and its permanent buildings were completed and opened early in 1931. In 1929 also an amendment to the University Act was passed, by which Lincoln College and Massey College became integral parts of the University of New Zealand.

Two Professorships of the University were created at Lincoln to supplement the two at Massey, and the two Colleges were granted representation on the University Academic Board. At the same time a new Degree, called the Bachelor of Agricultural Science, was instituted. The course covers four years, the first being occupied in the study of pure science at one of the ordinary University Colleges, and the remaining three at one of the Agricultural Colleges.

The state of higher agricultural education at the moment, then, is that there are two Colleges of the University equipped for teaching agriculture for Degrees. The older (Lincoln) is situated in the South Island, and is supported by endowments of the old Canterbury Provincial Council; the newer (Massey) is situated in the North Island, and is supported by Government grants, assisted by two endowments, one belonging to Auckland and the other to Victoria College. The two Colleges and their work will be described separately.

B. Lincoln College

Lincoln College (officially named Canterbury Agricultural College) consists of handsome old brick buildings, and a new laboratory block opened in 1930. It is situated in the middle of the mixed farming district of New Zealand, in the middle of the area where 80 per cent. of the wheat, 70 per cent. of the oats, and 60 per cent. of the potatoes are grown. It has accommodation for about 70 students in residence, and a staff of professors and lecturers, and is surrounded by 1,000 acres of first-class farming land. On this land, crops of wheat, oats, barley, potatoes, turnips, mangels, and linseed, as well as all fattening and catch crops, are grown, about 500 acres being continuously under the plough. On the remaining grass land, sheep, cattle, horses and pigs are raised, the sheep comprising seven pure-bred flocks, and being among the best in the Dominion. Cattle, horses and pigs are also pure breeds of several varieties. An additional 900 acres of land are situated seven miles from the College, and these are used for a flock of cross-bred ewes for the production of fat lambs. The whole farm is run as a commercial concern on modern lines, though a considerable proportion of it is given up to the field researches, to be afterwards detailed.

The commercial farm provides practice in farm operations for the diploma students, and material for observation of farm methods, and for comparison of costs for the degree students. This material is largely increased by the special experimental work done on the farm, and described below.

The financial resources of Lincoln College are derived from old Provincial endowments, fees of students, and Government grants for special research work. They aggregate about £13,000 per annum, and are supplemented by the profits from the farm.

The teaching staff of the College consists of two professors and nine lecturers, and besides this the teaching facilities of Canterbury University College, 13 miles away, are used for special subjects, with the object of keeping the students in the main stream of University life. The staff is engaged partly in teaching and partly in research work. There are three courses of instruction, as follow:—

1. A short winter course of two weeks for visiting farmers.

2. The course for the diploma of the College. There is no entrance examination, though most students are at or near the matriculation standard. Their average age at entering is 18 years, and most if not all have had some experience of farm operations. The course extends over two years, and each student spends half of each day at lectures or demonstrations, and the other half in carrying out the routine work of the farm. The subjects of instruction are chemistry, botany, farm engineering, field husbandry, live stock feeding and management, veterinary hygiene, and economics. The farm work consists of every possible farm operation, each student taking part in the full rota of duties, and being attached in successive weeks to the teamster, the shepherd, the stockman (cows and pigs), the mechanic, etc.

3. The degree courses. Students may read for the Degrees of Bachelor and Master of Agricultural Science. The course for the Bachelor's Degree extends over four years (including the equivalent of 12 months' practical work), the first of which is taken at one of the four main University Colleges. In the third and fourth year courses a certain amount of choice of subjects is allowed preparatory to the candidates advancing to the Master's Degree in Field Husbandry, Animal Husbandry, Agricultural Economics, or Plant Pathology.

The research work carried on by the College staff, usually helped by assistance outside the staff, is as follows:—

Wheat Breeding.—The Wheat Research Institute has its plant-breeding station on the College land, and the Professor of Botany is Director of the Institute. Its work is very extensive, and it is thought that this is one of the largest wheat-breeding stations in the Empire. The College supplies land, labour, machinery, etc., for the field work, and students have demonstrations of all the operations, and in their vacations sometimes work as paid servants of the Institute.

Grass and Clover Breeding.—This consists of the raising of improved strains of Rye Grass, Cocksfoot and Red Clover. Some 10 acres are occupied in the trials, and here again students make observation of the procedure, and assist in the operations of measuring, weighing and recording.

Animal Nutrition.—This is in charge of the chemist, and trials are made of feeding some hundreds of pigs on various feeds, and of rations supplementary to grass for lambs and breeding ewes. About 40 acres are given up to trials of rotational grazing.

Animal Hygiene.—Researches are conducted by the veterinary surgeon on the cause and cure of animal diseases, special attention being paid to the commonest, such as ante partum paralysis. About 150 ewes and

other lambs have been under special iodine treatment, and some scores are being treated with various substances for intestinal worms.

Wool.—A special scheme is on foot to record the weights of individual fleeces of ewes and their offspring, and one of the College staff has spent last year at Bradford in England studying the wool requirements of the manufacturers.

Farm Economics.—Several hundreds of Canterbury farms of all types of management have been costed by the Economist, and he has a scheme whereby he keeps the accounts of numerous farmers. Students assist in the collection of data and in the keeping of books.

Farm Management.—An officer attached to the College manages various farms handed over to him by commercial firms or public bodies, and applies to them up-to-date methods of management.

Agricultural Implements.—A Committee of the Department of Scientific and Industrial Research, of which the farm manager is a member, makes competitive trials of tractors, harvester, drills, etc., on the College farm.

While the College farm is run on commercial lines, very many small experiments are undertaken to elucidate special points for the instruction of students, e.g., strips in every field sown are left unharrowed, or unrolled, or unmanured, or double-seeded, etc., and observations are made on the results, as well as on different varieties of farm crops, different manures, etc. All of this farm work and special research work is available for the students' instruction, and their living on the farm, and taking part in all its operations, is considered the greatest importance in their instruction.

C. Massey College

Massey College, which commenced teaching in 1928, has new and very commodious and impressive buildings for class-rooms and laboratories, and the equipment of these is modern and complete. It has also a refectory, where students dine in hall, and dormitory accommodation for degree and full-year diploma students. Short-course students, however, live in lodgings in the adjacent town of Palmerston North. This town has some 20,000 inhabitants, is the railway centre of the North Island, and the centre of gravity of the population of New Zealand. The College is thus very favourably situated, and it has, besides, the advantage of being in the centre of one of the most important and fertile dairying and sheep-grazing districts, and close by the only areas in the North Island where cropping is practised to any considerable extent. Its own farm is 850 acres in area, and is fairly typical of the country. Its stock consists of a large herd of milking cows of pure-bred and grade Jersey, Friesian and Ayrshire cattle, and these are used for dairy research. The sheep are of pure-bred and cross-bred flocks, and the pigs pure-bred herds. A certain amount of

cropping is carried on, but the area is definitely a pastoral one, and grassland farming of sheep and cattle (with their attendant pigs) is the chief industry of the College farm. Students do not carry on farm operations to the same extent as is the case at Lincoln, except those who apply for practical training, but watch and record the results of various methods of farm practice.

The financial resources of the College are chiefly drawn from grants made by the Government. The original statutory annual grant of £15,000, made by Parliament in 1926, has now, under a Government economy measure, been reduced to £9,000. Besides this, there are fees from students and profits from the farm, and the income from the Auckland and Victoria College endowments for Chairs of Agriculture.

The staff, as at Lincoln, is engaged partly in teaching and partly in research. There are two series of courses offered, one for the University Degree in Agriculture, as at Lincoln,[4] and the other series embracing numerous shorter courses, as follow, the length of each course being noted beside its name:—

Diploma Course for dairy manufacturers	3 years of 11 weeks each.*
Diploma course in dairy farming	2 years of 25 weeks.
Diploma course in sheep farming	2 years of 25 weeks.
Certificate course in herd testing	1 year of 3 weeks.†
Certificate course in wool classing	1 year of 3 weeks.
Certificate course in wool classing	1 year of 11 weeks.
Certificate and advanced courses in poultry farming	1 year of 48 weeks each.

*A fourth year is available for students wishing to specialize further.
†The field staff of the Herd Testing Association is drawn entirely from these students.

The research work carried on is as follows:—

Dairy Research.—This is a very large and complete Institute, situated upon the College grounds, and a Professor of the College is Director of the Research Institute. A unit of the Dominion Department of Scientific and Industrial Research, its policy is controlled by a Dairy Research Management Committee of the (parent) Research Council. This Committee consists of three members nominated by the New Zealand Dairy Produce Board, two by the Department of Scientific and Industrial Research Council, two by the Massey Agricultural College Council, two by the Department of Agriculture, and one by the N.Z. Dairy Factory Managers' Association.

The expenses of running the Institute are borne jointly by the Dairy Produce Board and the Department of Scientific and Industrial Research. The Massey Agricultural College provides the use of its dairy factory, cowsheds, dairy equipment and stock for experimental purposes.

The Institute is intended to deal with matters affecting (1) the production of milk in relation to feeding, breeding, and management of dairy animals and factors influencing its purity, (2) the manufacture of dairy produce of all descriptions, (3) the utilization of dairy by-products,

4. Massey College offers a Dairy Science Option for the degree.

(4) the economic aspect of the production, manufacturing and marketing of dairy produce, (5) the investigation of the suitability of types and models of dairy machinery, metals suitable for dairy machinery and other engineering problems affecting the dairy industry.

Flax Research.—In conjunction with the Flax Research Committee of the Department of Scientific and Industrial Research, the Field Husbandry Department of the College has undertaken the botanical investigation of New Zealand flax (*phormium tenax*), and an area of 20 acres has been set aside for this purpose. Arrangements are now being made for the lease of 70 acres of land in the flax-milling and growing area near Foxton.

The immediate aim of the work is to secure improved strains of Phormium by means of selection, hybridising and testing. Resistance to disease, especially to yellow leaf disease, is a quality to which much attention is also being given.

Wool Research.—This aims at the detection and elimination of faulty types of wool, and at the explanation of the production and influences of yolk. The College flock is largely used to provide material for the research, and students are able to follow its course.

Wool, dairy and flax research constitute the main branches of investigational work at present being carried out by the College.[5]

In addition to these, there are very numerous trials and demonstrations carried out on the farm on such matters as seed mixtures, manures, methods of grazing, etc., and students are able to watch and record the results of these trials as their time at the College allows.

The fact that students are able to reside in the neighbouring town allows the admission of large numbers of special courses, and also of the admission of women. The marked increase in enrolments since the inception of the College is clear evidence of the eager demand for these courses, despite the financial difficulties of parents during the depression.

D. Scholarships

A limited number of University bursaries are awarded on a competitive basis, and are available for the payment of fees up to £20 per annum for (usually) three years at either College. Each year there are available five or six agricultural bursaries, giving a maximum of £60 a year for two years (extensible for one or two years longer on recommendation), and entailing on the student his teaching in the Dominion for three years out of the five succeeding his graduation. Lincoln College has two entrance scholarships, valued at £25 a year each; a Shell Oil Co. Scholarship of £25 a year to help deserving students in financial difficulties; and a

5. Detailed accounts of the nature and scope of this research will be found in Chapter XIII.

Job Osborne Scholarship of the same value for a similar purpose. Massey College has a Shell Scholarship of £25, tenable for one year, but extensible at the discretion of the Council; a Farmers' Union Research Scholarship of £100 a year; a John Court Scholarship of £60, available every fourth year to residents of Auckland who are entrants to the College; and a Sir James Gunson Scholarship of £250 a year for two years for post-graduate research. The two Colleges hold in common the McMillan Brown Scholarship of £200 a year for two years, available to men who have passed the Master's degree, and a Senior University Scholarship in Agriculture, and each has a Lord Bledisloe Prize for undergraduates. Their graduates, in common with those of the four University Colleges, are eligible for several National and other research scholarships, some of which entail travel overseas. In addition both colleges have numerous bursaries, medals and prizes for awards to students of the diploma courses.

E. Editorial Note

In spite of the considerable advances which have been made in recent years in senior agricultural education and research, many defects remain. These defects are to be found mainly in the method of organization.

Under the present system there are three distinct groups of workers with related interests who have little or no direct contact with each other:

(1) The purely scientific research workers;
(2) Teachers at the Agricultural Colleges;
(3) Officers of the Fields and Live Stock Divisions of the Department of Agriculture.

Of the first group, the research workers, some are employees of Government departments, some employees of 'secular' bodies (e.g., the Cawthron Institute), and some employees of the Agricultural Colleges. The common ground of these workers is in many cases fundamental scientific research, having as its object the acquisition of knowledge which may be of some use to the agricultural world as a whole, and to New Zealand agriculture in particular; and such fundamental work lies always at the back of whatever particular or local problems are in hand.

The teachers at the Agricultural Colleges are in many instances men of high scientific ability and attainments, appointed in a dual capacity as teachers and research workers. In other cases they are men whose qualifications are chiefly those that come from wide and competent practical experience of farming. The teaching staffs therefore consist of men of very diverse training and outlook, some being pre-eminently of the pure research worker type and others of the farm manager type. To a surprising extent these widely-divergent types work together successfully in

providing teaching courses which vary from the mainly practical to the mainly scientific. The combination of research work and teaching, though undeniably arduous for the individual, gives a definitely 'live' quality to the teaching, and often illuminates the research problem. The danger, in times of financial stringency, is that a growth both in the volume of teaching and in the ramifications of research will impose too great a burden on the worker; but this danger can seldom be properly appreciated by those who have not had the unique experience of working in a New Zealand University College.

The members of the third group, field officers of the Department of Agriculture, have duties which take them amongst farmers, partly in an advisory capacity, partly to administer legislation affecting stock diseases, certification, etc. To a large extent the direct contact which such officers have with the farmer and with the Department joins the scientific work of the Department to the practical problems of the farmer.

The main weaknesses of this organization are clear enough. In the first place research workers with essentially the same motives and aspirations have to work in different institutions where quite different official policies may prevail, and where, at times, the scientific point of view may be subordinated to the official. Research workers in Government Departments have to submit their results to their administrative head for approval, but on the other hand they have the advantage over College workers of more time and more facilities for observing problems in the field, and in many different districts. The multiplication of bodies controlling research has the further disadvantage that workers in different institutions meet, as a rule, only by private arrangement. It is realized by both sections that a fusion of the two staffs institutionally would lead to much greater mutual inspiration. This is clearly seen in the case of the Dairy Research Institute, which, though a separate organisation, is housed in Massey College, and directed by a Professor of the College.

The scientific staffs of the two Colleges spend far too much time in elementary teaching. The growth of diploma and short courses has seen no equivalent increase in the staffing, and more and more, men whose training and qualifications fit them for research and advanced teaching have had to undertake teaching of a pre-University standard. Any plan for the better utilization of the intellectual resources of the Colleges must include the liberation of the senior members of the teaching staffs from work which, in all probability, would be better done by juniors. It is difficult for any man with a research problem hot in his head to devote the necessary care to elementary teaching, which is often much more exacting than advanced work.

The College staffs suffer greatly through lack of mobility. Tied

down during the teaching session—about eight months of the year—by the claims of their numerous classes, they have little opportunity (and now less money) to move about the country. The inevitable tendency is for them to become too academic and too divorced from the practical problems of the farmer. They are alert to this danger, and recognise that their efficiency as teachers of a new generation of farmers depends largely on their ability to keep close to farming reality. On the other hand, if the research workers of the Government Departments have a closer and more continuous contact with the farmer, both through greater personal mobility and through the chain of field officers, the worker at the College enjoys greater freedom from political influences.

The advisory fields officer is closest of all to daily problems, but he is least able of all to make use of this contact. He is not encouraged to appeal to specialists for the latest knowledge, or to act (as he should) as a collector of information for the specialist. Although he has a more intimate knowledge of farm management procedure in his own district than anyone, there are no customary or official means by which he can pass this information back to teachers. The rich supply of information that could pass both ways between field officers and teacher is never availed of systematically. The contacts are infrequent and cursory.

The Colleges have done all that could be done to meet these difficulties. The immobility of the staff is, of course, not absolute, and some members have been able to establish more or less continuous associations with the land over a wide area. As far as possible, students are taken on demonstration tours to neighbourhood farms, and through the farm managers filter much information from the world of working farmers. Moreover, the institutional separation of workers has to a large extent been modified by more frequent personal meetings between members of the different bodies and by formal and informal conferences.

Nevertheless, closer co-ordination between the College worker and workers in the field, and in other institutions, is desirable. Existing divisions are to a large extent historical and fortuitous, and it is conceivable that a thorough rationalization of agricultural research and instruction would integrate institutions now separate. Such a fusion would make it possible for those primarily engaged in teaching to come into contact with those in direct touch with the farmer, while the research workers could, where necessary, travel in company with field officers to observe problems on the farm, and could, also, give specialist lectures to students where such lectures formed an essential part of the training of the future agriculturist. Every-day contact of this sort would widen the outlook of all sections, and would permit a closer co-operation in the main problem of facing present-day issues and of reorganizing for the future.

CHAPTER XV

THE DEPARTMENT OF AGRICULTURE

BY E. J. FAWCETT

I. General. II. Organization—A. Head Office: 1. Chemistry Section; 2. Plant Research Station; 3. Publications; 4. Accounts—B. Live Stock Division—C. Dairy Division—D. Horticultural Division—E. Fields Division.

I. GENERAL

THE functions of the New Zealand Department of Agriculture are varied in type, ranging from instruction in all phases of farming to inspection and grading of produce in the Dominion, and a supervision of products arriving on the markets of Great Britain. The fact that its major duties are concerned with production necessitates a comparatively large and reliable staff, so distributed that all sections of the farming community may be given the necessary service. Therefore its staff is stationed at strategic points all over the Dominion.

The history of the Department is closely associated with the development of primary production, its staff being strengthened in conformity with the demands made upon its services by producers, and by Government Acts devised to safeguard the interests of agriculture and the State generally.

II. ORGANIZATION

The organization of the Department is so arranged that direct liaison is maintained between its various activities and the Minister for Agriculture, who is the supreme head of the organization. Sections dealing with different branches of work are arranged under one of five heads, as follows:—

(1) Head Office.
(2) Live Stock Division.
(3) Dairy Division.
(4) Fields Division.
(5) Horticulture Division.

Head Office and Divisional Headquarters Staff are stationed in Wellington. The desirability of allocating certain branches of primary production to the care of separate divisions can only be fully appreciated when a study is made of the range of technical matters with which the Department has to deal.

A. Head Office

The main functions of Head Office are:—

(1) To provide a link between the Minister for Agriculture and the Department as a whole.
(2) To put into effect the policy laid down by the Government.
(3) To co-ordinate the work of the various divisions, and to attend to any matters which are outside the scope of divisions.
(4) To maintain close contact with the farming community and gauge its requirements.

Head Office is then principally concerned with organization and policy matters, and the co-ordination of effort aiming at maximum service to the community in an endeavour to advance the practice of agriculture in all its branches, and to ensure that quality of products is maintained.

In addition, a number of activities operate under the immediate control of Head Office:—

1. *Chemistry Section*

One of the major operations of the chemistry section at the present time is in connection with the investigation into mineral content of pastures under a scheme partly financed by the Empire Marketing Board. In addition to this work, analysis of soils and pastures are undertaken in connection with mineral deficiencies as they affect live stock.

The section is also engaged on an extensive soil survey of pumice areas.

Its routine work consists of the analysis of fertilizers under the Fertilizers Act, and numerous investigations at the request of the various divisions of the Department.

2. *Plant Research Station*

The Plant Research Station at Palmerston North, which functions under an advisory committee, on which the Department of Scientific and Industrial Research is represented, is under the direct control of the Assistant Director-General, stationed at Head Office. It is therefore an activity of Head Office, but is worked in constant and intimate co-operation with the Fields Division organization.

The station is comprised of specialized officers, in charge of each section, the types of investigation comprising:—

Agronomy.—Crop selection and certification, the production of pure seed, and the systematic introduction and trial of new varieties.

Agrostology.—Ecology of grass lands of New Zealand; grassing of new hill country; the regrassing of country cleared of secondary growth;

the grassing of special soil types; the investigation of strains in pasture plants; the collection of pasture samples for chemical analysis; and the consideration of seed mixtures generally.

Analytical Chemist.—Pasture analysis for the determination of mineral content; analysis of poisonous plants; analysis in connection with sprays and disinfectants, and general purity tests of materials used by the Fields Division or other specialists.

Field Experiments.—The general planning and supervision of the field experimental programme of the Fields Division; planning and execution of special experiments dealing with fertilizers and crops, and the improvement of laboratory methods in experimental technique.

Entomology.—The investigation of diseases of plants induced by insect agency; the combating of insect pests; investigation of parasites infecting animals; the biological control of weeds; inspection of plant products; determination of plant diseases; and the systematics of insects.

Farm Economics.—The general economics of farm organization and farm crops; investigation into management methods and the effect of management; economics of production costs; statistical analysis of disease incidence in dairy herds; effect of price levels and economics of manufacturing technique.

Mycology.—Investigation of diseases of plants caused by agencies other than insects; production of control methods of disease; production of disease free nucleus lines of seeds or tubers; dissemination of beneficial fungi and bacteria; systematics of fungi and industrial mycology generally.

Seed-Testing.—Commercial seed-testing; investigations into technique of testing and analysis; investigations into factors affecting germination; and study of the trend of deterioration or otherwise of exported seed.

Systematic Botany.—The systematics of the flora of the Dominion; the mapping of the geographic distribution of indigenous and introduced plants; plant identification; and general study of their economic importance.

From a study of this brief summary of the activities of the Plant Research Station, it will be appreciated that it has a close relationship with field instruction, forming, as it does, the investigating body for the provision of instructional data. Much of the field work of specialized officers is carried out by officers of the Fields Division, and thus close co-operation is essential.

3. *Publications*

The *Journal of Agriculture,* which is issued monthly, constitutes the official organ for dissemination of information amongst the farming community. In addition to the Journal, the publications section attends

to the printing and distribution of bulletins and pamphlets dealing with special phases of the work of specialists and administrative officers.

4. *Accounts*

As an adjunct to Head Office itself, the accounts section deals with all matters of receipts and expenditure, and is the channel through which close check is kept on the financial administration of all sections of the Department.

B. Live Stock Division

Although the Live Stock Division is primarily concerned with matters relevant to farm stock and meat inspection, it also administers the Noxious Weeds and Rabbit Nuisance Act. The administration of this division is decentralized, its Head Office in Wellington being linked up with field work through the four District Offices at Auckland, Wellington, Christchurch, and Dunedin, each of which is under the control of a District Superintendent. To facilitate the work of these organizations, a responsible clerical officer is stationed at each centre to control the necessary office organization. This delegation of immediate control from Head Office to districts has enabled field officers to be kept constantly in touch with their controlling officers, resulting in increased efficiency, and has at the same time ensured better contact with the requirements of the farming community.

The administration of Statutes containing an element of compulsion necessitates the use of a considerable amount of discretion on the part of responsible officers. It is, however, generally realised by farmers that Acts are enforced for the general good of the community, and in most cases their administration is in the form of advice rather than force.

The staff of the Live Stock Division is comprised of:—

Veterinarians.
Stock inspectors.
Meat inspectors.
Rabbiters.
Instructors.
Research specialists.

Although the veterinary staff and stock inspectors give advice and assistance to farmers on stock diseases, their main duties are inspectorial in nature. In addition to the control of outbreaks of disease, the veterinary staff exercise a supervisional control over meat inspection at killing works and care of live stock at quarantine stations.

The Live Stock Division has on its staff instructors in swine husbandry, wool, and in poultry keeping. These staffs are directly

responsible for the dissemination of up-to-date information, for the instruction of individual farmers, and the extension of their respective branches of primary production.

The Wallaceville Veterinary Laboratory is staffed by research officers. It has branch laboratories at Hamilton and New Plymouth, which deal almost exclusively with research connected with the dairy industry. The work of this laboratory deals specifically with analysis of specimens of all descriptions, investigations into cattle diseases, with special attention to sterility and abortion in dairy cows; routine and special investigation into diseases affecting sheep, swine and poultry, etc.

C. Dairy Division

The Dairy Division is essentially concerned with the administration of Acts designed to ensure that dairy produce exported from New Zealand arrives on its respective markets in a condition calculated to maintain or accelerate the consumption of our dairy products.

These Acts necessitate the grading of produce at exporting ports and the supervision of export generally. A liaison is maintained between the Dominion and the consumer through officers stationed in Great Britain, whose duty it is to test produce and report on matters of interest generally.

To ensure that the quality of produce coming forward to grading stores is maintained, the division exercises a supervisional control over cream and milk grading at the factory itself, and through the medium of farm dairy instructors carries out the inspection of milking plants and provides an instructional service which aims at the improvement in quality of the supply of raw material. Farm dairy instructors are paid partly by the State and partly by the factory to which they are attached.

The division also maintains a research staff dealing with dairy bacteriology.

The control of two branches of herd-testing is directly under the Dairy Division, namely, 'Certificate-of-record' and 'Government Official Herd Testing.' In addition, it is represented on the central executive of the Group Herd-testing Federation, which is responsible for the general supervision of the group-testing system.

D. Horticulture Division

The main staff of the Horticulture Division is comprised of orchard instructors and fruit inspectors. The instructional staff is concerned mainly with personal instruction to growers in matters pertaining to orchard management and the supervision of packing of export fruit. Fruit inspectors are mainly concerned with the supervision of export and inspection of local and imported fruit, etc., intended for the local market.

In addition to its contact with the main fruit industry, the division maintains an expert in grape culture and wine manufacture, and also officers dealing with horticulture in its relation to small fruits, vegetables and flowers, tobacco and hops, etc.

An Apiary Section is also attached to this division, its staff of instructors giving assistance and advice to the honey industry as required.

The division co-operates with the Department of Scientific and Industrial Research in cool-storage investigations, and with the Plant Research Station in a comprehensive research programme on the use of fertilizers and the efficiency of spraying compounds.

E. Fields Division

The objective of this division is to effect a progressive improvement in the methods and practice of agriculture and of pastoral farming.

Direct contact with the farming community is maintained through its staff of instructors, who take a leading part in the farming life of the community, especially through the control of Boys' and Girls' Clubs, Farmers' Field Competitions, and field experiments for demonstration purposes.

The field staff closely co-operates with specialists of the Plant Research Station, particularly in the execution of fertilizer and crop experiments and in the certification of crops and seeds.

The Fields Division also controls the Ruakura State Farm and the Farm School of Instruction attached to it. The farm consists of some 900 acres of mixed-quality land, and carries the full range of stock necessary for teaching purposes.

The grading regulations governing hemp for export are administered by this division, the work being carried out under the supervision of the Chief Hemp Grader, stationed at Wellington.

Chapter XVI

FARMERS' ORGANIZATIONS

By F. B. Stephens

I. General Trend in the Past Decade—A. Introductory—B. Effects of Industrial and Scientific Progress. II. Special Organizations—A. Breed Associations: 1. Cattle; 2. Sheep; 3. Pigs—B. Other Vocational Organizations: 1. Pig Industry Advisory Council; 2. Pig Recording Clubs; 3. Co-operative Pig Marketing Association; 4. Vealer Calf Marketing; 5. Wheat Growers' Co-operative Association Limited; 6. Sheep Owners and Farmers' Federation; 7. Calf Clubs; 8. Fruit Growers' Federation. —C. Social and Semi-vocational Associations: 1. Agricultural and Pastoral Associations; 2. The Farmers' Union; 3. Women's Organizations.

I. GENERAL TREND IN THE PAST DECADE

A. Introductory

IT is well known that the organization of the rural population into groups to express a common purpose and the development of institutions to satisfy common needs are, in general, more difficult than similar problems among urban dwellers. This applies less in older countries where communal organizations of many sorts have been grafted on to a comparatively stable village economy than in new countries where a continuous local tradition has had less time to develop, where the village is of less significance as a social centre, and where the population is much more mobile. In such countries the greater part of communal effort tends to be economic or politico-economic in significance. These observations are particularly true of New Zealand, where the most active organizations amongst farmers are economic.[1]

B. Effects of Industrial and Scientific Progress

The movement towards organization amongst farmers has received an impetus since the war owing to a number of factors. Scientific research and educational propaganda have been steadily developed and extended. A new generation of farmers, including many returned soldiers, bred and educated in many cases in the towns and more receptive of new ideas, has infiltrated the rural community. Improved roads, the development of motor transport, and improved communications and news services have made possible a closer contact of mind with mind and encouraged a more progressive attitude. These conditions, strengthened by the pressure of economic depression and reinforced by changing political events impinging on the farm economy, have not only promoted a rapid improvement

1. For a more general discussion than is attempted in this section see Belshaw: 'Some Aspects of the Country Life Movement in New Zealand,' *Monthly Bulletin of Agricultural Economics and Sociology*, April, 1929.

in farm technique but also brought home the need for combination amongst farmers to achieve particular economic or political ends.

The expansion and consolidation of co-operative activity amongst dairy farmers, and the establishment of control boards are evidences of the awakening of the rural community in response to the new post-war stimuli. In this section we shall not be concerned so much with co-operative and marketing control but with the activities of the types of farmers' organizations, many of which were in existence prior to the war, but most of which have enjoyed a new lease of life during the post-war years.

It is not easy to find a satisfactory basis on which to classify the various farmers' associations, and it is perhaps best to describe the various associations without attempting to label them. Broadly speaking, however, we shall proceed from those with more specialized to those with more general purposes.

II. SPECIAL ORGANIZATIONS

A. Breed Associations

1. *Cattle*

From a national point of view, Breed Associations are of immense value. Their object may be said to be, broadly, the development of a type of animal which possesses characteristics especially suiting it to a particular purpose or purposes. In practically all the pastoral industries there has been a considerable development of Breed Associations, and these Associations have, by their propaganda, aided considerably in grading up the standard of stock in New Zealand. By their very nature, Breed Associations are in the hands of breeders, that is, men who raise stock for sale as stock, rather than for the production of the ultimate product of the pastoral industry. That is to say, 'pure-bred' or 'pedigree' stock-raising is generally an industry separate from other branches of pastoral industry.

Of the pure-bred cattle in New Zealand, over 85 per cent. are of dairy breeds.[2] Breed Associations are more common with dairymen than with breeders of beef cattle. The three Breed Associations which are most prominent are the Jersey, Friesian and Milking Shorthorn Breed Associations.

The Friesian Association has twelve branches throughout New Zealand. The Association is strongest in Southland and Auckland, although it is represented in all dairying areas. The Milking Shorthorn Association has nine branches, four of which are in the Auckland Province, the others in Canterbury, Hawke's Bay, Marlborough, Southland, Wellington and Taranaki, while the Jersey Association has no branches *qua* branches

2. N.Z.O.Y.B., 1931, p. 457. More recent estimates not available.

but it encourages the formation of local Jersey Clubs which function more or less as branches of the parent body.

Broadly, the functions of the local associations and clubs are similar to those of the parent body, which aims at stimulating local interest in the breed, and which, by the publication of the butterfat returns of the cows of its particular breed, seeks to increase its popularity.

None of the associations holds breed shows, although they co-operate annually, at least in the Waikato, in a combined breeders' sale. There is a growing tendency to hold local pedigree sales in the early spring of each year and the movement seems likely to extend.

The Jersey Association, at least, assists its members in the financing of the purchase of pedigree stock, and, in common with other associations, assists its members in the classification of stock. The rules of all the associations as to classification are very strict, and there has been a noticeable grading up of the pedigree cattle under the influence of inter-breed competition. The present type of animal is somewhat different from the original animal imported, there having been evolved a New Zealand type suited to New Zealand conditions.

Although the Breed Associations are composed of breeders *qua* breeders, with a minimum of pure dairy farmers, yet the infiltration of pure-bred bulls into dairy herds has gone such a distance that in some cases dairy herds are almost pure-bred,[3] although these herds may not comply with the requirements of the Breed Association as to registration as pedigree stock.

2. Sheep

There are two major classes of sheep; those kept primarily for wool and those kept primarily for mutton. The New Zealand Sheepbreeders' Association is a national organization whose primary function is to further stud sheep breeding. It is not associated with any particular breed, but co-ordinates the activities of breed societies and acts as a registration body for breeds which have no individual association. As with all breed societies, its primary method of stimulating breeding is by offering prizes to be competed for at agricultural and pastoral shows. All breed societies endeavour to supervise export of pure-bred animals. By their general supervision they have undoubtedly encouraged pedigree sheep breeding and incidentally increased the efficiency of sheep farming generally in New Zealand. The Sheepbreeders' Association was formed in 1894 and the separate societies have been formed since that date.

The separate societies are: Corriedale Sheep Society, Lincoln Sheep Breeders' Association, Romney Marsh Sheep Breeders' Association, Marl-

3. See Smallfield: *Survey of Waipa County.*

borough Merino Breeders' Association, Ryeland Sheep Society, and Southdown Sheep Society. In the case of other breeds the controlling body is the New Zealand Sheepbreeders' Association.

In the North Island 24 per cent. of the total sheep are of a distinctive breed; in the South Island 42 per cent., while in New Zealand as a whole, 32 per cent. are of a distinctive breed. In the North Island only 5 per cent. of the sheep of a distinctive breed are in registered flock books; in the South Island 4 per cent., while in New Zealand as a whole 4·5 per cent. are registered.

The relatively small proportion of sheep registered, however, does not imply that sheep-breeding societies do not play a very important part in the sheep industry of New Zealand, since there is a steady stream of rams from registered to unregistered flocks. While it is true that there are at the extremes, two distinct types of sheep which may be classified as wool-producing and mutton-producing, the aim of the average sheep farmer is to maintain a double-purpose sheep which maximizes wool and mutton production.[4]

The Romney Marsh breeders are the most numerous. The Romney breed is the most prominent in the North Island, followed by the Southdown. In the South Island most distinctly wool-producing sheep are to be found in the high country, so that, although Merinos comprised only a little under ·2 per cent. of the sheep in the North Island, they comprise nearly 9 per cent. of the sheep in the South Island. On the other hand there are more purely mutton sheep in the South Island.

There are no branch associations of the Sheep-breeders' Association, but the central organization controls all registration by means of inspectors.

In the export of stud sheep the associations give certificates to stock, and retain the right to refuse a certificate to stock which, for any reason, does not conform to type.

3. *Pigs*

The New Zealand Pig Breeders' Association is an organization of pig breeders, and controls the six recognized breeds of pigs at present in New Zealand—Berkshire, Tamworth, Large White, Large Black, Middle White, and Duroc-Jersey.

Within the Association there are four branches, situated in the Manawatu-Oroua, South Auckland, Taranaki and Bay of Plenty districts. Prospective branches are in the process of formation at Nelson, North Auckland, and Te Awamutu areas. A South Island branch, with headquarters at Christchurch, ceased active operations as a result of the

4. Omitting, of course, the large runs, particularly in the South Island, where sheep are kept almost solely for wool. The uses to which different types of sheep are put are discussed in Chapter XX.

depression during 1932. Since pig-raising is an industry subsidiary to dairying, the more active branches have developed in the dairying districts.

The breeding of pure-bred pigs and the production of commercial pigs are distinct functions in New Zealand farming, and the objects of the Association may be said to be the maintenance and the improvement of the quality of pure-bred pigs as the foundation of the commercial fatteners' herds, as well as the encouragement of pig-keeping generally. For this purpose the Association maintains a Herd Book, and in common with other stock societies, co-operates with agricultural and pastoral associations in the organization of and the provision of prizes for pig classes at the various agricultural shows. It also watches the interests of pig-breeders generally. Interesting developments in this latter direction, largely traceable to the activities of the Association and its branches, have been the replacement of 'foot buying' by 'hook buying,' practically all pigs now being sold on dressed-carcass weight, and the institution of an at first voluntary (1931-2) and now compulsory (1933-4) system of pig grading on a differential price basis, for both local and export trade.

The former marked a definite marketing advance, while the latter, though not as yet working as efficiently as desired by pig producers, will be bound to react favourably, not only on the market in England, but also on the individual producer, through the stimulus given to the production of better-type pigs.

The activities of the branches of the Association are somewhat wider in scope, involving in certain instances the co-operative supply of supplementary foodstuffs at contract prices to members, the organization of 'Pork and Bacon Utility Classes,' both export and local, at A. and P. shows, as a means of educating the farmer in the type of pig demanded by modern market requirements, and the dissemination of information on pig-raising methods by lectures, publications (curtailed by the effects of the depression), and by field demonstrations. The membership of the branches thus embraces farmers producing commercial pigs in addition to breeders of pure-bred stock.

1. *The Pig Industry Advisory Council*

This body was set up in 1932 by the Minister of Agriculture in response to the representations of various sections of the industry. The function of the Council is to act in an advisory capacity to the Minister of Agriculture and to the pig producer on all matters pertaining to the industry, with the object of guiding its development along sound progressive lines. The Council is formed of representatives of the N.Z. Pig Breeders' Association, Pig Recording Clubs, N.Z. Bacon Curers' Association, N.Z. Co-operative Pig Marketing Association, meat export firms,

Massey Agricultural College, Lincoln Agricultural College, and the Department of Agriculture.

Though only of recent origin, this organization, through bringing together all the varied interests, is regarded as the leading body in all matters relating to the pig industry in the Dominion.

Its activities to date (1934) have been associated mainly with assistance in the establishment and development of grading methods as an aid to more rational marketing, with the encouragement of pig-raising amongst producers by the dissemination of authoritative information, and with assistance to pig recording clubs in the establishment of a national pig improvement scheme comparable with the advanced register of merit system employed in the improvement of dairy cattle.

2. Pig Recording Clubs

An interesting development during the past few years has been the attempt to bring to bear on the pig-raising industry the same scientific outlook as herd testing has secured in relation to dairy cattle. This is the pig recording movement, which is based on a recognition of 'selection on performance' as the surest means of effecting improvement in live-stock production. The general objects of pig recording are:

(1) The measurement and comparison of the productive capacity of individual sows and boars in a farmer's herd.
(2) Assisting the farmer in locating where and how his herd and his management is succeeding or failing in pig production.
(3) The supply of a rational basis for the sale of breeding stock and for utility classes of live stock shows in the same way as milk records are employed in the sale and judging of dairy cattle.
(4) The collection of reliable data on a large scale for detailed analysis by trained investigators.
(5) The development of pig-raising generally by the foregoing methods.

Aided in the first instance by a Government grant, recording clubs commenced operations in the 1928-29 season in the Waikato, Manawatu and Canterbury districts. The methods adopted were based on similar systems in Denmark, Sweden, Norway, Germany, England and Canada. A recording officer appointed by the club visits the farms of members, and collects data on (1) the number of piglets farrowed per litter; (2) the litter weights and numbers at 3 and 8 weeks of age; (3) details of feeding; (4) details of management, housing, and care; (5) breed and breeding of sow and boar.

Enthusiastic support was accorded the movement by Waikato farmers, which club has operated continuously since its establishment. Less support was forthcoming in the Manawatu and Canterbury areas, these clubs ceasing actively after but one or two years' work respectively. Interest revived, however, in the Manawatu area in 1932, largely as a result of the success achieved by the Waikato Club during the intervening period. The Manawatu-Oroua Pig Recording and Development Club was formed, and is now functioning successfully.

Finance for the work has been provided since 1930 by the Meat Export Control Board, from funds collected by way of a levy on pigs exported. This subsidy to the movement is available owing to the activities of the recording clubs in stimulating the production of the desired type of pig for the export trade.

Though the litter recording work, which is proving of definite value in the grading up of pig stock, through the elimination of unproductive and uneconomical individuals and strains, is necessarily restricted to farmers[5] with whom immediate contact can be made, these clubs, through additional activities, exert a marked educative influence upon pig production methods generally. Such work, to which adequate publicity is given through the agricultural and daily press, and through the issue of pamphlets from time to time, embraces the following:—

(a) *Feed Demonstration Trials.*—Feed trials, comparing different feeding and management methods, are carried out under the control of the Recording Officer, for the purpose of demonstrating to farmers not only the potentialities of the pig as a revenue producer, but also the relative merits of different productive methods.

(b) Export of feed-trial pigs to England for expert assessment of market quality.

(c) Demonstrations of educative nature on farms and at killing centres.

(d) Collection of accurate farm statistics relating to the production of pigs on the dairy farm.

(e) Arrangement of sales of recorded pedigree and grade breeding stock.

(f) Lectures to farmers during the winter period.

(g) Advice through correspondence to any farmer seeking information and assistance.

Recently the clubs have been successful in instituting a national pig improvement scheme, under which certificates of performance are granted to pure-bred breeding stock attaining specified minimum standards of performance of prolificacy, early maturity and carcass quality. Breeders

5. Approximately 400 sows annually are under test.

outside the immediate areas of the clubs can enter the scheme through the co-operation of the Department of Agriculture, whose officers will control the record work in such districts.

The success of the pig recording movement generally has led to efforts being made in other districts to establish similar clubs, but lack of finance has been a serious obstacle. Neither of the present clubs has yet become self-supporting, each requiring an annual subsidy of about £500 for the work. Members contribute little, the membership fee being only 5/- per annum. It is hoped, however, that a stage will soon be reached when farmers will be prepared to meet the entire cost, and to this end a national movement is being developed.

3. *Co-operative Pig Marketing Association*

A Co-operative Pig Marketing Association, with its origin in the Waikato, now operates throughout the whole of the North Island, and in Canterbury. The Association is organized on a co-operative share basis, and operates by means of a levy on all pigs sold by it. Advance payments are made when the pigs are received, and a final payment when the ultimate returns from sale are available—at the end of the season.

Originating in the unsatisfactory condition of the local and export market, the Association has concentrated on the development of an export trade in pork. Competitive conditions, however, have necessitated the handling of all classes of pigs, special provision for the sale of which have been made:—

(a) By arrangement with a local organization, in which the Association is financially interested, and through which bacon and chopper pigs are marketed locally.

(b) By arrangement with the London agents, who have established a special curing factory in England for the handling of a minimum of 2,000 bacon pigs per month.

The Association handles bobby calves on a similar basis, in this way retaining their buying organization and reducing overhead charges during the early part of the season, when few pigs are coming forward.

The Association now seems to be well established, having marketed 80,000 pigs and 160,000 bobby calves during the 1932-3 season. It has had quite a marked competitive effect upon prices, and has been partly responsible for the increased pig exports of recent years.

4. *'Vealer' Calf Marketing*

Since 1929 a new branch of marketing has sprung up in the marketing of 'vealer' or 'bobby' calves. These calves are a minimum of three days old. After considerable proprietary competition, a scheme of semi-

co-operation was evolved, but the direct interest of the farming community is small.

5. *Wheat Growers' Co-operative Association Ltd.*

This is an association of wheat growers who are interested in the orderly marketing of wheat. The wheat area is almost wholly in Canterbury and North Otago, and its operations are confined thereto. It is estimated that between 45 per cent. and 50 per cent. of the wheat of this area is marketed by the Federation. This represents approximately 115,000 acres out of a total wheat acreage of (approximately) 243,000 acres. The total membership of the Association is 2,466, all of whom are wheat-growers.

While the primary object of the Association is the orderly marketing of wheat, yet three subsidiary functions arise out of the main function:—

(a) The reaction of national politics on wheat marketing. The major issue here is the 'sliding scale' tariff on imported wheat, which is, of course, a form of protection by tariff to the wheat grower. The Association has acted as the mouthpiece of wheat growers in this regard.

(b) Research into wheat production. The Federation has collaborated with the Lincoln Agricultural College in this matter, and the activities of that College have resulted in a considerable improvement in wheat cultivation.

(c) The publication of a monthly journal devoted to education in wheat growing and marketing, and also serving as the expression of the official attitude of wheat growers towards national policy.[6, 7]

6. *Sheep Owners' and Farmers' Federation*

The Sheep Owners' and Farmers' Federation represents the economic interests of the sheep farming industry as a whole. Its major functions are:—

(a) To represent the sheep owners in matters of national interest in particular in questions of national politics, and

(b) to co-operate with other bodies in research as affecting the industry.

It does not engage in any marketing activity on behalf of its members.

There are several local branches of the Federation which are registered as Associations of Employers under the Arbitration Court. They are the only bodies of primary producers so registered. The Federation

6. Certain phases of the co-operative side of the movement are discussed in Chapter XXXIV.
7. The general problem of Co-operation as a Farmers' Organization is discussed in Chapter XXXIV. Herd Testing Associations are dealt with in Chapter XVII.

works in close co-operation with the various Breed Societies and also with the Farmers' Unions.

7. Calf Clubs

Farmers' Unions, Agricultural and Pastoral Associations and related bodies have endeavoured to promote Calf Clubs amongst the children of farming areas. These Calf Clubs, which are run on lines similar to those successfully operated in the United States and elsewhere, aim at stimulating interest in scientific stock management among the younger sections of the farming community. The incentive is usually a prize at an annual show for the best developed calf of a given type.

8. Fruit Growers' Federation

Fruit Growers of the Dominion are organized into a Federation, with provincial or district branches, the objects being as follows:—

(a) To engage in any business dealing with the fruit industry or in any enterprise calculated to advertise, extend or otherwise advance the interests of those it represents;
(b) To act in any capacity for the Fruit Control Board, set up under the Fruit Control Act, 1924;
(c) To edit any literature relating to fruit or fruit diseases;
(d) To carry on any business as merchant and buy and sell anything that may be of use to fruit growers;
(e) To promote, foster and protect the fruit industry throughout the Dominion, and to establish a closer bond of unity and co-operation amongst all those engaged in the production of any kind of fruit;
(f) The Federation (as representing the fruit growers of the Dominion) receives as revenue the amount collected yearly as orchard tax under the Orchard Tax Act, 1916.

As one section of its activities, the Federation has attempted to unify and standardize the marketing of all kind of fruit on the local market by the inauguration of a Dominion Mark Scheme, i.e., a registered brand owned by the Federation, which may be affixed by the standards set up by the Federation.

C. Social and Semi-vocational Associations

1. Agricultural and Pastoral Associations

While the Agricultural and Pastoral Associations are not entirely farmers' organizations, yet their orientation is decidedly rural. It would appear from replies to enquiries that on the average 50 per cent. of the membership of these associations are farmers, the other half being urban

business men and firms whose businesses bring them into contact with farmers, either for the sale of their produce or for the provision of farm requisites.

Geographically the associations are very widely distributed. There are well over 100 agricultural and pastoral associations in New Zealand, of which about 40 per cent. are in the Auckland Province. As might be expected, the major associations are in the larger towns: Auckland, Hamilton, Stratford, Palmerston North, Napier, Christchurch, Dunedin and Invercargill.

Until quite recently there was little, if any, co-ordination in the activities of associations, each acting as a local, self-determining unit. Within broad limits this is still the case, as the objects are such that the real gain to be got from co-ordination is small. About ten years ago there emerged the National Conference, to which at present are affiliated about 50 local associations, practically all of which are in the North Island. This Conference deals with agricultural and pastoral matters solely, and ". . . . does not interest itself in anything else."[8] In addition there is a District Council in the Auckland Province subsidiary to the National Conference. To this District Council are affiliated about 75 per cent. of the agricultural and pastoral associations in the Auckland Province. The District Council deals with such routine matters as show dates.

The major objects of agricultural and pastoral associations are to provide an opportunity for:—

(a) The display of stock.
(b) The dissemination of new production methods.
(c) The free discussion of matters of rural vocation interests.
(d) The advertisement of rural requisites.

In the words of one correspondent, the agricultural and pastoral associations are practically *in loco parentis* to the breed societies, as they provide an opportunity for the display of, and competition relating to, pure-bred stock. The societies which show at agricultural and pastoral shows include not only cattle, sheep, horse, and pig societies, but also dog fanciers and poultry breeders.

The showing of stock is confined mainly to the summer show. Some of the city associations hold, in addition, winter shows. At these latter shows the chief exhibits are dairy produce and industrial or trade products.

In addition to the above competitive exhibits, the shows are largely used for the display of farm requisites. All types of farm machinery, implements and tools are on display, and as a consequence a considerable amount of business is transacted.

The advent of more speedy transport has rather undermined the

8. Letter from National Conference secretary.

educational value of the shows, and as a consequence shows have developed more of the atmosphere of a fair, with the attendant 'side-shows.'

Show Week is usually taken advantage of for the holding of various annual meetings of societies of farmers and of those interested in rural industry. In addition, various educational talks are becoming more and more a feature of show programmes.

The agricultural and pastoral associations have proved in the past a valuable educational feature, and have given an opportunity for the intermingling of town and country life.

2. The Farmers' Union

The Farmers' Union, which was established in 1899, may be said to represent the response of the farmer to the need for some organization to express his attitude towards the more general, social, economic and political questions which affect his interests. As might be expected in view of the regional distribution of farming enterprise throughout New Zealand, it tends in the various provinces to express the attitude of particular branches of the industry. Thus it is practically a Dairy Farmers' Union in the Auckland Province. In point of fact the Union as a whole is weighted in favour of dairy farmers, as the sheep owners and wheat growers have their own federations, which serve, *inter alia*, as a means of expressing their united opinion on national politics.

One of the objects of the Union is:

> 'To keep and maintain a vigilant watch on all legislative measures brought before Parliament, and to protest against such measures as are deemed injurious to farmers' interests.'

This seems to be the main function of the national, provincial, and sub-provincial organizations. Local branches are more interested in local politics and more specialized problems.

The organization of the Union consists of local branches which are affiliated to at least 12 major provincial districts. These are headed by a national organization, with headquarters at Wellington. Some of the provinces are very large, hence there is provision for sub-provincial districts to which may be affiliated local branches inside a certain area. There are, for instance, seven sub-provincial districts in the Auckland Province. These sub-provincial districts act as a focus for district interests as distinct from the merely local interests of the branches. Annual provincial conferences are held, to which delegates from all branches are invited. An annual Dominion Conference is also held.

Finance is provided by annual subscription, the amount of which differs in different provinces. For instance, in Auckland it was, in 1931, 30/- per annum. This included a free copy of the Auckland Province's

magazine, *Farming First*. Hawke's Bay graded its subscription on the unimproved value of the land, with a maximum of £10.

Questionnaires returned from various provincial secretaries indicate that between 50 per cent. and 60 per cent. of farmers are Union members. This would reinforce the statement made above that the Union is the main mouthpiece of farming opinion in the Dominion.

The growth in importance of the Union since the war has been more than in proportion to its growth in numbers. While its motto is 'Principles, Not Party,' yet in relation to New Zealand as a whole it has adopted a definite political programme, which may be summed up as 'less protection to the city worker.' This involves not only a reduction in the tariff protection to secondary industries, but also the abolition of the protection afforded to city workers by compulsory arbitration.

A movement sponsored by the Auckland Province to maintain a 'country' party has not met with much support outside the Auckland Province. In the Auckland Province one member of the party was returned at the last election. In other parts of New Zealand participation in party politics is regarded with less favour. It should be noted, however, that the Dominion President is an Independent member of the House, while many of the other members of the House are also members of the Union. Hence the official attitude of the Union has definite expression on the floor of the House, and this attitude has had a formative influence on legislation in New Zealand.

In addition to the above major functions, the Union is active in more purely vocational matters. The group herd-testing movement originated in Farming Union circles. Various farmers' tours, including tours of overseas farmers, are organized, and these have proved of undoubted educational value.

3. *Women's Organizations*

Of recent years there has been a considerable development of the Women's Division of the Farmers' Union and of the Women's Institutes. Both these Institutions have similar aims, although the latter is more of a social club in which attention is more directly focussed on the domestic and cultural side of rural life. The Women's Division of the Farmers' Union, although not neglecting these activities, is a more practical body. Among its activities are the provision of nursing and domestic help for times of sickness and a library organization for back-blocks settlers. It also provides a forum for the expression of rural feminine opinion on current affairs.

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CHAPTER XVII

DAIRY HERD TESTING IN NEW ZEALAND[1]

By A. H. WARD

I. Objects of Herd Testing. II. Development of Herd Testing—A. The Association System—B. The Official System—C. Group Herd Testing. III. Organization of Group Herd Testing—A. Administration and Staff—B. Members—C. Technique of Testing—D. Finance—E. Calf Marking. IV. Statistics.

I. OBJECTS OF HERD TESTING

HERD testing provides one of the outstanding examples of those applications of scientific methods to production which have contributed to the rapid development of the dairying industry in New Zealand. During the past 20 years herd testing has been adopted by the majority of farmers in New Zealand, and has been an important factor in increasing the Dominion average butterfat production per cow from 140·10 lbs. in 1911-2 to 220·8 lbs. in 1933-4.

The major function of Herd Testing is primarily to determine the milk and butterfat producing ability of individual cows, and from this information to secure accurate data for the elimination of low-producing cows and also to provide a more scientific basis for the breeding of dairy stock. The elimination of the low-producing animals ('culls') from the industry still remains a serious problem. Such dairy cows are of very low value for beef purposes, and there is a tendency for them to drift to saleyards for sale as dairy animals. In the absence of any identification mark, the purchaser cannot know that he is purchasing a 'cull' cow. Experiments are at present being carried out which have for their object a clearly visible marking of all tested cows, and a responsibility on the part of a vendor to produce records for cows he sells. The elimination of the poor producer from the herd not only raises the general average in the present, but, by guaranteeing that young stock are from proved producers, raises the standard of the herd in the future. Of course, this requires that the sire as well as the dam should be of proved producing strain. Steady educational work has been carried on in the latter direction, with the result that the 'scrub' bull (a cross-bred bull of poor milking strain) is now the exception, and the aim is to use not only pedigree bulls, but pedigree bulls from proved high-producing strains.

In addition to the direct benefits accruing from the improvement in dairy stock, herd testing has also yielded substantial indirect benefits. Herd testing figures, in the collection of which herd testing officers have been used as enumerators, have been used in research into farm management

1. See also Dairy Industry Commission Report, 1934, paras. 321 to 334.

problems, such as the factors influencing butterfat yield, the effect of times of milking on milk and butterfat production, and general questions of feeding and breeding. In addition, the herd testing officer is likely to become a valuable channel for the dissemination of information to the farmer on such problems as diseases of dairy stock and their control.

II. DEVELOPMENT OF HERD TESTING

A. The Association System

Although herd testing and milk recording societies existed in Germany, Denmark, England and other countries many years earlier, systematic herd testing appears to have been first developed in New Zealand about the year 1910, when a model Herd Testing Association was established by the New Zealand Department of Agriculture in the Wairarapa. An official testing officer was provided by the Department to carry out the testing of all milk samples forwarded to him, and also to compile the necessary cow-production records.

This system, known as the *Association* or *own sample* system, was rapidly developed in many districts by dairy companies, similar facilities to those offered by the Department of Agriculture being provided. The figures quoted in Table LXXVIII show the remarkable growth of this system up to the year 1923, when group herd testing rapidly replaced the Association system. The disadvantages of the Association system were quickly revealed when the introduction of machinery speeded up milking, so that the loss of time involved in weighing and sampling each cow's milk became an important consideration. This work had to be carried out by the farmer, and consequently was often missed during the busiest (and from a production point of view, the most important) months of the year. Another great disadvantage was the gradually increasing difficulty of obtaining official records for the purchase and sale of milking stock other than pedigree stock; these factors, together with the slump season of 1921-1922, which at least brought home to farmers the necessity of applying scientific methods to production, were largely responsible for the rapid development of the group herd testing system. Before discussing this system further, however, it would be better to review the growth of another phase of testing work in the Dominion.

B. The Official System

With the rapid advance of yield testing for grade and cross-bred cows, and a keener desire on the part of farmers to improve herd returns, the demand for pure-bred sires, whose dams were of high milk and butterfat producing capacity, necessitated the introduction of an official system of testing for pure-bred milking cattle, so that duly authenticated records of production might be available. This work was undertaken by the Depart-

ment of Agriculture after collaboration with the breed societies about 1912, and became known as the C.O.R. (Certificate of Record) System. The essential difference between this system of testing and the group system lies mainly in the fact that an official Government testing officer attends the herd under test during the milking *prior* to taking weights and samples of each cow's production. This officer personally supervises the stripping of all cows at that milking, and then weighs and samples the milk for testing purposes at the two (or three if the cows are milked three times daily) following milkings. Under this system the farmer must supply the Department of Agriculture with daily records of milk weights for each cow under test, and the butterfat production for the month is calculated at the test recorded on the testing officer's monthly visit. Unlike the group system, it is not necessary to test every cow in the herd. Certificates are issued by the Department for all cows and heifers producing in accordance with the standard of butterfat required in their particular class, and recalving within the specified time after the commencement of testing. The standards required for such certificates of record are as follow:—

A heifer starting a test on the day she is 2 years old, or before that date, shall be required to give the amount of butterfat required of a 2-year-old. For every day she is over 2 years old she shall be required to give 0·1 lb. of fat more than her requirement as a 2-year-old. This daily increase shall continue until the cow is 5 years old, when she shall be required to give the minimum for a mature cow. Thus:—

C.O.R. (YEARLY) TEST

If 2 years old at commencement of test	275·5 lb. fat
If 3 years old at commencement of test	312·0 lb. fat
If 4 years old at commencement of test	348·5 lb. fat
If 5 years old at commencement of test	385·0 lb. fat

C.O.R. (305-DAY) TEST

If 2 years old at commencement of test	250·5 lb. fat
If 3 years old at commencement of test	287·0 lb. fat
If 4 years old at commencement of test	323·5 lb. fat
If 5 years old at commencement of test	360·0 lb. fat

To qualify for a *first-class* certificate it is necessary for the cow to re-calve within 455 days of the commencement of a 365-day test, and within 395 days of the commencement of a 305-day test.

A *second-class* certificate is issued for all cows which produce the required standard of butterfat, and which re-calve within 30 days of the limit allowed for a first-class certificate, that is, within 485 days (365-day test), and 425 days (305-day test) of commencement of test.

A *third-class* certificate has recently been introduced for cows producing in accordance with the above standards, but failing to re-calve within the specified period.

C. Group Herd Testing

This movement first developed in the Waikato in the 1922-23 season, when 7,500 cows were tested under the control of the Waikato branch of the Farmers' Union. In the following season 43,000 cows were tested under the group system by the newly-formed New Zealand Co-operative Herd Testing Association. Table LXXVIII indicates fairly clearly the growth of testing in the Dominion, and also shows that group herd testing quickly obtained general acceptability and the confidence of the farming community. Dealing chiefly, as it did, with grade and cross-bred cows, it proved of inestimable benefit to the dairying industry as awhole, as hitherto official records had been available only for pedigree cows, which form a small percentage of the total cows in the Dominion.

The group herd testing movement has from its inception been mainly of a co-operative nature. With two or three exceptions, the associations which followed the lead of the Waikato in the Bay of Plenty, North Auckland, Manawatu, Taranaki, Hawke's Bay and in the South Island have all been co-operative organizations. In 1926 a central co-ordinating body, the Dominion Group Herd Testing Federation was formed, with the following objects:—

(a) Through group herd testing associations and/or societies to improve the standard of dairy cattle in the Dominion of New Zealand by systematic and efficient testing, by the marking and registering of calves, by the elimination of unpayable cows, by the eradication of scrub bulls, by the encouragement of the use of pure-bred bulls bred on the best butterfat record, and by any other means which may be deemed necessary and expedient.

(b) To standardize and/or assist in standardizing the group herd testing methods throughout the Dominion of New Zealand.

(c) To asisst in the extension of the group herd testing system in New Zealand.

There are 28 associations affiliated with the Federation, of which 18 are in the North Island and 10 in the South Island. Each herd testing association affiliated with the Federation has the right to send its registered delegate to the Annual Conferences of the Federation, where policy matters concerning herd testing are discussed and uniform rules adopted. The calf-marking scheme, which will be mentioned in detail later, is directly

under the control of the Federation. The Federation supervisor regularly visits each affiliated association in order to keep in touch with its activities and co-ordinate the work as much as possible. He also assists in the organization of new associations, and endeavours to stimulate interest in the herd testing movement in all districts, especially those in which herd testing has not been adopted.

Considerable assistance has been given to the group herd testing movement, particularly in the early stages, by dairy companies. In several cases subsidies were granted to local herd testing associations so as to reduce the cost of testing to members. Testing facilities were also provided at various factories, and assistance was always readily forthcoming in the organization of new associations.

Government assistance was also provided to establish herd testing associations on a sound financial basis and reduce the cost of testing. The following are the amounts so received:—

1927-28	£10,500
1928-29	£10,500
1929-30	£8,500
1930-31	£8,000
1931-32	£8,000
1932-33	£6,000
1933-34	£5,000

In 1931-32 the Dairy Control Board granted a subsidy of £6,000 to the herd testing associations to reduce still further the cost of testing. These subsidies, which have been distributed through the Herd Testing Federation, have materially reduced the cost of testing, which now averages between 3/- and 4/- per cow per annum.

III. THE ORGANIZATION OF GROUP HERD TESTING

A. Administration and Staff

Uniform rules adopted at annual meetings of the Dominion Group Herd Testing Federation ensure uniformity of method so far as testing and calf marking are concerned. However, there must, of necessity, remain a certain amount of disparity in method of control and organization resultant chiefly upon local conditions and the size of the association concerned. The methods outlined in the following pages are chiefly those employed by the parent association, the New Zealand Co-operative Herd Testing Association, but are fairly general, with minor modifications, throughout the Dominion. This Association has a staff of over 80 field officers, and tests approximately 45 per cent. of the total cows under group herd test in the Dominion.

The activities of the Association are controlled from a single central office, where all records are kept and all necessary production calculations

made. Testing returns are forwarded by each field officer at least two or three times a week, are completed at head office, and returned direct to the members concerned. The field staff is drawn from Massey Agricultural College students who have secured their certificate in herd testing, and who have a certain amount of practical farming experience. Testing work, entailing, as it normally does, visits to 27 farms each month, affords a really excellent training for young farmers, and consequently an exceptionally fine class of officer is available for this work.[2] Each association affiliated with the Dominion Group Herd Testing Federation has a strictly defined territory within which to carry out herd testing activities. This precaution, taken to prevent overlapping, and its consequent economic waste, is of considerable benefit when the annual canvass for members is being carried out, as each association can divide up its territory into convenient areas or groups for such purpose.

B. Members

Canvassing for members is usually carried out in the winter months, June or July, by the field officers of the Association. Wherever possible, the district in which the officer has been operating the previous season is allotted to him for canvassing, on account of his knowledge of the district and his acquaintance with the farmers of that district. To save undue travelling on the part of the herd testing officer, farms are grouped so that each officer has 27 farms as nearly as possible in geographical proximity. For statistical and general administrative purposes, the area of operation is divided into geographical districts called 'groups,' which are not necessarily coterminous with the area covered by any one or more herd testing officers. Each district has its own committee of three, the chairman of which committee is convener and also the 'group' representative at the annual meeting of the Association.

C. Technique of Testing

Testing usually commences in July or August, and, except in the case of a few herds tested all the year round, is completed by the following May. Herd averages are compiled on the amount of butterfat produced between June 1 and May 31, and include the returns of all cows tested for more than 100 days.

Calculations are made from the date of calving to a date 15 days after the testing date (that is, so as to approximate to half-way between consecutive testing visits).

Transport is provided by the Association in the form of horse and vehicle, except where the testing officer elects to provide his own car, in which case the Association pays a monthly car allowance on a mileage basis

2. Twenty-seven constitutes a full group; but in new districts where the work is being developed there may be fewer in a group while in other cases where conditions permit the group may be slightly larger than twenty-seven.

The testing officer is present at the milkings in the evening and the following morning. He weighs and takes a sample of the milk from each tested cow. The samples are tested by the officer on the farm or, wherever more convenient, at a nearby dairy factory. On the basis of weights and tests so obtained the head office staff calculate the monthly production and production since calving, and forward the results to the farmer.

The fact that group herd testing is conducted on the basis of 10 to 12 monthly tests has given rise to some criticism of the accuracy of this system. The writer has conducted a careful investigation for several years into the actual daily production of a number of cows, over their complete lactation period, and the results indicate an accuracy for the group system within approximately 3 per cent. of the actual production and with a very limited variation.

D. Finance

Testing fees, fixed on a sliding scale based on the number of cows in the herd, are collected from members, either by cash at the commencement of testing or by orders lodged with the dairy company which the member supplies. In the latter case deductions are made from the member's butterfat cheque in the months of October, November, December, January and February. All cows tested must be paid for except for certain provisions relating to sick cows, slips, strippers, and cows nominated for culling at the commencement of testing.

E. Calf Marking

After systematic herd testing had become definitely established it was natural that some scheme should be developed to ensure that the progeny of high-producing dams was not lost to the industry. Hitherto herd testing had concentrated on the elimination of the 'boarder' cow from the herd, and in raising the herd average through discriminate culling, etc. In the 1925-26 season the N.Z. Co-operative Herd Testing Association formulated the calf-marking scheme, under which the progeny from tested dams, which had produced in accordance with standard butterfat requirements, could be individually marked and registered. Marking is now under the control of the Dominion Group Herd Testing Federation.

The Federation insisted that the sire of such calves should in all cases be registered in the books of a recognized dairy breed society. In the early years of the scheme, butterfat backing for the sire was not insisted on, although provision was made for showing such backing on the certificate of the marked calf. The butterfat qualifications for the dam were as follow:—

2 years old at commencement of test . . . . . 250 lbs. fat
3 years old at commencement of test . . . . . 275 lbs. fat
4 (or more) years old at commencement of test . . 300 lbs. fat

to be produced in not more than 305 days from date of calving.

In the first year of the scheme 641 calves were marked and certificated, and the rapid expansion of the scheme in the following years may be judged from the following statistics:—[3]

1925-26 season ..		641	calves	marked	for	99	members
1926-27	„ ..	1,541	„	„	„	235	„
1927-28	„ ..	3,200	„	„	„	400	„
1928-29	„ ..	4,854	„	„	„	600	„
1929-30	„ ..	6,797	„	„	„	764	„
1930-31	„ ..	7,025	„	„	„	769	„
1931-32	„ ..	6,465	„	„	„	728	„

Marked calf fairs have frequently been held in various districts, all being quite successful in demonstrating the general preference for marked calves as against unmarked calves. Since the inception of calf marking, marked calves have commanded a considerable selling premium over unmarked calves.

The certificate makes provision for showing the butterfat production of the dam since it was first tested, also the pedigree and butterfat backing (if any be available) of the sire; the desirability of continuity of records (that is, seasonal records of production) is repeatedly stressed. Stock from a dam which produces irregularly is not considered equal to that from a dam producing three, four, five or more hundred pounds of butterfat regularly each season, as no animal can be effectively judged on the production for one season only.

In the year 1931 a further qualification for marked calves was made, namely, that of a minimum butterfat production for the *dam of the sire.*

Until this year the number of marked calves available had not been equal to the demands of the industry, and qualifications concerning butterfat backing on the side of both sire and dam could not be enforced without seriously affecting the number of calves eligible to be marked. With the rapid expansion of group herd testing and calf marking since the 1925-26 season this difficulty soon disappeared, and it became possible to introduce the very desirable qualification regarding butterfat backing of the sire.

Marking is carried out by the testing officer on his monthly rounds, so that a minimum of expense is incurred; members are charged a small fee (approximately 1/- per calf for heifer calves and 3/- for bull certification) for the marking and certification of calves. The calf is marked when (and only if) the dam qualifies, but once the dam qualifies all her future calves are eligible for marking, provided the herd had not missed testing for two or more consecutive seasons. Heifer calves cannot be marked for registra-

3. These figures refer only to the calves marked by the New Zealand Co-operative Herd Testing Association; figures are not at present available showing the total number of calves marked in the Dominion.

tion after they are 12 months old, nor after they have been permanently transferred from the farm on which they were born and reared; this is owing to the difficulty of identification.

The calf-marking scheme now takes a very large place in group herd testing work, and must ultimately prove of inestimable value in raising the standard of dairy stock in New Zealand. The scheme provides for the selection and retention of only the progeny from consistently high-producing stock, and, with the inevitable insistence on breeding through production and type, will rapidly replace the discredited system of selection and breeding through type alone.

IV. STATISTICS TABLE

This table provides a fairly complete analysis of herd testing work in New Zealand since its inception, and also indicates the rapid improvement in dairy farming over the same period. (The table does not include any pedigree cows tested under the C.O.R. (Government test) system, but these form a very small percentage of the Dominion total.)

TABLE LXXVIII

Season	Cows Tested			Butterfat per Tested Cow		Cows in Milk or Dry at January 31		
	Association	Group	Total	Fat	Days	Total 000 omitted	Per Cent. Tested	Butterfat Production per Cow
1909–10	815	—	815	—	—	583	·14	148·45
1910–11	4,317	—	4,317	—	—	634	·68	139·46
1911–12	13,440	—	13,440	—	—	655	2·04	140·10
1912–13	25,000	—	25,000	—	—	678	3·68	150·78
1913–14	25,000	—	25,000	—	—	701	3·56	156·52
1914–15	24,000	—	24,000	—	—	725	3·30	154·07
1915–16	24,105	—	24,105	—	—	750	3·21	160·52
1916–17	14,343	—	14,343	—	—	777	1·84	163·96
1917–18	26,768	—	26,768	—	—	793	3·37	152·23
1918–19	17,000	—	17,000	—	—	826	2·05	150·64
1919–20	25,134	—	25,134	—	—	893	2·78	152·04
1920–21	35,757	—	35,757	—	—	1,005	3·55	154·25
1921–22	45,564	—	45,564	—	—	1,137	4·00	174·97
1922–23	77,325	7,500	84,825	233·71	225	1,249	6·79	180·62
1923–24	108,070	43,144	151,214	213·01	230	1,313	11·52	174·10
1924–25	96,795	100,055	196,850	223·54	229	1,323	14·87	182·09
1925–26	64,549	105,227	169,776	220·51	230	1,304	13·02	179·40
1926–27	60,323	109,827	170,150	240·48	236	1,303	13·05	198·50
*1927–28	59,520	164,610	224,130	224·68	230	1,352	16·57	195·38
1928–29	47,114	212,480	259,594	240·50	242	1,371	18·93	210·84
1929–30	41,043	242,688	283,731	253·61	247	1,440	19·69	218·05
1930–31	30,249	241,155	271,404	241·05	247	1,602	16·95	201·00
1931–32	25,330	234,527	259,857	236·87	253	1,702	15·26	199·7
1932–33	—	—	286,054	255·57	—	1,846	15·55	215·1
1933–34	—	—	297,647	262·44	—	1,933	15·60	220·8

*Drought year.

PART III

ORGANIZATION OF FARMING

CHAPTER XVIII

PASTURES OF NEW ZEALAND

BY E. BRUCE LEVY

I. Natural pastures. II. Sown Pastures—A. Sown on Cultivated Land: 1. Temporary Pastures; 2. Short Rotation Pastures; 3. Long Rotation and Truly Permanent Pastures—B. Surface Sown Pastures: 1. Surface Sown Primary Burns; 2. The Secondary Burn.—C. Volunteer Species in Sown Grasslands; 1. Grasses and Clovers; 2. Weeds. III. Grassland Soil Types—A. Gum Lands of the North—B. Pumice Soils—C. Low Tussock Country of Southland—D. Irrigated Country of Central Otago. IV. Basic Factors in Pasture Establishment, Maintenance and Management—A. The Species Sown—B. Strain in Pasture Species—C. Soil Fertility—D. The Moisture Factor —E. The Temperature Factor—F. Management and Utilization of Herbage Produced. V. Conclusion.

I. NATURAL PASTURES

THE total occupied area of New Zealand is approximately 44,000,000 acres, 24,000,000 unimproved and 20,000,000 in an improved state; of the unimproved some 14,182,000 acres is in natural pasture; of the improved 17,350,000 acres are in sown pastures, and 4,000,000 acres is surface-sown hill deforested country that has reverted to secondary growth.

Natural pastures fall into two major groups, (a) low tussock, and (b) tall tussock grassland respectively. The former is dominantly *Poa caespitosa-Festuca novae zelandiae*, tussock, and the latter is Danthonia tussock (*Danthonia Raoulii-D. flavescens-D. Raoulii var. rubra*).

Ecologically each tussock species, when dominant occupies a specific habitat—the Festuca tussock occupies the most xerophytic habitat, the Poa tussock a dry but less xerophytic, and the tall tussock a mesophytic habitat, *D. Raoulii var. rubra* at high altitudes, *D. flavescens* at intermediate to high altitudes, and *D. Raoulii* at low altitudes to almost sea-level, as in Otago and Southland. By far the greater area of tussock grassland is in the South Island. The low tussock country itself may be regarded ecologically as a stepping-stone to Southern Beech Forest (*Nothofagus*), or as a subphase in the retrogressive succession that follows the action of the disruptive orogenetic and biotic factor on the forest cover. Thus, much Poa tussock has replaced Southern Beech Forest, and much Danthonia tussock now occupies the site of a former rain-forest type, particularly in Southland. In the North Island the transition to forest has almost annihilated the tussock grassland. In the higher parts of the volcanic plateau comparatively small areas of tussock grassland still exist, most probably as a result of the complete destruction of the developing forest by violent volcanic action, a destruction so complete that the succession back to forest is as yet in its pioneering phases.

Large areas of Poa tussock, and to a lesser extent Festuca, tussock

country have been converted to arable or short rotation farming, and are particularly suited to cereals. The Danthonia tussock, *D. Raoulii,* particularly of the lowlands, is essentially potential grassland country, and in its natural state will support a sward of *Agrostis tenuis* (New Zealand Brown Top), and by drainage, cultivation, liming and manuring may be brought to a fertility standard to grow a mixed pasture of the best English grasses, perennial ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*), white clover (*Trifolium repens*), etc.

The natural pastures provided the only grazing available for the stock of the pioneer settlers, and in consequence early New Zealand settlement began mainly in the South Island. The feed from these pastures did not consist necessarily in the tussock itself, but in the small herbs and finer grasses that grow as a sub-storey within the tussock shelter—*Agropyron scabrum, Danthonia semi annularis, Dichelachne crinita, Poa intermedia, Poa colensoi, Hierochloe redolens,* etc. Some shrubs and herbs also provided feed.

With the coming of the European flora, and with the destructive agencies of man, with the firestick and the grazing of stock and rabbits, great modifications were made in the flora of the natural pastures.

L. Cockayne,[1] referring to these modified associations, writes: 'Frequent burning of the tussock and constant grazing by sheep, cattle, horses and rabbits, where these latter occur, has led to great modifications both from alteration in the relative abundance of the indigenous species, and from the introduction of a considerable foreign element. Where burning and stocking in a specially dry area has been excessive, the steppe has been changed to veritable desert. The introduced element varies considerably in different localities, as also at different altitudes. *Anthoxanthum odoratum, Holcus lanatus, Dactylis glomerata, Poa annua, P. pratensis, Festuca myurus, Rumex acetosella, Cerastium viscosum, Trifolium repens, T. dubium, Erodium cicutarium, Centaurium umbellatum, Plantago lanceolata, Achillea Millefolium,* and *Hypochoeris radicata* will probably all be present together, generally, with a good many more foreign plants. Where sheep "camp" there is invariably abundance of *Marrubium vulgare,* and perhaps *Urtica urens.* Where roads pass through the driest steppe there is a roadside flora of, but all are not usually present at the same time, *Eschscholtzia californica, Reseda luteola, Acaena ovina, Gilia squarrosa* and *Echium vulgare*[2]—a remarkable assemblage! Also, as already noted, there may be thickets on the steppe of *Ulex, Cytisus scoparius* and *Rosa eglanteria.*

'But it is not the presence of aliens only that distinguishes modified steppe, rather it is the special societies of indigenous species that are evolved

1. Die Vegetation der Erde, XIV. *The Vegetation of New Zealand.*
2. Of course other species enter in, but the above are characteristic.

and the superabundance of plants normally of second-rate importance or less. Thus, repeated burning will gradually wipe out, or greatly reduce, the tussock and many of the smaller plants, and the ground be eventually occupied by a close turf of *D. pilosa* agg., i.e., the dominant growth-form is changed, and indigenous-induced meadow rather than steppe results. Or, again, extensive colonies of *Phormium tenax, Peteridium* heath, or *Coriria ruscifolia* may arise. Certain species of Acaena, too, will greatly increase in amount. In wettish parts or shady slopes of montane and sub-alpine steppe *Chrysobactron Hookeri,* or its var. *Angustifolia,* will form extensive colonies, and in some localities *Celmisia spectabilis* will become dominant.'

II. SOWN PASTURES

These may be divided into two groups—(a) sown on cultivated land, and (b) surface sown after forest, scrub or fern burn. The pastures sown on cultivated land were originally confined in the main to the South Island, particularly in Canterbury, Otago, Southland and Marlborough, and in these districts approximately 5,000,000 acres are to-day sown grasslands, the seed bed being prepared by ploughing and cultivation. In the North Island and in Westland, in the South Island, the main original sowings were made by surface sowing the seed on the ash of the forest, scrub or fern burn, and it is estimated that a total of approximately 11,000,000 acres were so sown. During the past 20 years, however, large areas of the original surface-sown lands have been stumped and the area ploughed, cultivated and resown to grass, following roots and other supplementary crops.

The sown grasslands in New Zealand are gradually increasing in area at the expense largely of the natural tussock grassland and forest. During the last decade approximately 1,000,000 acres have been added to the sown grasslands. Approximately 3,750,000 acres yet remain in forest, but the rate of conversion of forest land to grass is now exceedingly slow, only 750,000 acres being felled and grassed during the past decade. Of the 11,000,000 acres of sown grasslands, approximately 4,000,000 have reverted to scrub and secondary forest growth, albeit in most cases after a profitable period of grassland that well repaid the initial costs in felling, burning, seeding and fencing the country. Recent research work on the regrassing of this secondary growth country gives promise, once wool prices return to a profitable basis, that the ultimate fate of most of this reverted country is grass rather than forest.

A. Pastures Sown on Cultivated Land

These are divisable into three major types—(1) temporary pastures, (2) short rotation pastures, (3) long rotation and truly permanent pastures. European species of grasses and clovers are almost universally employed in

the grassing down of pastures sown on cultivated land, the type of pasture sown being governed largely by the needs of the type of farming practised and by soil and climate governing the farming operations.

1. *Temporary Pastures*

The species of grasses and clovers used in these are rapid to establish, and quickly productive of feed. Italian ryegrass (*Lolium multiflorum*) and the variety western wolths, and broad red clover (*Trifolium pratense*) are the main species used. A typical seed mixture is as follows:—Italian ryegrass 30 lbs., broad red clover 6 lbs., or Italian ryegrass 15 lbs., western wolths ryegrass 15 lbs., broad red clover 6 lbs., a total in each case of 36 lbs. per acre. Alsike (*Trifolium hybridum*) may wholly or partially replace red clover, particularly in saline soils and under damper conditions generally. For sowings in late autumn alsike is also more likely to be successful than broad red clover, owing to the fickleness of the latter to establish at this time of the year.

The main functions of temporary pastures are—(1) to act as a special supplementary feed during summer or winter, or as a special hay crop, (2) to initiate the breaking-in processes of various lands where weed, fern and scrub growths are to be suppressed prior to permanent grassing, or where the raw soil conditions require consolidating, as in peat swamps, or ameliorating as in heavy clays.

2. *Short Rotation Pastures*

This class occupies many types of soil, and the name, short-rotation grasslands, is given because the pastures on such soils are, generally speaking, short-lived, and enter into a short-rotational system of farming. The dominant type of sown pastures in Canterbury, Otago and Southland are short-rotational in character. Since the soil and climatic conditions do not favour high-producing permanent grassland, an intensive or semi-intensive type of arable farming is practised. Again, the severer winters of the South Island make it more necessary to grow winter supplementary feed, while potatoes and wheat provide an excellent rotation with grass. Perennial ryegrass, Italian ryegrass, broad red clover and white clover are the main species used, and the following is a typical seeds mixture used: Perennial ryegrass 25 lbs., Italian ryegrass 10 lbs., red clover 4 lbs., white clover 2 lbs., total 41 lbs. per acre. In Southland the tendency is to increase on the quantities of the above seeds mixture, and Timothy (*Phleum pratense*) 6 lbs. and alsike 2 lbs. may be added. In Canterbury lighter seedings than 41 lbs. per acre are often employed.

3. *Long Rotation and Truly Permanent Pastures*

These occupy the naturally better soil types in both islands or those areas where manurial top-dressing is an established practice on the farm.

The main species used are perennial ryegrass, Italian ryegrass, cocksfoot (*Dactylis glomerata*), crested dogstail (*Cynosurus cristatus*), white clover, red clover, Timothy, alsike, meadow foxtail, strawberry clover (*Trifolium fragiferum*), and *Poa trivialis.*

The following is a typical seeds mixture for good average conditions: Perennial ryegrass 25 lbs., cocksfoot 10 lbs., white clover 3 lbs., extra late red clover 3 lbs., total 41 lbs. per acre. Italian ryegrass, 6 lbs., may be added for early growth, crested dogstail 1-3 lbs. may be added in rolling country, particularly for sheep grazing. Timothy 2-4 lbs. may be added on rich soils inclined to be wet, meadow foxtail 4 lbs., and *Poa trivialis* 2 lbs., may both be added on fertile soils where the conditions are too wet for ryegrass to thrive satisfactorily. In the Auckland Province, *Paspalum dilatatum,* 6 lbs., may be added, and the cocksfoot correspondingly reduced. On reclaimed saline soils, alsike, 2 lbs., and strawberry clover, 2 lbs., may be added, and red clover and white clover somewhat reduced. Of recent years the tendency is to employ a good standard mixture containing the best species, using certified strains of these, and by manuring, drainage, harrowing, soiling, etc., to create soil conditions so that the better species will thrive. This is in marked contradistinction to the older practice, which chooses species to suit the poor and impoverished conditions rather than try to make the conditions suit the first-class grasses and clovers that have a high potential per acre productive capacity.

B. Surface-Sown Pastures

These fall primarily into two classes—(1) surface-sown after a primary forest burn, and (2) surface-sown after a secondary forest scrub or fern burn.

1. *Surface-Sown Primary Burns*

The ash remaining after the primary forest burn is considerable, and this presents an excellent seed bed, giving good cover and being high in available plant foods. The forest is felled by the axe in the winter, and the burn is made between Christmas and the end of March, depending largely on weather experienced. The seed is sown while the ash is still fresh, if possible, and this ensures a good cover when rains fall. Turnips may be included in the seeds mixture, or in the case of an early burn (December) soft turnips alone may be sown and the seeds mixture sown approximately three months later. In an autumn burn it is general to sow the turnips and the seeds mixture together, or the turnips may be entirely omitted from the sowing. The following species form the basis of the seeds mixture for a primary burn: Perennial ryegrass, cocksfoot, crested dogstail, *Poa*

pratensis, white clover, brown top, Lotus major, *Danthonia pilosa,* and the following is a good typical mixture: Perennial ryegrass 12 lbs., cocksfoot 8 lbs., crested dogstail 3 lbs., *Poa pratensis* 2 lbs., brown top 1 lb., white clover 2 lbs., Lotus major 1 lb., *Danthonia pilosa* 3 lbs., total per acre 31 lbs. In the Auckland Province, *Paspalum dilatatum,* 4 lbs., may be used, and the cocksfoot correspondingly reduced. Timothy, meadow foxtail, and *Poa trivialis* may be added in the case of wet forest, where such trees as Kahikatea (*Podocarpus dacrydiodes*) and Pukatea (*Laurelia novae zelandiae*) are dominant.

2. The Secondary Burn

In the case of the secondary burn there is comparatively little ash remaining after the burn, and, generally speaking, the soil fertility standard is much lower than in the case of the primary burn. The following species are employed in regrassing secondary growth : Brown top, *Danthonia pilosa,* suckling clover (*Trifolium dubium*), crested dogstail, Lotus major, with white clover and perennial ryegrass. The burn may be top-dressed with fertilizers subsequent to sowing. The following seeds mixture is adopted: Perennial ryegrass 8 lbs., crested dogstail 4 lbs., brown top 2 lbs., Lotus major 1 lb., white clover 1 lb., *Danthonia pilosa* 3 lbs., Chewing's fescue (*Festuca rubra var. fallax*) 3 lbs., total 22 lbs. per acre of burn. Where the burn is made in the spring, and particularly on a bracken burn, 6 lbs. Italian ryegrass is of value in the above mixture to give an earlier growth and to aid in control of reappearing bracken fern in the spring soon after the burn.

C. Volunteer Species in Sown Grasslands

1. Grasses and Clovers

According to the ecological conditions ruling—soil type, soil fertility, soil moisture, species and strains of grasses and clovers sown, class of stock, and manner of utilization permitting the light and shade factor to express itself—so we find volunteer species of grasses, clovers or weeds entering into and competing with the sown species in the sward. In the wet, waterlogged, flood-area soil types, floating sweet grass (*Glyceria fluitans*), reed meadow grass (*Poa aquatica*), tall fescue (*Festuca arundinacea*) may assume dominance. In shady, highly fertile and lightly stocked portions, prairie grass (*Bromus unioloides*) may dominate; on wet, peaty areas, Yorkshire fog (*Holcus lanatus*) assumes an important rôle, and this species, under loose management conditions, may dominate over some first-class pasture lands. Brown top volunteers on second-class soils of a wet, stiffish clay nature, and this grass has assumed a dominant place over some millions of acres on shady hill country, and on the run-out, short-

rotational grassland soil of Southland, South Otago, on the foothills of the Canterbury plains, and throughout the wetter and stiffer-soil types of the North Island. Sweet vernal, *Danthonia pilosa* (indigenous), suckling clover, clustered clover, ratstail (*Sporobolus indicus*), hairgrass (*Festuca myuros*), goosegrass (*Bromus mollis*), clustered clover (*Trifolium glomeratum*), striated clover (*T. striatum*), haresfoot trefoil (*T. arvense*) are common volunteers on drier second to third class hill and plains country where the conditions are unfavourable to growth of the better species. Suckling clover is ubiquitous on all second and third-class country; *Danthonia pilosa* is dominant on some millions of acres of dry hill country, partly from seeding in the original mixtures sown, but largely as a volunteer, seed being in-brought by the grazing animal. Burr clovers (*Medicago maculata* and *M. denticulata*), English trefoil (*M. lupulina*) and subterranean clover (*T. subterrancum*) are often volunteer dominants on friable open-textured soils, which may be fairly fertile when well supplied with moisture. English trefoil is more particularly confined to friable limestone country, and is one of the best indicators that lucerne (*Medicago sativa*) will thrive well on that particular soil type. *Lotus hispidus,* baygrass (*Eragrostis Brownii*), and to a lesser extent, *Lotus angustissimus* and Grimmer grass (*Triodia decumbens*) are common volunteers on the clay gum lands of the Auckland Province. *L. hispidus* has spread remarkably during the last 20 years.

2. Weeds

The weed population of sown permanent grasslands is legion, but the following are alone of much significance, and may be regarded as being general throughout the grazed pastures, the prevalence or otherwise depending on soil-fertility standards, soil moisture, method of herbage utilization, class of stock employed, etc. Catsear (*Hypochaeris radicata*), ribgrass (*Plantago lanceolata*), greater plantain (*P. major*), field daisy (*Bellis perennis*), self heal (*Prunella vulgaris*), hawkweed (*Crepis capillaris*), hawkbit (*Leontodon hispidus*), pennyroyal (*Mentha Pulegium*), buttercup (*Ranunculus sardous*), creeping buttercup (*R. repens*), small-flowered buttercup (*R. parviflorus*), rush (*Juncus effusus,* and other species), Scotch thistle (*Cirsium lanceolatum*), winged thistle (*Cirsium pycnocephalum*), Californian thistle (*Cnicus arvensis*), dock (*Rumex obtusifolius* and *R. crispus*). The following may be regarded as being more localized than general: Ragwort (*Scnecio Jacobaca*) and oxeye daisy (*Chrysanthemum leucanthemum*), (dairying pastures), blackberry (*Rubus fruticosus*), sweet briar (*Rosa rubiginosa*), goat's rue (*Galega officinalis*), gorse (*Ulex europaeus*), tutsan (*Hypericum Androsaemum*), and St. John's wort (*H. perforatum*) are shrubby weeds of neglected grasslands. Hutiwai (*Acaena*

sanguisorbae and *A. novae zelandiae*) are indigenous weeds of hilly country devoted almost entirely to sheep grazing. Woolly mullien (*Verbascum thapsus*) and mullien (*Verbascum blattaria*) and foxglove (*Digitalis purpurea*) may assume a dominant rôle on weak, open turf, rubble hill and plains country. Tarweed (*Bartsia viscosa*) is a common annual weed of the gum lands of the north.

III. GRASSLAND SOIL TYPES

The grassland soil types may be classified according to the pasture type these soils will support in their natural unimproved state. Expressed in terms of the grass cover, the major pasture soil types are as follow:—

(1) The *Glyceria fluitans-Poa aquatica* soil type.
(2) The meadow foxtail, *Poa trivialis*, Timothy soil type.
(3) The ryegrass-white clover soil type.
(4) The cocksfoot, white clover, *Poa pratensis*, crested dogstail soil type.
(5) The brown top Lotus major soil type.
(6) The *Danthonia pilosa*-sweet vernal, ratstail, suckling clover soil type.
(7) The *Danthonia semi annularis*, haresfoot trefoil, *Lotus hispidus*, baygrass soil type.

From this it will be seen we may regard plants growing on the soil as indicating the intrinsic value of that soil, under the existing conditions of the habitat. The extent by which improved pastures may be obtained on the above soil types is determined in the main by the soil fertility and soil moisture factor as summed up in the manurial practices adopted, and in soil drainage or soil water applications made or water conservation measures taken.

Given ample soil moisture and added soil fertility by top-dressing the ideal sward, consisting dominantly of perennial ryegrass, cocksfoot or paspalum, red and white clover, are possible irrespective of the original natural soil conditions. The cost of obtaining such a sward, however, will vary greatly according to the natural inherent attributes of the soil and climate. In the more arid districts, such as Central Otago, irrigation is essential. Certain examples of such soils being brought to a relatively high standard of efficiency may be cited:—

A. The Gum Lands of the North

These are stiffish clay and of inherent low fertility, with a copious seasonal rainfall—the natural vegetation is stunted manuka (*Leptospermun scoparium*), tahinu (*Pomaderris phylicaefolia*), club moss (*Lycopodium*

densum), which, when cleared, supports a low productive sward of *Danthonia semi annularis*, baygrass and stunted *Lotus hispidus*. These soils, by cultivation, fallowing, working and manuring, can be made to carry first-class ryegrass, paspalum, white clover, dominant pastures, and with lesser manuring, working, etc., may be brought to a standard where brown top and Lotus major form good second-class pastures.

B. The Pumice Soils

These are of a loose, friable, coarse-textured soil, and are particularly barren of plant nutrients. They support in their natural state a cover of stunted manuka and monoao (*Dracophyllum subulatum*), but with lavish use of quickly available phosphates (superphosphate), the sowing of persistent strains of perennial ryegrass, cocksfoot, red and white clover, following on ploughing and cultivation, and with heavy rolling to firm the seed bed, these soils make excellent high-producing first-class pastures. The initial cost of pasture establishment, however, is high.

C. The Low Tussock (Danthonia) Country of Southland

This country in its natural state is wet, and the soil is sour. It supports a poor, sparse growth of brown top and Yorkshire fog prior to treatment. By drainage, liming, cultivation and manuring this soil type will support a perennial ryegrass, crested dogstail, white clover dominant sward.

D. The Irrigated Country of Central Otago

This country in its natural state carries a very poor type of vegetation, consisting of *Poa* and *Festuca* tussock, reduced over large areas by burning and rabbit infestation, to depleted country, where scabweed (*Raoulia lutescens* and *R. australis*), together with sorrel (*Rumex acetosella*), storksbill (*E. rodium cicutarium*), *Poa maniototo,* hairgrass, may form the dominant cover. This soil, when watered by irrigation, is a fertile mica-schist, rich in available phosphoric acid, and will support under irrigation a first-class pasture of perennial ryegrass, cocksfoot, red and white clover.

IV. BASIC FACTORS IN PASTURE ESTABLISHMENT, MAINTENANCE AND MANAGEMENT

The species sown, the strain of these, soil fertility, soil moisture, temperature, and the management and utilization of the herbage produced are basic factors upon which the constancy, improvement, or deterioration of the sward depends.

A. The Species Sown

It is of the utmost importance that the species sown should be ecologically adapted to the conditions ruling, or that it is a practical possibility to so

alter the ecological conditions by manuring, drainage, watering, etc., that the species sown may be attuned to such altered conditions. Each grass and clover has a specific habitat, a specific fertility demand, a specific soil moisture demand, a soil temperature demand, a demand in relation to the amount of light and shade it will tolerate, and unless such are provided the species is ecologically unsuited to the habitat, and it is almost certain to fail, and to be replaced by some more suitably adaptive species.

B. Strain in Pasture Species

The importance of strain in pasture plants is fast receiving attention in New Zealand, and certified seeds of a truly permanent nature of ryegrass, cocksfoot, white clover and extra late red clover are available to the farmer. The production of improved pedigree strains is well advanced at the New Zealand Plant Research Station. Persistent strains of pasture plants make a perennial sward which holds the ground against weed invasion: High-production strains give the greatest returns in money spent in manuring and other cultural aids to growth. Strains with a long seasonal growth or mixtures of strains that may be evolved extend the grazing period and tend to level up better the seasonal production from grassland. Persistent strains stand up better to hard-season conditions, such as drought or severe punishment in times of stress. Improved certified strains give greater scope for specialist management and create an added incentive to better farming.

C. Soil Fertility

The soil fertility factor is the greatest single factor relative to grassland production. By soil fertility is meant the supply of available plant foods in the soil at the disposal of the sward. Ecologically, species may be arranged according to their soil fertility standard, and this may be correlated with the inherent productive capabilities of the species, an inherent high-producing species demanding a high standard of soil fertility. If that standard is not maintained the production of the species will dwindle until a point is reached when a species lower in the fertility scale will equal or excel in production the higher-fertility demander. Thus we have the rise to dominance of the lower-fertility-demanding species, because of the lack of competition as a result of the dwindling yield of the high-fertility-demander. An increase of the soil fertility standard results in a comeback of the high-fertility-demander and a rise to dominance once more.

D. The Soil Moisture Factor

Apart from waterlogged soils, the soil moisture factor is closely associated with the soil fertility factor, but there is, none the less, a defined range of species attuned to varying degrees of wetness or dryness. The

high-producers demand a soil retentive of moisture yet free from water-logging. *Glyceria fluitans* and *Poa aquatica* demand waterlogged conditions and thrive under conditions of periodic inundations for weeks at a time. Meadow foxtail, *Poa trivialis*, Timothy, meadow fescue (*Festuca pratense*), tall fescue, *paspalum dilatatum*, creeping bent (*Agrostis stolonifera*) and knee-jointed foxtail (*Alopecurus geniculatus*) will stand comparatively wet conditions, whereas perennial ryegrass, cocksfoot, white and red clover demand a moist but freely-aerated soil. *Danthonia pilosa*, ratstail clustered clover, striated clover and haresfoot trefoil stand at the dry end of the soil-moisture scale. The practical application of this concept, if our ideal ryegrass-cocksfoot-red and white clover pasture is to be attained, is the need for drainage to rid the soil of surplus water and to conserve moisture in dry soils or to apply by means of irrigation.

E. The Temperature Factor

New Zealand is essentially a temperate climate, bordering on the sub-tropical in the north, and with fairly intense winter cold in the south. Semi-tropical grasses such as *paspalum dilatatum*, buffalo grass (*Stenotaphrum glabrum*), *Axonopus compressus*, Kikuyu (*Pennisetum clandestinum*), Rhodes grass (*Chloris gayana*), ratstail and Indian doob (*Cyanodon dactylon*) thrive in the Auckland Province and coastwise over the greater part of the North Island. In the South Island, with the exception of a portion of the northern coastal country of Nelson, Marlborough and Westland, the climate is too cold for these species to thrive. The influence of climate on total yield and seasonal growth is a factor of prime consideration in grassland farming, and the successful exploitation of the peak growths of production, together with the tiding over of the low-production periods, is the keynote of successful management in grassland farming.

F. Management and Utilization of the Herbage Produced

A mixed sward of young-leaf grass and clover is essentially a balanced milk-producing food, whether of the dairy cow or the ewe. Old grass or mixed pasture allowed to 'get away rough' is at best a store stock food. Efficient grass farming depends on the maximum exploitation of young-ever-growing grass and clover. Utilization must take into consideration the growth stage of the plant, and must conform to specific demands made by the plant itself. Grasses and clovers such as perennial ryegrass, cocksfoot, red and white clover are intolerant of close and continuous grazing close to the crown, particularly in dry weather. Perennial ryegrass, white clover, crested dogstail are readily smothered out of the pasture if much tall-growing, shade-loving grasses such as cocksfoot and paspalum

are allowed to grow rank. Close and continuous grazing is a fruitful practice bearing on the invasion of light-loving weeds into the pasture sward. Spelling of the pasture, so as to keep the ground surface partially shaded excludes weed establishment and creates a correct atmosphere for new root development of those pasture species that have their crown, and hence their source of origin of new roots at or above ground-level. It would appear that a system of rational, rotational grazing is the best method of pasture utilization, care being taken at no time to bring the sward to ground level, particularly in dry weather, nor to let it get so rank as to endanger the persistence of the bottom grasses of the sward. The principle of rotational grazing is practised fairly closely in New Zealand, far more particularly in relation to dairying, the practice being to rotational graze the top 2 to 4 inches of the pasture rather than the lower 2 inches. In rotational grazing by sheep the sward is kept relatively shorter, but at no time is it kept close-grazed for more than a few days. The intervals between grazings are shorter than in the case of the dairy farm.

V. CONCLUSION

The grassland concepts of species, strain, soil fertility, soil moisture and management are basic to grassland progress, and the co-ordination of these factors towards maximum efficiency will have, in the future, an even greater bearing on land utilization and land exploitation than in the past, because competition for grassland products is now keener on world markets, and the virgin soil fertility has been largely depleted.

Chapter XIX

FERTILIZERS AND MANURES IN NEW ZEALAND

By A. W. Hudson and F. L. C. Scrivener

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I. TYPES OF FERTILIZERS USED

A. Introduction

THE use of fertilizers plays a prominent rôle in New Zealand farm management. The types of farming in common practice are less involved than in most countries, and the care devoted by the most successful farmers, in the more intensely-farmed districts, to the selection, distribution and time of application of fertilizers reaches a very high standard. This is specially true of the North Island, with its high proportion of permanent pasture. Here the art of field husbandry resolves itself mainly into selection of suitable seed mixtures at the initial sowing, subsequent top-dressing to maintain or improve soil fertility and good utilization of the feed produced. While the use of fertilizers on grass land is less intensive in the South Island, a high standard of arable farming is maintained in those districts where arable farming is common. The comparatively low rainfall occurring in such districts is probably the chief factor limiting the more intensive use of fertilizers.

The early settlers in New Zealand were quick to appreciate the benefits to be derived from fertilizers, and considering the geographical isolation of New Zealand and the difficulties of transport, it is remarkable to find records of imports of fertilizers as far back as 1867.

As in Australia, the outstanding feature of fertilizer practice in New Zealand is the predominating importance of phosphates. In both these countries the imports of phosphatic fertilizers constitute over 90 per cent. of the total amount of fertilizers imported. Phosphates all over the world give the greatest response to crop growth in the greatest number of cases,

from which it may be assumed that the amount of this particular nutrient in the soil is most likely to fall below the requirements of the plant. But in New Zealand the great importance of phosphates is particularly apparent from nearly all experimental trials, and the need for phosphates constitutes the major limiting factor in crop growth.

The climate of New Zealand is ideally suited to the growth of grass, which continues all through the year over a good proportion of the country. Consequently a very large area of the Dominion, even in those districts suitable for arable farming is under permanent grass. In other districts where cropping is more extensively practised most of the land is laid down to grass for periods varying from three to seven years in each rotation. The accumulation of organic matter under grass, combined with the nitrogen-fixing properties of the clovers in the pasture, reduce the necessity for the general application of organic and nitrogenous manures for arable crops in New Zealand.

It is probable also that the attention given to phosphatic manuring is due partly to the proximity to large resources of phosphatic deposits on certain islands of the Pacific Ocean. The distance that separates New Zealand from sources of nitrogenous and potassic fertilizers is much greater. This last factor, however, must not be stressed unduly, since, as will be shown later in this article, in experimental trials conducted throughout the Dominion, phosphates have proved of overwhelming importance.

The fertilizer practices adopted in the various districts of New Zealand depend on differences in geology, topography, climate and type of farming.

There is less correlation between geology and fertilizer requirement in New Zealand than in most countries. This is due mainly to factors already discussed, but also partly to the absence of large areas of similar soil type.

New Zealand is a mountainous country, and topographical features play a large part in controlling fertilizer practice. Millions of acres of grassland are capable of improvement by top-dressing, but the difficulties of access and of distribution render the task uneconomic or of doubtful economy. The proximity of the mountains to the sea, and the immaturity of the river systems have led to large areas of recent alluvial deposits, which are strikingly fertile, but which repay the cost of fertilizer treatment to a remarkable degree.

The occurrence of a high mountain range forming a backbone of both islands, and the existence of conditions leading to very definitely prevailing winds, cause a sharp distinction in rainfall between the west coastal districts and the eastern side of the country. This climatic factor has a profound influence upon farm management and fertilizer practice.

Depending upon these various factors of geology, climate and topo-

graphy, the types of farming practised in New Zealand can be roughly grouped into sheep farming, dairying and arable farming.

On the great majority of farms in the South Island arable farming is in reality mixed sheep farming and cropping. A straight-out cropping farm of any size is practically unknown. On richer South Island soils, dairying and/or sheep may supplement cropping. The particular type of farming influences the fertilizer practice. The hill country sheep farmer of the North Island applies occasional dressings; the dairy farmer on rich alluvial country or the volcanic regions of the North Island practices fairly intensive systems of manuring; the arable farmer of the South Island regularly uses small quantities with arable crops, but tends to neglect the top-dressing of pastures. The great increase in fertilizers used in New Zealand in the last 20 years is largely due to the increase in dairying.

B. Manures Supplying Humus

1. *The Excreta of Farm Animals*

The climate of New Zealand is such that, except in special cases, stock are not housed at any time of the year. The collection of large quantities of farmyard manure is not, then, a part of the normal farm economy. All types of stock are grazed throughout the year, any supplementary feeds being given either in the paddocks or to dairy cows at milking time. A small quantity of dung is collected from milking-sheds and stables, and from under woolsheds, and distributed over neighbouring paddocks, but the quantity thus dealt with is negligible.

Where stock are fed on the paddocks the minerals and some of the nitrogenous and other organic constituents contained in the animal excreta eventually must become incorporated with the soil, but a large amount of valuable organic matter is lost by oxidation. Sheep on poor hill country in some instances are given licks containing an abundant supply of phosphate and other minerals, and their droppings, containing the major part of these minerals, are distributed by them over the hills. The lack of uniformity in distribution, and the small amounts involved, make this method a very poor substitute for top-dressing as a means of soil improvement. The practice of giving stock access to mineral licks is not to be condemned on this account, but should be considered mainly from the point of view of making good the mineral deficiencies in the herbage.

2. *Green Manuring*

The practice of ploughing under green crops specially grown for the purpose of enriching the soil in nitrogen and organic matter in preparation for the succeeding crop, is not widely carried out in New Zealand. The

favourable conditions for pasture growth in New Zealand makes possible the establishment of good temporary or permanent pasture on soils which under less favourable climatic conditions could not support anything but the poorest quality vegetation. When a sole of grass and clover is established, accumulation of nitrogen and humus proceeds apace and green manuring is not so necessary.

The growing of the blue lupin (*Lupinus angustifolius*) has proved of striking value in reclaiming land on light shifting sand-dune country. The same plant is used in cultivated orchards, chiefly in the Nelson district, as a green manuring crop, and is also to be seen at times on the Canterbury plains sown between two arable crops in the rotation, or grown in association with other crops such as rape, kale, and grass as a fodder plant. Other fodder crops such as barley, oats, vetches, Italian ryegrass and red clover may be included as green manuring crops, they being ploughed under after being grazed.

C. Organic By-Products

1. *By-Products of Freezing Works*

The place occupied by organic manures in New Zealand farming is not an important one. This is due to a number of factors, chief among which are the following:—

(a) The comparatively small response to slow-acting nitrogenous manures in the case of nearly all crops. This is due partly to the accumulated fertility of the soil under long-term pasture leys and partly to the climatic conditions, which, after ploughing, encourage rapid decomposition of the accumulated organic matter and the consequent liberation of abundant available nitrogen during the growing period of most arable crops.

(b) The low price of quick-acting phosphatic fertilizers, manufactured locally from Pacific island phosphates.

(c) The small number and limited scope of secondary industries in New Zealand.

Practically the whole of the industrial by-products used as fertilizers are derived from meat-freezing works, slaughter-houses, and boiling-down works.

Before refrigeration made possible the export of carcasses, the only outlet for by-products of the wool grower was that of boiling down for tallow. Considering the large quantities of bones available, and the common practice in England, even in the eighteenth century, of using bones as a

fertilizer, it is surprising that no record is to be found in New Zealand of a serious attempt to make use of the bones from boiling-down works until 1878, when the meat-preserving works established at Timaru turned out a steamed bonedust. This fertilizer began to be used for annual crops, and further works were soon established to deal with the bones from the boiling-down process. By 1885 the annual output amounted to 2,575 tons of bonedust. In 1880 bonedust was imported from Australia, and in 1889 the first shipment was received from India.

With the development of the refrigerative process, and the growing efficiency of technical methods employed, the local production of bonedust and blood manure increased rapidly. The demand for these organic fertilizers increased, however, at an even faster rate, and imports of bone manures reached a very high figure. By 1910 the imports of bonedust were 12,177 tons, and of 'blood and bone' manure 175 tons. With further increases in local production, and the growing preference for quicker-acting fertilizers, the imports have fallen steadily in the last 20 years. By 1920 the imports had fallen to 6,272 tons of bonedust and 288 tons of 'blood and bone' manure. Imports of the latter ceased in 1923. In 1925, 2,452 tons of bonedust were imported, and in 1931 only 160 tons (from India). In the latter year regulations were gazetted under the Animal Diseases Act prohibiting importations of bonedust from India.

From 1916 onwards outlet was found for the surplus bone fertilizers in export to Australia; small quantities were also exported to Fiji, Hawaii and the Pacific coast of U.S.A. In 1928 the total quantity of bone and blood manures exported reached 3,060 tons, but this figure had fallen in 1931 to 338 tons.

The method of treating the waste parts of animals slaughtered in freezing works is as follows:—

The offal, such as head, feet and paunch, is placed in a digestor, covered with water, and heated for several hours with steam. This treatment loosens the fat and the flesh from the bones. The liquid part is run off into settling tanks, allowed to cool, and the fat removed. The solid matter is dried and ground. Such material has a very variable composition, and is sold under such names as 'blood and bone' or 'meat and bone.' In some cases the liquid part, after the removal of the fat, is evaporated and the residue sold as 'tankage.' According to the nomenclature adopted in other countries, the term 'tankage' would be more appropriate for both products, and the name 'blood and bone' reserved for mixtures of bonedust and dried blood.

For the manufacture of bonedust, clean bones free from flesh are placed in digestors, steamed and finally dried and crushed. Only small amounts of highly phosphatic fertilizers from chemically degreased bones,

similar to the steamed bone flour (with nitrogen content of approximately 1 per cent.) produced in England, are made in New Zealand. All the bonedust manufactured in New Zealand does not conform to the standard of fineness of division and ready availability in the soil expected of bone fertilizers in other countries. It is unquestionably true that much improvement could be effected in the local manufactures of certain bone fertilizers, and if these products are to compete with superphosphate and the modern nitrogenous fertilizers, some innovations are necessary. In recent years the tendency has been to turn out more specialized products. Less of the hybrid, variable product, 'blood and bone' manure is being produced, and more 'bonedust,' 'dried blood' and 'meat meal.' These three products, with sufficiently careful treatment, find a ready sale for stock-feeding purposes. In the preparation of dried blood in freezing works, the blood from the killing boards is evaporated by means of vacuum dryers. Meat meal is prepared from livers, hearts and other clean trimmings from the carcasses.

The production of bone and blood by-products from New Zealand freezing works and boiling-down works in the last three years is shown in the following table. A large proportion of the products of these works is incorporated with superphosphate and other fertilizers to be sold as compound mixtures. Such products are included in this table under 'other manures.'

TABLE LXXIX

Output of Fertilizers from New Zealand Freezing Works and Boiling-down Works

Year	Bonedust †Tons	Dried Blood Tons	Blood and Bone Tons	Other Manures Tons	Total Tons
1929	5,504	*	14,014	18,471	37,989
1930	5,042	3,176	8,178	18,594	34,990
1931	5,452	3,566	9,488	17,700	36,206

*Previous to 1930, the figures for the production of dried blood were included in the statistical returns under the heading of 'Other Manures.'
†English tons.

Bruce (1) gives the following figures for the composition of some of the organic manures manufactured in New Zealand:—

TABLE LXXX

Composition of Organic Manures Manufactured in New Zealand

Manure	Average Percentage of Fertilizing Ingredients		Range of Percentage of Fertilizing Ingredients	
	Nitrogen	Phosphoric Acid	Nitrogen	Phosphoric Acid
Bonedust	3·5	21·9	2·3 to 4·3	17·2 to 27·2
Dried Blood	12·6	—	12·0 to 14·0	—
Blood and Bone ..	6·6	11·7	4·7 to 8·5	8·2 to 21·9
Meat and Bone ..	7·3	11·5	6·5 to 8·0	10·0 to 13·0
Fish Fertilizer ..	5·8	12·8	—	—

2. Fish Fertilizers

There are several plants in New Zealand, manufacturing fertilizers from fish waste. Some of these products contain too much oil, and thereby suffer from the disadvantage that they decompose too slowly in the soil.

D. Inorganic Nitrogenous Fertilizers

New Zealand has participated to a certain extent in the recent world-wide revolutionary change of outlook with regard to soluble nitrogenous fertilizers, following the economic production of such fertilizers from the atmosphere by various technical processes. The lowering of prices combined with the improvement in quality of such produce has led to an extension of trials in all types of farming. Prejudice against the alleged 'forcing' effects of such fertilizers, and the alleged soil exhaustion following their use, is being modified as a result of more carefully-conducted experiments, and the place of nitrogenous manuring in grassland farming is being investigated from a new angle. Details of the experimental work will appear later in this article, but this preliminary review will serve to explain the increase in imports between 1925 and 1929.

Table LXXXI

Imports of Nitrogenous Fertilizers into New Zealand.

Year	Sulphate of Ammonia Tons	Nitrate of Soda Tons
1910	113	246
1915	590	545
1920	67	135
1925	841	816
1929	8,992	2,098
1930	8,245	1,854
1931	4,845	670
1933*	6,840	1,862
1934*	2,813	749

*For year ended March 31 (2).

The big drop subsequent to 1930 is occasioned principally by the fall in prices of farm produce. In New Zealand, phosphates, and in some cases lime, constitute the basic dressing, and the use of nitrogen must be considered as an accessory which can raise the standard of production when required, but is not so likely to be profitable in times of low prices unless the cost of nitrogenous fertilizers falls still further.

Sulphate of ammonia constitutes the major source of supply. Previous to the introduction of synthetic nitrogenous compounds the supplies of by-product sulphate of ammonia came mostly from Great Britain, Australia and U.S.A. The British synthetic product now constitutes practically the whole of the imports.

Small quantities of nitrate of soda are also used in New Zealand, chiefly by market gardeners and orchardists, but a large proportion of the

imports of this substance are used at the superphosphate works in the leaden chamber process for the manufacture of sulphuric acid.

The recent developments in fertilizer manufacture may have a profound influence on New Zealand imports in the future. The introduction of highly-concentrated combined nitrogenous and phosphatic fertilizers such as ammonium phosphate made possible by the synthetic process, and the saving in freight charges thereby entailed, would appear to be particularly important to a country like New Zealand, situated at such a great distance from the manufacturing centres. On the other hand, these new fertilizers have to compete with the local industry—the manufacture of superphosphate —with raw material close at hand, together with the competition of sulphate of ammonia, which is imported at a comparatively low cost to the farmer. At present the proportions of the ingredients in most of these new synthetic products are not ideally suited to New Zealand requirements, and the prices do not compare as a rule with standard products. Furthermore, the mechanical condition of some of these substances by the time the consignments reach New Zealand has been distinctly unsatisfactory.

No figures are available in the official statistics showing the quantities of these fertilizers imported. For the most part their use in New Zealand is at present confined to field trials which are being conducted at various experimental centres.

Small quantities imported from Germany about 1928 gained considerable popularity among orchardists.

E. Phosphatic Manures

The pre-eminent importance of phosphates in New Zealand has already been discussed. New Zealand is fortunate in having abundant supplies of high-grade phosphate within easy reach, and the problem of supplying the Dominion's needs, even if the high annual rate of increase in demand immediately prior to 1929 were to continue, does not seem to raise any serious difficulties.

There is no doubt concerning the almost invariably high response all over New Zealand to phosphatic dressings. Various opinions are held regarding the best form of phosphatic fertilizer to use in different districts and for different purposes, but in most districts, and for most crops, a phosphatic dressing of some kind is considered essential.

1. *Local Deposits of Phosphates*

It was not until 20 years after the importation of phosphates into New Zealand that a search was undertaken for local supplies of phosphatic rock. Several very small deposits were worked during the latter part of last century, but in 1902 a fairly extensive deposit was discovered at Clarendon, 30 miles south of Dunedin, and working commenced in the same year. A similar deposit was discovered shortly afterwards at Milburn.

The phosphate was blasted out with gelignite, dried and ground. The rock contains just over 60 per cent. of tri-calcium phosphate.

Production ceased in 1926 owing to the fall in cost of imported phosphate. During the period about 138,000 tons had been mined.

2. Imports

Certain islands of the Pacific and Indian Oceans abound with rich deposits, presumably of sea-bird origin, nearly all of them being practically non-nitrogenous, and having a phosphate content equivalent to 80-90 per cent. tricalcium phosphate, and others, lower in phosphate content, containing a small percentage of nitrogen.

The former are used to a small extent for direct application to the soil, but mainly for superphosphate manufacture. The latter are used extensively in New Zealand for increasing the phosphate content of proprietary mixtures, and are more appropriately known as 'phosphatic guanos.'

The first imports of phosphatic guano were made in 1868, and continued in increasing quantities from various sources, such as New Caledonia, Surprise Island, and Walpole Island, up to the end of last century. In 1900 commenced the import of rock phosphate from Ocean Island, and in 1906 from Nauru Island.

Makatea Island, Christmas Islands, Seychelles Islands, and Madagascar have also supplied considerable quantities of phosphate.

In 1919 agreement was arrived at between Great Britain, Australia and New Zealand whereby each country was assured of a proportion of the annual output from Nauru and Ocean Islands, in the ratio of 42 : 42 : 16, at a stable price. A Commission was appointed to control the output. The importations into New Zealand since 1920 have been as follow:—

TABLE LXXXII

Importation of Rock Phosphate into New Zealand from Nauru and Ocean Islands

Year Ended June 30	Tons	Percentage of the Total Output
1921	17,100	4·69
1922	38,500	10·65
1923	51,550	16·43
1924	60,850	13·47
1925	98,790	20·99
1926	77,400	19·76
1927	135,200	22·79
1928	124,270	24·75
1929	142,195	24·66
1930	127,100	25·21
1931	122,930	31·85
1932	146,270	33·89
1933	177,915	26·95

During the same period Australia's imports have risen from 265,914 tons in 1920 to 463,090 tons in 1927, a very much smaller proportional increase. New Zealand has taken more than her quota, and in increasing proportions, since 1925.

The big drop in imports from Nauru and Ocean Islands in 1930 caused the Government of New Zealand to consider steps to encourage the use of superphosphate. A drop of this magnitude in the imports meant a loss to the Government on the year's workings. In addition the technical advisers were alarmed at the prospect of deterioration in fertility that might eventuate from such a general falling off of top-dressing. The magnitude of this decline is shown by the returns quoted in the Annual Report of the Department of Agriculture to the effect that in 1929 the total amount of fertilizer used was 450,000 tons,, while in 1930, owing to the decline in values, especially of wool, the tonnage applied had fallen to 404,000.

In October, 1931, legislation was enacted granting relief to the farmer to the extent of 17/6 per ton of superphosphate. This relief was provided by means of a Government subsidy amounting to 11/- per ton, a contribution from the superphosphate manufacturers of 5/- per ton, and a contribution from the distributors amounting to 1/6 per ton. The subsidy has been reduced each year, so that in 1934 it amounted to 2/6 per ton.

The effect of the subsidy on the imports of rock phosphate and basic slag are shown in the following table:—

TABLE LXXXIII

Imports of Phosphatic Fertilizers into New Zealand (2)

Year Ended March 31	Basic Slag Tons	Pacific and Indian Oceans Phosphates Tons
1928	48,913	143,373
1929	93,222	178,057
1930	94,332	170,997
1931	67,766	156,950
1932	47,776	178,466
1933	42,022	214,445
1934	14,982	182,333

The importations of rock phosphate increased during the period 1930-1933, whilst the importations of basic slag fell during the same period. Economic conditions caused a falling away in the imports of both in 1934.

At various times, North African phosphates have been imported in considerable quantities, the first being the Egyptian Phosphate Company's product 'Ephos' in 1914. In recent years Moroccan and Tunisian phosphate have been imported, partly to supplement supplies for superphosphate manufacture when weather and labour conditions precluded the full out-

put from Nauru and Ocean Islands and partly for the specific purpose of direct application to the soil. The North African phosphates are ground very much more finely than the harder Pacific Island phosphates and a greater rate of availability in the soil is claimed in consequence. There have also been some imports of Florida phosphate.

3. *Superphosphate*

Superphosphate is the most important fertilizer in New Zealand. In 1929-30, 203,868 tons of superphosphate were used on 1,761,958 acres.

The first importation of superphosphate appears to have been in 1875. By 1909 the imports had risen to 21,910 tons and the highest annual importation was reached in 1921 when 40,731 tons were landed.

With the development of local manufacture importations have practically ceased, small quantities being imported only when overseas manufacturers can undersell the local works. In 1931, 300 tons were imported from the Netherlands and Germany.

The first superphosphate works in New Zealand were erected at Burnside, near Dunedin, in 1882, followed by another at Westfield near Auckland in 1887. There are now eight large plants operating.

The sulphuric acid is manufactured at the works from sulphur imported principally from Texas. The high-grade rock phosphate obtained from Ocean and Nauru Islands leads to a more economical use of sulphuric acid and to a higher grade product which is sold to contain 44-46 per cent. water soluble phosphate (equivalent to over 20 per cent. water soluble phosphoric acid).

4. *Basic Superphosphate*

To fulfil a special demand in certain districts in New Zealand, superphosphate is mixed with lime during the manufacturing process. This mixture, of variable composition, is screened and sold as 'basic superphosphate.' In some cases the material consists only of superphosphate mixed with either burnt lime or unburnt limestone, but in some cases high-grade rock phosphate is added to give a total amount of phosphate equivalent to about 40-43 per cent. tri-calcium phosphate (19-20 per cent. phosphoric acid).

It is claimed that the water soluble phosphate is all converted to di-calcium phosphate, thus altering those properties of the superphosphate which may be undesirable under some circumstances, whilst retaining a measure of rapidity of action in the soil. At the same time the reduced acidity of the mixture is claimed to be an advantage. Examination, however, shows that the reaction is not complete and in some cases a considerable quantity of water soluble phosphate remains in the mixture.

The writers know of no evidence to justify the use of basic superphosphate as it is sold commercially in New Zealand at the present time.

5. *Basic Slag*

The popularity of basic slag as a top-dressing for grassland among New Zealand farmers, especially in the North Island, is second only to that of superphosphate.

Nearly 600,000 tons have been imported into New Zealand in the last twenty years. Slag was first imported in 1891, imports increased to 30,350 tons in 1914, practically ceased during the War and rapidly increased from 1920 onwards until in 1929 no less than 93,222 tons were imported. The Government subsidy on superphosphate has naturally influenced the proportions of basic slag and superphosphate used since 1931 (2). Practically all the basic slag imported has come from Belgium and is a by-product of the Bessemer process of steel manufacture. New Zealand is fortunate in not having yet to educate her farmers to distinguish between the high-grade soluble slag to which they are accustomed and the inferior products of more modern methods of steel manufacture. If the Bessemer process goes further out of use and if the world's steel production is further affected by the economic depression, the New Zealand farmer who wishes to continue to use slag may find Bessemer slag very scarce and may be faced with the alternative of paying a high price for the high-grade product or of experimenting with an inferior article.

In certain districts in New Zealand basic slag has continued to hold first place in popularity but on the whole superphosphate has proved superior.

F. Potassic Fertilizers

The potash content of New Zealand soils is high. Large areas of country are derived from rocks high in felspahtic minerals and even in the coarser-textured soils the amount of potash is relatively high. This fact combined with the comparatively high price of imported potash manures has not encouraged the use of potash by farmers. The imports of potash fertilizers constitute only 4 or 5 per cent. of the total imports of fertilizers. In a few districts, notably in North Taranaki and parts of Southland, marked potash response has been obtained. The more concentrated potash manures have never been popular in New Zealand in spite of the fact that muriate of potash has compared favourably in unit price with the lower-grade salts. Before the War and until 1925 kainit was most in favour but in the last few years the use of 'potash salts' has increased to a great extent. The following table shows the imports of the various potash compounds:—

TABLE LXXXIV

Imports of Potash Fertilizers

Year	Sulphate of Potash	Muriate of Potash	Potash Salts	Kainit	Total
		Tons	Tons	Tons	Tons
1910	350	14	350	2,025	2,739
1915	1,196	13	977	1,962	4,148
1920	—	—	65	—	65
1925	1,126	2	2,287	4,001	7,416
1928	1,502	23	4,267	786	6,578
1929	1,207	18	7,006	901	9,132
1930	1,296	50	6,230	1,059	8,635
1931	772	20	3,486	397	4,675

G. LIME

Lime occupies second place only to phosphates in popularity in New Zealand. In 1929-30 the figures were:—

TABLE LXXXV

Fertilizers and Lime Used in New Zealand in 1929-30

Phosphatic fertilizers	284,848 tons
Lime	171,539 tons
All other manures and fertilizers	50,482 tons

The use of lime varies widely in the different districts. In the South Island lime is applied with phosphate as a basic dressing and in some cases no appreciable response to phosphatic dressing is obtained without its use. In the North Island, however, response to lime treatment is far less general and in many cases lime is not applied at all or is applied solely because of a deep-rooted faith in its benefit. The marked difference in lime response between the two islands is very sharp and is difficult to explain, but the reasons are probably partly due to climatic factors, partly to geological and partly to the greater amount of cultivation practised in the South Island.

It has been found difficult to estimate accurately the quantities of lime used in New Zealand. The most reliable information is obtained from statistics supplied by the Railway Department giving the quantity of lime delivered to railway stations. It must be remembered, however, that in some districts, especially in Southland, a considerable quantity of lime is delivered by motor transport direct from the quarries to the farms. The following table is, therefore, not comprehensive:—

TABLE LXXXVI

Lime Delivered to Officered Railway Stations to March 31

	1928–29	1929–30	1930–31	1931–32	1932–33	1933–34
North Island ..	42,258	60,476	72,678	70,570	94,701	99,919
South Island ..	99,858	111,063	81,615	69,766	79,413	94,068
	142,116	171,539	154,293	140,336	174,114	193,987

The amount of lime used in the North Island in 1929-30 represents only 12 per cent. of the total quantity of fertilizer used but in the South Island the figure for the same year is 58 per cent.

A very marked increase in the use of lime has occurred in the last few years. Official statistics show that a 200 per cent. increase in acreage treated with lime occurred between 1928 and 1930. Connell (3) comments on this as follows:—

'In this connection it is well to recall that the period under consideration has been one of falling prices for farm products, during which farmers naturally search for ways of reducing their expenditure. The tone of enquiries received by the Fields Division (Department of Agriculture) suggests that at least some farmers have been looking to the use of lime as a means of cutting down their outlay on fertilizers. That lowering of expenditure is the objective which may have led to some of the increased use of lime is supported by the fact that no other adequate reasons for a sudden expansion in the use of lime can be readily found. In recent years investigations have not yielded new results which could reasonably be expected to have led to a trebling of the area of limed grassland after it had previously remained fairly constant.'

While these comments are undoubtedly well-founded it should be pointed out that the increase in the use of lime coincided with a reduction in cost to the farmer, and in some localities of the North Island lime-super mixtures are being used in lieu of basic slag.

New Zealand is well supplied with easily accessible and easily worked limestone deposits of a high-grade rock mostly of a soft nature capable of being ground at a very reasonable cost.

By far the larger proportion of lime is applied as ground limestone, the use of burnt lime being restricted, especially for the top-dressing of grassland, slaked lime scarcely being used at all. Burnt lime is unpopular on account of the inconvenience of application and on the whole is more expensive than limestone.

The average dressing all over New Zealand on land to which lime was applied in 1929-30 was about 5½ cwt. per acre.

In order to encourage the use of lime the Government has for many years subsidized a service of free railage on lime to bona fide farmers for distances up to one hundred miles. This has undoubtedly encouraged liming to a considerable extent but has not necessarily encouraged it most in districts where it is most needed. The free railage may also have contributed to the greater use of ground limestone in place of burnt lime. It is to be regretted that neither burnt lime nor ground limestone are sold under a guaranteed analysis.

H. Miscellaneous

1. *Sulphur*

A deposit of sulphur occurs on White Island in the Bay of Plenty. The deposit is of volcanic origin and consists of 20-40 per cent. of free sulphur with about 10 per cent. of calcium sulphate and other sulphur compounds. In 1926 a company was formed to prepare the material for use as a fertilizer although sulphur is not recognized as a fertilizer under the Fertilizers Act. Favourable results have been reported from its use and actual trials of its application to lucerne in Otago showed it to have a beneficial effect on yield in some experiments (32). Its actual value under different conditions is not properly known.

2. *Compound Proprietary Fertilizers*

In addition to the compound fertilizers mixed at the freezing works many of the fertilizer distributing firms in New Zealand make special proprietary mixtures sold for special purposes under names such as 'Orchard Manure,' 'Rape Manure,' etc. These fertilizers usually contain superphosphate as a base with varying quantities of organic by-products and slow acting phosphatic fertilizers and sometimes potash.

There is doubtless something to be said in favour of such mixtures. An inexperienced farmer unaccustomed to the use of fertilizers is encouraged to use these mixtures for some specific purposes on the recommendation that the prepared mixture will fulfil the special requirements of a particular crop. In this way crops may be manured and profitable results obtained where otherwise possibly no manure would be considered. The physical condition of these mixtures is usually highly satisfactory due to the presence of the granular organic fertilizer and a very fair degree of drillability is thus attained.

It must be stressed, however, that such mixtures should not attract the farmer who understands the use of fertilizers. In most cases equally good results at a lower cost can be obtained by the use of 'straight' fertilizers and in many cases the exceedingly small proportion of the more expensive ingredients such as nitrogen and potash cannot have any appreciable fertilizing value and only add to the cost of the mixture without beneficial results.

II. GENERAL PRACTICE AND RESULTS OF EXPERIMENTS IN THE USE OF FERTILIZERS

A. Introductory

Practice in the use of fertilizers is so varied according to district and even within any district of more or less uniform soil and climatic conditions that it is impossible, except where the results of carefully systema-

tized experiments have moulded practice, to make any definite statement in regard to quantities of fertilizer used. Hence this aspect of practice must be discussed in terms of general averages and the ranges of quantities normally used. Methods and times of application for any particular crop are more uniform except insofar as the top-dressing of grassland is concerned. Quantities used, methods and times of application, vary somewhat with the type of crop so that it is necessary to discuss practices adopted and the results of experiments in connection with each of the main types of crops grown in the Dominion, under separate headings.

Fortunately the results of fertilizer experiments carried out in the South Island prior to 1923 on the main annual crops were very ably summarized by Hilgendorf (4) and will be referred to later. Since 1923 the Fields Division of the Department of Agriculture has carried out most of the experimental work conducted in the South Island and for the greater part of the period the policy has been directed along certain definite lines each of which is carried to a definite conclusion, insofar as this is possible. Summaries of the results on different crops, each covering a period of years, provide information in a readily available form to which references will be made.

The results of a large amount of valuable experimental work in the use of fertilizers on pasture and annual crops carried out in the North Island are recorded in the annual reports of the Department of Agriculture from 1893 to 1909, and in the *Journal of Agriculture* from 1910 onwards. Unfortunately the type and design of experiments has been so varied as to render the selection of the results of even a few investigations inadvisable and an attempt at summarizing results extremely difficult. It is quite certain that the experiments carried out have guided farm practice; and present-day practice has embodied the application of the main findings from the experiments carried out. The enormous importance of, and bias towards, grassland farming in the North Island demands that the greater part of the energies of investigators must be devoted to grassland problems, and the present-day policy, so far as fertilizer investigations are concerned, will be indicated under the discussion on the use of fertilizer on grassland.

B. The Use of Fertilizers on Grassland

Quantities and kinds of fertilizers used are governed very largely by the system of farming adopted. This in turn is dependent to a considerable extent on the soil and climatic conditions. The general suitability of the North Island to the production of grass has resulted in its becoming preponderantly the dairying portion of New Zealand. The lower rainfall conditions experienced over the greater portion of the arable lands of the South Island has resulted in this portion of New Zealand becoming the

country's granary. Notwithstanding this, however, grassland occupies pride of place so far as area is concerned even in arable farming districts. The higher rainfall districts being farmed, generally speaking, are also represented by higher temperatures, more particularly in the winter months, with the result that their production capacity is considerably enhanced. Higher production means higher utilization of food material in or supplied to the soil; hence, the more intensive use of fertilizers accompanies higher rainfall.

1. *Lime*

Statistics presented earlier in this article indicate that a greater amount of lime has, until the last three years, been used in the South Island than in the North. Statistics show, however, that the smaller tonnage used in the North Island is spread over an area more than twice that of the area limed in the South. In 1930-31 over 307,000 acres were top-dressed with lime in the North Island as against 131,500 acres in the South Island. These figures serve to emphasize the difference in methods of using lime in the two islands. Smaller and more frequent applications, principally to grasslands, is the practice in the North, whereas larger but less frequent applications are made in the South. The Southern figures are influenced appreciably by the practice adopted in Southland where the application of a ton or more per acre, prior to or when grass is being sown, is quite common.

No definite research work has been done in New Zealand to test small and frequent applications of lime as compared with large and infrequent applications, although an investigation which has been proceeding for about two years at the Marton Experimental Farm is definitely attacking this problem.

Experimental work, principally of an observational nature, indicates that while there are soils in the North Island badly in need of and highly responsive to lime, this condition is much less general than in the South Island. A survey of Canterbury (5) and Marlborough (6) with 243 simple observational experiments indicates that from 90 to 95 per cent. of the places under investigation showed definite responses to lime, the degree of response varying, however. The work of the Cawthron Institute (7) in Nelson has demonstrated a high degree of importance of the use of lime in association with phosphate on many of the Nelson soils. Westland is highly deficient in lime and markedly beneficial effects have resulted from its use. Under extremely high rainfall conditions in this Province it is certain that the frequent use of lime is desirable to counteract the big losses which must occur. In Canterbury, under a rainfall of about 25 inches, the effect of applications of 1 ton of ground limestone to pasture have been discernible for at least five or six years.

A series of 33 experiments on top-dressing for hay conducted by Tennent (8) in North, South and Central Otago showed only a comparatively slight response to the use of lime on the general average. Southland soils are reputed to be among the most deficient in lime in New Zealand and it is in Southland where the use of lime is exploited to the greatest extent. McGillivray (33) reports striking results from the use of lime in experiments on temporary pasture at the Winton Experimental Area in Southland.

Ground limestone is the most commonly used form in which lime is applied. The unpleasant nature of effects on the individual of using burnt lime, plus the fact that lime for use by farmers is carried by rail for 100 miles free of cost no doubt contributes largely to the popularity of ground limestone.

2. Phosphates

In 1930-31 over 2,400,000 acres of grassland were top-dressed with artificial fertilizers. It is certain that practically the whole of this area received phosphate irrespective of what other fertilizers were used. The great preponderance of top-dressing in the North Island is indicated by the fact that 2,100,000 acres were top-dressed in the North compared with about 338,000 acres in the South. Superphosphate is the most commonly used form, quantities applied per acre ranging from 1 to 2 cwt. once in two or three years, up to 6 or 7 cwt. each year on a few of the more intensively manured dairy farms. In an economic survey of over 200 farms in the Waikato and Taranaki, Fawcett (9) has shown that small farms of 50 to 60 acres use an average of about 3 cwt. of fertilizer per acre per annum. Larger farms of about 200 acres show an average usage of about 2 cwt. per acre per annum. No doubt these figures are fairly reliable averages so far as dairy farms are concerned. Sheep farms by virtue of the fact that they are generally situated on naturally poorer or more difficult country from point of view of applying fertilizers, receive much less than the quantities quoted above.

While it is generally true that under normal conditions top-dressing pays, there are considerable areas of second- and third-class country on which the improvement resulting from the use of artificial fertilizers is barely remunerative because of the costs entailed in transport and applying fertilizers.

Next to super, basic slag is the most commonly used phosphatic fertilizer, its use being confined almost entirely to the North Island and Southland. Auckland, particularly North Auckland, and North Taranaki districts are the principal users of basic slag. For the seasons 1929-30, 1930-31, and 1931-32, from 53 to 59 per cent. of the total importations of slag was

landed at Auckland, from 23 to 29 per cent. at New Plymouth, from 8 to 10 per cent. at Wellington, and from 4 to 5 per cent. at Invercargill (Bluff). (Estimated from annual records of importations of fertilizers in the *New Zealand Journal of Agriculture.*)

The most popular time for the application of phosphates in the North Island is the autumn, about March to May. Records of fertilizers delivered by rail show that the greatest deliveries take place during this period. A secondary peak period takes place during the early spring months, when, no doubt, a large amount of fertilizers is used for the top-dressing of pastures intended for hay or silage. Mid-summer in the North Island represents a period during which the use of fertilizers is lowest. Recent research indicates (10), however, that there is a considerable scope for the extension of the use of phosphatic fertilizers on well-controlled pastures about this time.

In the South Island the greatest quantities of fertilizers are railed from about August to December. In view of the comparatively small area top-dressed it is certain that fertilizers railed at this time are being used principally for special fodder crops, such as rape and turnips, which are sown from October to January, and for special green-feed crops such as Italian rye grass, oats and barley, which are sown either in early spring or late summer.

Experimental and research work has demonstrated a general need for phosphates throughout the greater part of New Zealand, although it must be understood that in a few isolated districts even phosphates are of comparatively little value. Numerous experiments conducted throughout the North Island have undoubtedly influenced the practice and pointed the way to the value of phosphates; such experiments, extending over a period of about 40 years, have been considerably varied in character, and make it difficult to instance any particular ones which have had a greater bearing in influencing practice than others.

In the South Island the less-certain response to top-dressing with phosphatic manures, generally as a result of the lower rainfall in most districts and the general lack of appreciation by farmers of the value to grassland has limited to a considerable extent the development in the practice of top-dressing.

In both islands phosphates are almost always used in the sowing down of grassland, from 2 to 4 cwt. per acre being used in the north and from 1 to 2 cwt. per acre in the south. More particularly in the south, however, manuring of the grass at sowing down is more or less incidental to the use of the fertilizer on the accompanying crop with which grass is often sown. It is more common to sow grass in the spring on a winter or spring-sown cereal crop, or in the late spring and summer with rape, kale or turnips, than

it is to make a pure sowing of pasture species. The sowing of short-rotation pastures of Italian ryegrass and red clover is an exception to this, however.

The series of top-dressing experiments carried out in Canterbury and Marlborough referred to previously, and those carried out by Tennent in Otago, have clearly demonstrated the general need for the use of phosphate in arable districts in the South Island. Tennent's investigations (8) showed a marked superiority of superphosphate over basic slag on all but the poorest types of pasture over a period of three years (two years for poorest pastures).

A series of trials carried out in the Wellington Province, and reported on by McCulloch (11), show a general superiority of superphosphate over basic slag, Ephos phosphate, and commercial basic super, except on heavy clay soils in the Wairarapa, where slag appeared to be slightly superior to super.

Investigations carried out during the last four years at the Marton Experimental Farm (10: pt. i), under a technique ensuring a high degree of precision in the measurement and results, have brought to light some interesting and valuable information concerning methods and times of applying phosphatic fertilizers. The superiority of annual applications of superphosphate over an equivalent quantity per acre of basic slag is shown to be consistent over a period of three years, irrespective of the time of application (10: pt. ii). Spring, summer or autumn applications of superphosphate gave slightly better total production than did the winter application. Summer and autumn applications were superior to winter and spring ones in the yield of pasture herbage during periods of low production due to dry conditions in the later summer, and during autumn, winter and early spring, when production was limited by temperature.

Somewhat similar results were obtained at the Ruakura State Farm (10: pt. v), in the Waikato, with the exception that applications in the spring were slightly better from the point of view of total production of herbage than applications at other times of the year. Probably the most valuable information derived from these experiments is that the use of superphosphate can be so manipulated so far as time of application is concerned, as to improve production appreciably during periods of little growth, without any loss so far as the total effect of the fertilizer is concerned.

Another investigation dealing with frequency of application of superphosphate (10: pt. iii) has shown that twice or thrice yearly applications are considerably more effective than a single application once in two years. There appears to be little advantage in applying twice or thrice yearly compared with once yearly so far as total production is concerned, but those portions of the more frequent applications made just prior to

periods of low production were definitely beneficial during such periods. Another important feature of this investigation is the revelation of the fact that summer applications of superphosphate have an appreciable influence on the phosphate content of the herbage during the late summer, at which time it is generally at its lowest. On country where stock suffer from phosphate deficiency the application of readily-available phosphate just prior to the period of late summer drought may have an important bearing on the health of stock at this time.

These investigations have shown also that superphosphate applications increase appreciably the lime and phosphate and protein content of the pasture herbage irrespective of the time of the year. Similar results in this respect were obtained by Rigg and Askew (13) in an investigation carried out in Nelson, though the soil in question was one well supplied with phosphate, and did not show any marked effect in the yields of herbage following the application of superphosphate.

A certain amount of information on the duration of the effect of dressings of superphosphate and basic slag under South Island conditions is provided by experiments under haying in Canterbury (14), (15), (16), and Otago (8). Generally speaking, an application of 2 or 3 cwt. per acre of superphosphate applied in the winter or early spring gave a marked increase in the hay crop taken in the following summer. The crop taken in the second summer following application of fertilizers generally showed a marked diminution in the effect of the fertilizers, although it was still very considerable in a number of cases, especially where the season in which the first crop was produced was a very dry one. The third hay crop, while still showing the influence of the fertilizers, did so to only a very small extent. In the Otago trials basic slag was generally inferior to super. even in the second and third hay crops following application, except on the poorest pastures, on which it proved slightly superior to super in the second season. It is apparent that where top-dressing with phosphate pays in the South Island an application of at least 2 cwt. every year is desirable.

The relative merits of superphosphate and basic slag for pasture top-dressing are much discussed in certain districts, particularly North Taranaki and North Auckland. Many experienced farmers are firmly of the opinion that slagged pastures have better milk production and fattening capacities than ones treated with superphosphate. How much this may be due to a greater effect from slag, how much to some effect on the mineral content of the herbage, and how much due to management it is impossible to say. It is certain that slagged pastures are, generally speaking, more easily controlled than ones treated with superphosphate, the more rapid action of which necessitates greater care in management to prevent the grass from getting out of control. Analyses of herbage by Doak, from super.

and slag-treated plots respectively from the Marton trial referred to, (10: preface) do not reveal anything which would suggest a superiority in feeding value of slag-treated pasture over that treated with superphosphate. Where slag compares more favourably with superphosphate in its effect on production the position may of course be different.

3. *Potash*

The comparatively high supply of potash in New Zealand soils has been referred to previously, and although the use of potash may be highly important in certain localities, its deficiency is by no means general. Experiments carried out in recent years indicate marked potash response in North Taranaki (34) and in parts of Southland, more particularly in the Mataura Valley. Apart from these districts, potash deficiencies are indicated at a few isolated points in the Westland, Canterbury, and in Auckland Provinces (more particularly Franklin and Manakau Counties, where quite marked potash responses have been noted in a few cases during the past year). Where used, from 1 to 2 cwt. of 30 per cent. potash salts per acre per annum constitutes the average dressing. One interesting feature of some of the trials referred to is that the use of potash alone is comparatively ineffective, but used in association with an efficient phosphatic fertilizer excellent results are obtained.

The series of top-dressing experiments carried out in Canterbury (5) and Marlborough (6) show so few potash-response areas as to warrant the general conclusion that in these districts the use of potash on grassland is, generally speaking, unnecessary.

4. *Nitrogen*

Sulphate of ammonia is the cheapest and most commonly-used nitrogenous fertilizer in New Zealand. Although the total tonnage used at the present time is not large, a considerable increase in its use took place during 1929 and 1930. In the North Island it is used almost entirely for the production of late autumn or early spring grass, in association with superphosphate, as so-called ammoniated super. This consists of a simple mixture of two parts of superphosphate to one of sulphate of ammonia. In the South Island it is also used for the same purpose, and in addition a small amount is applied to ryegrass pastures being used for seed production. Considerable success has also attended its use in the production of Chewing's fescue seed in the Southland district. From 1 to 2 cwt. per acre is applied in the spring at about the time the paddocks are closed up for the seed crop.

While the use of phosphate plays an important part in the production of grass in the autumn and spring periods, its influence in this respect is considerably enhanced by the addition of soluble nitrogenous fertilizers. Nothing so far tried can give as much late or early grass as nitrogen does.

Its use in the North Island is confined more particularly to dairy farms, but in the South Island it is used on sheep pastures on the better country as well as on dairying pastures. For late autumn and winter production applications are made about April and May and for early spring feed in late July and early August in the milder northern districts, and in late August and early September in the colder southern ones. In 1928 a series of grazing experiments to determine the value of nitrogen, applied three or four times during the year, was inaugurated by the Fields Division of the Department of Agriculture (17). The first year of these trials indicated fairly clearly that the most beneficial rôle of nitrogen was in the production of out-of-season grass. Of the three or four applications used in the first year, those made in the late spring or during the summer proved to be comparatively ineffective in increasing the growth of pasture herbage. Furthermore, in the majority of cases these applications exerted an undesirable effect on the growth and productivity of the white clover in the pastures. In the second year of the trials applications were confined to autumn and early spring ones with the result that a slight improvement in the effect per cwt. of sulphate of ammonia applied occurred. A number of these trials have been continued for a period of three or four years, the general result being that 1 cwt. of sulphate of ammonia per acre has been shown to be capable of giving an increase of about 20-cow-grazing days on the average. Unfortunately, it is impossible to estimate the value of nitrogen when used for the production of out-of-season grass, because production of extra feed at a time when it is wanted badly is obviously of more value than the same production at a time when the growth is prolific.

More detailed investigations of the effect of nitrogen on the production of pasture herbage have been carried out at Marton (10: pts. iv and vi) and at Ruakura (10: pt. v). These investigations have clearly demonstrated the fact that the beneficial effect in periods following the applications are generally followed by periods of slump in production. The continued use of heavy and frequent applications of sulphate of ammonia have caused a progressive deterioration in the productivity of the pastures, even though increasing production for a time. Results of a similar nature have occurred in Nelson (7). While these investigations show fairly clearly that the intensive use of nitrogen in the form of sulphate of ammonia, at the present state of our knowledge regarding its use, is likely to be a dangerous practice, its advantages in the production of out-of-season grass cannot be overlooked. Providing its use is confined to small dressings of about 1 cwt. per acre once in two to three years on the same pasture, it does not seem likely that undesirable effects will be sufficiently appreciable to outweigh the advantages, providing lime, phosphate and potash are used in adequate amounts where necessary.

C. Policy of the Department of Agriculture in Respect of Fertilizer Investigations on Grasslands

Two main types of investigation are being pursued at the present time. The first is the careful investigation into such problems as (i) the influence of time of application of fertilizers on total production and on production at various seasons of the year; (ii) the comparison of infrequent heavy applications of fertilizers with frequent light ones; (iii) comparison of the effect of different forms of phosphatic and nitrogenous fertilizers. As yet, these problems are being investigated only at Marton, under a special technique (12), which has been evolved, which ensures that the pasture is stocked under conditions comparable with those of intensive rotational grazing, but enables the lawn-mower and scales to be used as the measuring agents. A high degree of accuracy in the measurement of yields of herbage is obtained.

The second main project is what is termed a response-to-manure survey of New Zealand. Lime, phosphate, potash, and, in some cases, nitrogen, alone and in various combinations, are being tried in as many places as possible, and the responses, as indicated by observations, recorded. By using small plots (1/200 ac.) each experiment requires only a small area of ground. The cost and labour entailed are small, and as a result a larger number of experiments can be carried out than would be the case if larger plots were used. This type of experiment has already proved of considerable value in Canterbury (5) and Marlborough (6), where the almost universal lime deficiency was unsuspected prior to experiments being carried out. Outstanding results from potash in North Taranaki, and from lime and potash in parts of the Auckland Province, have also demonstrated the value of this type of experiment in indicating major deficiencies cheaply and rapidly, and the demonstrations which they provide to farmers on their own farms have a considerable influence in guiding local practice. In a good many cases results are so indefinite as to leave doubt as to the economic value of a treatment, but on the other hand the results are often so outstandingly positive or negative as to leave no doubt.

D. Use of Fertilizers on Root Crops

1. *Turnips and Swedes*

So far as fertilizer practice is concerned turnips and swedes may be regarded as being practically identical. The greater dependence on grassland has caused an appreciable reduction in the area sown to these crops in the North Island during recent years. Manuring practices vary considerably, the quantities used ranging from about 2 to 4 cwt. per acre of straight-out phosphatic fertilizers, or mixtures, the principal constituent of which is some form of phosphate.

In the drier districts of the South Island, superphosphate is the principal fertilizer for these crops, but as a result of research conducted during the past eight years a considerable area is now sown with a mixture of equal parts of superphosphate and carbonate of lime. The reasons for this are indicated below.

In the wetter districts, more particularly in Southland, mixtures of superphosphate and blood and bone, or superphosphate and rock phosphate or so-called guano, with the addition of some lime, are commonly applied. Under such conditions the superiority of the water soluble phosphates over other forms is not so great as in drier districts. Where club-root is likely to be serious the use of basic slag, or a mixture of equal parts of super and slaked lime, has been advocated by Gibbs (18) as the result of extensive investigations into the effect of various fertilizers on the development of club-root. This disease, more particularly in Southland, and to some extent also in the North Island, is a serious limiting factor to the production of cruciferous root crops.

Numerous proprietary mixtures of so-called special root fertilizers are put on the market by commercial firms. The main constituent of these is superphosphate, or basic superphosphate, to which is added small quantities of nitrogen in the form of blood and bone or sulphate of ammonia, and small quantities of potash. Assuming the addition of nitrogen and potash to be desirable, it is obvious that the quantities supplied in such mixtures are so small as to be negligible in their effect. The addition of blood or blood and bone usually imparts a better physical condition to the mixture, causing it to run more freely through the sowing machine, and from this point of view is to some extent desirable. The addition of soluble fertilizers, however, such as sulphate of ammonia and potash salts, is liable to increase the risk of injury to the germination of the seed; and even though the addition of potash and nitrogen may be desirable in larger quantities than are normally used in such mixtures, the almost certain possibilities of their injuring germination precludes their being used in reasonable amounts. Hilgendorf (4) states: 'The use of superphosphate as a turnip manure was introduced into New Zealand by Mr. W. E. Ivey, the first Director of Lincoln College, in 1882.' McGillivray, in a private communication, points out that superphosphate was imported into South Otago in 1875.

A series of experiments on the manuring of turnips and swedes was carried out in the South Island by the Department of Agriculture between 1908 and 1915.[1] The results of these experiments were statistically analysed by Hilgendorf, the general conclusions being that the best manure for turnips was 1½ to 2 cwt. of superphosphate plus ½ cwt. slow-acting phosphate per acre. Potash which was used at up to ½ cwt. per acre had no effect on the yield.

1. Bonedust, slag, guano, sulphate of potash were included usually as additions to superphosphate.

So far as the series of trials on swedes is concerned the general conclusions arrived at were that 2 cwt. of superphosphate supplemented by ¾ cwt. of bonedust proved to be the best mixture tried and the addition of bonedust or some other slow-acting phosphate to superphosphate was likely to be better than using super alone. The results showed that potash could not be expected to be of benefit to the swede crop. It should be noted that most of the turnip and swede experiments were conducted in the Otago and Southland districts. The benefits resulting from the addition of a slow-acting phosphate to super are of interest and are further commented on below.

In manuring trials of turnips carried out in Canterbury by Hudson (19) it was found that superphosphate was superior to Ephos (Egyptian phosphate) and Nauru phosphate, but that a mixture of super and Ephos gave a slightly higher yield than straight-out superphosphate sown at the same rate per acre. During the carrying out of these trials an improvement in germination was noted, where some of the superphosphate was replaced by rock phosphate. This led to the investigation of the effect of manures on germination of the seed as well as on yield.

The fact that a mixture of two things, one of which was superior to the other when each was used separately, was as good as the better of the two, was rather difficult to understand. However, the differences in germination suggested that the amount of superphosphate could be increased up to a point where the injury to germination nullified the good effect of the fertilizer on growth. When some of the super was replaced by rock phosphate the injury to germination was reduced and the greater number of plants was able to produce as much with a mixture of the more efficient and less efficient fertilizers as with a similar quantity of the more efficient one. It appeared, therefore, that if the injurious effect of the superphosphate could be reduced or eliminated entirely without any appreciable reduction in the availability of the phosphate, considerably better results should be obtained.

The experience and practice of a farmer, Mr. A. Adams, in the Sheffield district and Canterbury, gave a clue as to how this might be brought about. Mr. Adams had adopted the use of a mixture of superphosphate and carbonate of lime and claimed that as a result his germination was more dependable and his yield in the main considerably enhanced. This led to the trial of mixtures of superphosphate and carbonate of lime in the proportion of two of super to one of lime, and one of super to one of lime. The results proved entirely satisfactory, in that even under very dry conditions serious injury to germination was eliminated and over the average of a large number of experiments a considerable increase in the

yield resulted.[2] It has now been fully demonstrated that the use of a mixture of super and carbonate of lime under dry conditions is superior to a mixture of superphosphate and a slow-acting phosphate, and that the quantity of super used can be safely increased to 2 or 3 cwt. per acre, providing the same amount of lime is added, without any risk of serious injury to germination.[3]

The method of drilling in seed and manure through the same coulter, which is practically universal in New Zealand, necessitated consideration being given to the effect of manures on germination. A series of 24 experiments (20) extending over a period of five years revealed the fact that 1 cwt. of super sown with the seed was liable to reduce germination to little more than half of that resulting where rock phosphate or a mixture of super and carbonate of lime was used. Increasing the quantity of super to 2 cwt. per acre under Canterbury conditions lowered the germination still further and in some cases resulted in almost total loss of germination.

The injury to germination is probably caused by the highly soluble nature of the fertilizer. Under moist soil conditions even large quantities of superphosphate may have little or no effect on germination, but even under moist climatic conditions such as are experienced in Southland and in the North Island injury to germination is sufficiently common to warrant the precaution of mixing superphosphate with carbonate of lime. Other methods of reducing the amount of super sown in contact with the seed, such as pre-drilling or post-drilling of some of the fertilizers, have proved decidedly advantageous, but in view of the extra operation involved it is doubtful if they are as useful as the method of using carbonate of lime with super.

Investigations into the effect of sulphate of ammonia and potash salts (20) and (21) on the germination of turnip seed show conclusively that quantities as low as 1 cwt. per acre when sown in contact with the seed may have very serious effects on germination.

A few experiments in the use of sulphate of ammonia on turnips and swedes in Southland and South Otago (20), have not given consistent results.

While the findings from the experiments summarized by Hilgendorf regarding the benefits to be derived from the addition of slow-acting phosphate to superphosphate are undoubtedly real enough, it is probable that the explanation of the advantage lay in the reduced injury to germination resulting where some of the superphosphate was replaced by rock phosphate.

2. Investigations being carried out at present (December, 1934) indicate that a few limestones from districts other than Canterbury are relatively ineffective when mixed with super in correcting germination injury due to the latter. These investigations will be the subject of an article in the *New Zealand Journal of Agriculture* in the near future.

3. McGillivray states that the superphosphate-lime mixture was used in South Otago and Southland as early as 1894 with beneficial results.

2. Mangels

As is the case with other crops the main fertilizer used on mangels is a phosphatic one. In some districts salt is commonly used, and good results following its application are claimed, but there is no evidence to show that the benefits derived from it are general. Potassic and nitrogenous fertilizers are also used with varying success.

Quantities of fertilizers used range from 2 or 3 cwt. per acre in the drier districts in the South Island up to as much as 8 or 10 cwt. per acre of mixed fertilizer in the North Island.

Hilgendorf (4) summarized the results of 19 experiments conducted in Canterbury and North Otago in which superphosphate was the basal dressing to which guano, sulphate of potash salt and dried blood were added.

Examination of the data from these trials led to the following general conclusion: 'The experiments gave no encouragement to the use of expensive potassic and nitrogenous fertilizers, the immediate lesson drawn from them being that the use of phosphatic manures alone was most necessary, unless local experience had shown that potash and nitrogen were useful.'

E. Use of Fertilizers on Fodder Crops

Manuring of rape, kale and chou moellier follows very closely that of turnips and swedes. From 1 to 2 cwt. of fertilizers are used in the drier districts, and from 2 to 4 cwt. in the wetter districts of Southland, Westland and the North Island.

Italian rye grass, oats and barley are commonly drilled in with from 1 to 2 cwt. of superphosphate per acre, the quantity varying with climatic conditions, the smaller quantity being used in the drier arable farming districts.

The treatment of a lucerne crop is more or less the same irrespective of district, the chief difference being the quantity of fertilizer used. This is one crop above all others on which the beneficial effects of lime are recognized, and the standard practice is to apply about 1 ton of ground limestone per acre when the crop is sown down and top-dress with 10 cwt. to 1 ton at intervals of a few years.

The work of Reid (22) on the inoculation of lucerne has modified the practice adopted in sowing to some extent. The treatment of the seed with inoculum prior to sowing is now a standard practice. Reid found that mixing inoculated seed with superphosphate for sowing, as was commonly practised, or with other highly soluble fertilizer, resulted in considerable damage to the inoculating organism. Less damage was likely to result where the seed and manure were drilled from separate boxes and fell together in the ground, but the practice was attended with such risk as to

render its cessation desirable. The practice now adopted is to sow the lucerne with basic slag or a mixture of equal parts of superphosphate and carbonate of lime, or if superphosphate has to be used alone, to apply it as a pre- or post-dressing to the ground so that it does not come into intimate contact with the inoculated seed. Subsequent to the establishment of the crop, superphosphate can be used quite safely and is generally recommended with the addition of potash in districts where potash constitutes a deficiency.

F. Use of Fertilizrs on Cereals

1. *Wheat*

The fact that nearly all the wheat grown in New Zealand is produced in the South Island, particularly in Canterbury and North Otago, obviates the necessity of discussing practices in districts outside these. We are particularly fortunate in having a considerable amount of guidance from experiments in the manuring of wheat and the practice now adopted by growers is virtually a standard one. About 1 cwt. of superphosphate is drilled in with the crop. Statistics show that in 1931, 72 per cent. of the wheat grown in the South Island was manured at the average rate of 1·1 cwt. per acre.

In 1923 a body known as the Soils Improvement Committee and consisting of representatives of fertilizer firms, Canterbury Agricultural College, the Department of Agriculture, and other interested bodies was set up at the instigation of Mr. G. H. Holford and instituted manuring trials on wheat in Canterbury. Subsequent to 1923 the work was taken over by, and at the expense of, the Department of Agriculture. Since then, 141 experiments have been carried out. A series of experiments was also carried out by Scott (Canterbury Agricultural College) in 1925-26 (24). The results of experiments carried out by the Department of Agriculture over a period of eleven years have been summarized in the *New Zealand Journal of Agriculture* (23). Some of the earlier experiments compared the effects of the following phosphatic fertilizers: Superphosphate, commercial basic slag, Ephos phosphate and Nauru phosphate.

Superphosphate at 1 cwt. per acre was shown to be superior in its effect to a similar quantity of the other phosphatic fertilizers mentioned. One hundred and twenty-four experiments extending over 11 years in which 1 cwt. of superphosphate per acre has been sown have yielded an average increase over no manure of 4·1 bushels per acre, and it is only in comparatively isolated areas that a paying response has not been obtained. A number of experiments has been carried out comparing 2 cwt. with 1 cwt. of superphosphate. With the exception of a few experiments on better class land there has been no appreciable improvement from the greater

quantity, and it therefore appears that 1 cwt. of superphosphate represents the maximum desirable quantity in the main. Except in a few experiments, potash has failed to increase the yield of wheat. It has never given sufficiently large increases to warrant its use. Not infrequently the depressing effect on the germination as a result of sowing 1 cwt. of muriate of potash with the seed has been reflected in the reduced yield. It can be concluded, therefore, that potash is of no consequence in the manuring of wheat.

Considerable attention has been devoted to the trial of nitrogen in different forms and applied at different times. Favourable results accompanied by high prices for wheat, led to the recommendation of the use of nitrogen in the form of sulphate of ammonia as a spring top-dressing, of wheat which had been previously manured with super. Subsequently less favourable results consequent on extremely dry seasons, and a reduction in the price of wheat, have tended to reduce the economic value of nitrogen for the wheat crop to such an extent that, at the present time, it is obvious that the use of nitrogen is not justified, except on crops which are obviously and markedly nitrogen starved.

Nitrate of soda and sulphate of ammonia represent the main forms of nitrogen which have been under trial; in addition calcium cyanamide, urea and cal-nitro have been tried to a small extent. Results indicate that nitrate of soda and sulphate of ammonia are the most efficient forms of nitrogen for wheat and that nitrate of soda should be applied during September or early October; sulphate of ammonia during August or early September. As a result of the beneficial effect from applying sulphate of ammonia at seeding time or in the late autumn at the Waite Research Institute, this method has been under trial in New Zealand. In some cases the results have been satisfactory compared with applications made in the spring, but in others the injury to germination has been so severe as to render this practice too uncertain to be worth adopting.

Alleged beneficial effect from using carbonate of lime in conjunction with super led to a series of trials being carried out to determine the value of lime used at the rate of 2 cwt. of lime to 1 cwt. of superphosphate and sown with the seed. Increased yields resulted in a few experiments on soil highly deficient in lime. It is obvious that the practice is not of sufficient general benefit to warrant its adoption.

The results of trials on manuring of wheat carried out between the years 1909 and 1915 were summarized by Hilgendorf (4) with the following general conclusion: 1½ cwt. of superphosphate increased the yield by an average of 6·5 bushels per acre (12 trials). The increase, however, was not statistically significant, but was supported by further evidence from trials of 1½ cwt. super compared with ½ cwt. giving a significant increase of about seven bushels per

acre. Hilgendorf states: 'There does not seem any definite indication in favour of manures and this is one of the cases where further work is urgently called for to decide the matter.' He further states 'that the small returns from manure applied to wheat are probably due to some extent at least to the favourable position in the rotation given to wheat on most farms. Wheat is usually taken after grass or after rape following grass, at a stage in which much available plant food may be expected to be present in the soil.' A certain amount of evidence that the prior crop does not effect the results appreciably is shown by an examination of the summarized data (23). The increase due to super on wheat following grass is rather better than where rape, peas or cereal was the prior crop.

2. *Oats*

The manuring of oats follows very closely that of wheat. A few isolated experiments hardly warrant general conclusions being drawn.

In 1931, 62 per cent. of the oat crop in the South Island (240,000 ac.) was manured at the average rate of 1·3 cwt. per acre, as against 77 per cent. of the total of 11,000 acres in the North Island, which received an average of 1·9 cwt. per acre. Reviewing eleven trials on the manuring of oats carried out in the South Island from 1909 to 1916 Hilgendorf (4) draws attention to the very favourable results of the use of 1 cwt. of superphosphate per acre, the average increase being about 7 bushels per acre and highly significant.

3. *Barley*

The manuring of barley as for wheat and oats is represented in the main by the application of about 1 cwt. of superphosphate per acre. A few trials carried out by the Department of Agriculture during the last four or five years in Canterbury and Central Otago indicate an appreciable improvement from superphosphate. The use of nitrogen has given indifferent results in Canterbury but quite good results in Central Otago. (Unpublished results.)

In 1931 about 53 per cent. of the barley sown was manured at the average rate of about 1·2 cwt. per acre. There is obviously considerable scope for an increase in the area manured.

Hewlett (25) has investigated very thoroughly the manuring of barley grown under contract for the Canterbury Seed Company which he estimates to represent, in 1930, 46 per cent. of the total Canterbury crop. Of this amount 90 per cent. was manured as against 70 per cent. of the barley grown on contract in 1924. He estimates the average increase as the result of using 1 cwt. of superphosphate to be about 7½ bushels per acre, equal to 14·6 per cent. of the yield of unmanured crop.

G. Use of Fertilizers on Potatoes

The practice so far as the manuring of potatoes is concerned is best considered in relation to two principal branches of the potato growing industry. These are, firstly, the early potato crop of the North Island (Auckland), and secondly, the main crop of the South Island.

1. *Early Potatoes—Auckland*

The manuring practice in this locality is very unusual and extreme insofar as quantities applied is concerned. The early crop which is planted about May and dug about September or October usually receives from 15 cwt. to 1 ton of fertilizer per acre. In some cases the quantity goes as high as 2 tons per acre. It is probable that earliness resulting from forcing, is the object as much as increased yield.

Superphosphate is now the main phosphatic fertilizer used and in some cases the only one, although it is frequently augmented by the use of bonedust or blood and bone. Sulphate of ammonia or other nitrogenous fertilizer such as blood can be depended on to produce further increases in yield, and up to 4 or 5 cwt. of sulphate of ammonia per acre may be added to 12 to 15 cwt. of superphosphate or other phosphatic fertilizer.

Usually the early potato crop is an extremely valuable one so that even a small increase in yield pays for considerable quantities of fertilizers.

Experimental work has been carried out by the Department of Agriculture in this district since 1926, the general findings of which are that superphosphate is the best form of phosphatic fertilizer and that sulphate of ammonia is the best nitrogenous fertilizer, the quantities recommended being about 12 to 15 cwt. of super and up to 4 cwt. of sulphate of ammonia per acre. Potash has not proved effective in increasing yield except in one or two instances. It is claimed by some that the use of potash is essential to ensure good keeping quality. This point has not been sufficiently investigated to justify comment.

Various methods of applying fertilizers have been tried. Fairly wide distribution over the open furrow at planting time has been compared with concentration in a narrow band along the lines of potato sets. The concentration of the narrow band has been slightly superior to the wider distribution. The application of the whole of the fertilizer at planting has also been compared with the application of half at planting and half as a top-dressing after the plants are through the ground. Applying the whole of the manure at time of planting has proved slightly more beneficial.

The common practice is to take a second crop of potatoes after the first; the second crop is generally manured with a similar fertilizer to that applied to the first, at the rate of up to 10 cwt. per acre. The practice of using such large quantities regularly is of particular interest, and suggests

that a considerable loss of phosphate by fixation in an unavailable form must be taking place. Otherwise soils would rapidly become saturated to the extent that additional application of phosphate would be ineffective. A limited amount of evidence suggests that the quantities of phosphate used are unnecessarily heavy and that as good results on yield may be obtained with smaller quantities. (References (26) and (27) cover reports on practically all the experiments carried out on the early potato crop.)

2. *Main Crop—South Island*

The main fertilizer used is superphosphate which is frequently supplemented by blood and bone and bonedust. Special commercial mixtures so-called 'special potato manures' are also used. These consist in the main of superphosphate but include small quantities of nitrogen and potash, the amount of these added being so small as to be negligible in their effect. As a result of experimental work conducted during the past seven or eight years the use of sulphate of ammonia has become more popular, some growers using up to 1 cwt. per acre in addition to 2 or 3 cwt. of superphosphate. In certain districts this is supplemented by ½ to 1 cwt. of sulphate of potash.

Between the years 1908 and 1916 a series of 48 experiments were conducted in Canterbury and Otago. The results of these have been summarized by Hilgendorf (4). The manures under trial were superphosphate, bonedust, dried blood and potash. The general conclusions arrived at were as follows: 'There can be no doubt that manuring potatoes pays. There is, however, no significant difference between the results of any of the manures. Potash and nitrogen had comparatively little or no effect.'

From 1924 onwards further experiments were conducted on more careful and modern lines. In 1924-25 superphosphate alone was shown to be superior to a mixture of super and bonedust on the one hand and super and Ephos on the other (28). The further trial of slow-acting phosphates was not proceeded with, it being considered desirable to pursue investigations along the lines of determining the effect of varying quantities of super and of additions of potash and sulphate of ammonia to superphosphate.

The results of sixty-seven experiments extending over six years were summarized in the *New Zealand Journal of Agriculture* for September, 1931 (29), and the following general conclusions arrived at:—

(i) On the lighter to medium class potato land superphosphate at 3 cwt. per acre increased the yield to a highly profitable extent. The average increase from 44 trials being 19 cwt. per acre of table potatoes and 5 cwt. of seed.

(ii) Increasing the quantity of superphosphate up to 5 cwt. per acre

caused satisfactory and paying increases on the more fertile potato soils only. Quantities greater that 5 cwt. are not justified in the main.

(iii) Sulphate of ammonia has given promise of yielding fairly consistent increases when added at the rate of 1 cwt. per acre with superphosphate. Thirty-six trials show an average increase of 9½ cwt. of table potatoes and 5½ cwt. of seed. The effect of sulphate of ammonia dressings is induced more by the weather conditions experienced during the growth of the crop than by any differences in soil fertility: in dry seasons the effect is less than in moist ones. The general tendency under dry conditions is for sulphate of ammonia to increase the yield of small rather than table potatoes. The use of 1 cwt. of sulphate of ammonia in addition to 3 to 5 cwt. of superphosphate is now generally recommended.

(iv) Sulphate of potash at 1 cwt. per acre has been tried in 32 trials over a period of six years. The results from potash are influenced more by soil type than by climatic conditions. In certain parts of Canterbury and Southland the effect of potash has been fairly consistent and appreciable while in other parts response to its use has been negligible. Some rather extraordinary results have been experienced in a number of cases. Both sulphate of ammonia and sulphate of potash as single additions to superphosphate have increased the yield, but when the three fertilizers have been used conjointly no improvement over the yields from super plus sulphate of ammonia or super plus potash have resulted. It seems probable that in such cases moisture has been the limiting factor. Rigg states that the best results in the Nelson district have been obtained with a complete fertilizer consisting of 4 cwt. of superphosphate, 1 cwt. sulphate of ammonia and 1 cwt. sulphate of potash per acre (private communication).

Further experimental work at the present time is aiming at the determination of the effect of increasing the quantities of sulphate of ammonia and sulphate of potash and using them in different proportions as additions to superphosphate.

In 1926-27 the broadcasting of fertilizers prior to sowing the seed was compared with applying them in the rows at planting time (30). The results favoured the application with the seed.

Some of the newer concentrated fertilizers, viz., American ammophos and the German diammonphos were compared with equivalent mixtures of super and sulphate of ammonia (29). In some cases there was no difference, but in others the simple mixture proved superior to the concentrated fertilizers although the latter were never superior to the simple mixtures.

Statistics in 1931-32 season show that 57 per cent. of the total area planted in the South Island was manured at the average rate of 3 cwt. per acre.

The manures are applied along with the seed by means of a potato-planting machine or more commonly from a manure box attached to the back of the plough. Ploughing with double or three-furrow ploughs and planting the potatoes by hand in the back furrow is the most common method of planting. In some cases, however, the land is ridged with a moulding plough and the potatoes planted by hand, after which the ridges are split and the earth thrown back over the planted potatoes. When this method is adopted fertilizers are applied by hand along the rows, but in the absence of a mechanical fertilizer sower it is probable that in the majority of cases crops are unmanured.

In view of the almost universal response to fertilizers, superphosphate in particular, it is obvious from the figures quoted above regarding the percentage of area manured, that there is considerable scope for the greater use of fertilizers on the potato crop.

H. Use of Fertilizers on Peas

The most common practice in the manuring of peas is to drill in from 1 to 2 cwt. of superphosphate with the seed. So far as the writers are aware there are no records of experiments having been conducted on the manuring of this crop in New Zealand.

I. Use of Fertilizers on Linseed

A comparatively small area, from 3,000 to 12,000 acres, of linseed is grown each year. In spite of its reputation as an exhausting crop, linseed is not regarded as being particularly responsive to manures. There seems no reason, however, why the use of 1 cwt. of superphosphate and possibly some readily-available nitrogenous fertilizer should not prove of considerable economic value in the growing of this crop. Experimental work is needed to determine this point.

J. The Technique of Field Experiments on Annual Crops

In 1926 a description of the methods adopted in carrying out field experiments on annual crops was given in the *Journal of Agriculture* (31). Although the technique has undergone various modifications since 1926, the description given is sufficient to indicate the general nature of the methods adopted by the Department of Agriculture. More modern equipment for use on cereal experiments was illustrated in the *Journal of Agriculture,* Vol. 38, No. 4, April, 1929.

III. CONCLUSION

The development of the farm lands of New Zealand has only just begun. The country is only now emerging from the pioneering stage. This is best shown by the general outlook upon farm management. Until the

economic depression altered values and caused such universal distress amongst the farming population of the Dominion, the farmers had enjoyed an uninterrupted period of many years' duration of rising prices and rising land values. Speculation, especially in the North Island, took the place of the art of farm management. The cream of the fertility of the land was skimmed off and rising values were relied upon to provide for the future. Top-dressing was practised only where lack of phosphates was proved to be a serious limiting factor in production. The soil was looked upon as a storehouse of wealth awaiting exploitation with no thought of the future. This has been a feature of the agricultural adolescence of all new countries. Sooner or later, the viewpoint must change and the soil must be viewed rather as a medium for converting fertilizers into farm produce. Complete manuring and the replacement annually of all plant foods removed or sold off the farm combined with a consideration of the natural resources of plant food in the soil has become a recognized practice in all mature countries. At present in New Zealand the overwhelming importance of phosphates limits the further immediate development of this concept of complete manuring.

Provided that readjustments between costs of production and prices of farm produce enable agriculture once more to be a profitable undertaking in New Zealand and the overseas markets are available there is no doubt that increased output from the Dominion will occur. The problem of raising the standard of production from the farm lands of New Zealand involves itself mainly with two phases. The easily accessible and fertile plains will probably carry a higher proportion of purely dairy farmers. There is no doubt that by more skilful management these fertile districts of New Zealand are capable of producing an output much greater than at present. Improvement in farm management will have to be effected along the lines of subdivision, the greater use of fertilizers, better control of grazing, use of the best strains of pasture plants, the better utilization of surplus feed and better provision of supplementary crops in some districts. The future of the hill country sheep farmer is more difficult to prophesy. Much of the poorer hill country which is rapidly reverting to secondary growth can only be kept in profitable farming in times of high prices for farm products. It is probable that much of this type of land will be permanently abandoned or used for afforestation. The use of cattle on such country is the largest factor in preventing deterioration. At present the use of cattle in this way although unprofitable in itself is really a means of avoiding greater potential loss due to further deterioration of the country. If the hopes for the development of the export trade in chilled beef from New Zealand are realized, the economic aspect of this system of farming may be considerably changed. If the better lands can be developed more

economically and at a less cost of human endeavour and the total production of the Dominion thereby increased, the abandonment of farming on the poorest hill country, that perhaps should never have been settled, may be a forward step rather than a retrograde one. On the other hand, there is a very large area of hill country in New Zealand that can be farmed without this constant combat against secondary growth. It is safe to predict that such land will continue to produce and at a higher level. Top-dressing will become more common and better systems of management will be practised.

The trend during the last five years in New Zealand has been definitely towards more intensive grassland top-dressing with the aim of maintaining permanent pasture in place of a system of more or less temporary leys relying upon the rejuvenation following each ploughing to maintain fertility. There are many farmers and others who hold that the increased top-dressing of pastures and the reduction in arable cropping has been responsible for many stock ailments and poorer quality of New Zealand export products. There is a widely-held view that the intensive treatment of grassland increasing stock-carrying capacity beyond a certain degree without fairly frequent ploughing to 'sweeten' the land must reach a limit especially on sheep farms, and that New Zealand will see a return to a greater use of arable crops even under North Island conditions. On the other hand the modern treatment of grassland is such a new project that we are only beginning to understand its possibilities. Obviously, the relationship between supplementary cropping and permanent pasture is mainly influenced by climate. Only since 1922 has the world as a whole and the British Empire in particular begun to realize the potentialities of grassland properly managed. One thing is certain—New Zealand has more to gain by an intensive study of grassland problems than almost any other country, and furthermore no country is so likely to develop a technique to meet modern conditions in grassland farming.

The rapidity of the progress likely to be made, while being governed principally by the prices of our primary products in relation to land values (and capital costs), will also depend very materially on the extent of the knowledge gained in the use of quantities and kinds of fertilizers. Although at the moment phosphates are of overwhelming importance there are considerable areas where the other principal fertilizers—lime and potash—are equally important. Their importance has to some extent been overshadowed by the recognition of the almost universal need for phosphates.

Whilst research into the classification and fundamental properties of New Zealand soils has been undertaken to a limited extent with undoubted benefit to those interested in fertilizer practice, there is abundant evidence to indicate that an active campaign into the broad question of whether particular treatments do or do not give outstanding responses, would assist

very materially in guiding farmers in the use of various management and fertilizer practices. The response-to-manure-survey of grasslands with small observational experiments indicates the importance of acquiring further knowledge.

Such a system of investigation has serious and obvious disadvantages and must be regarded merely as a step toward more searching enquiry into the economic aspect. The latter does not present great difficulties when annual 'cash' crops are being dealt with as the carrying out of numerous experiments with varying conditions presents no serious obstacles. Where the final product is meat, milk or wool the economic investigation is liable to become so unwieldy as to permit so few experiments being carried out that there is the danger that they are not sufficiently representative. In this case the rough and ready type of investigation may be regarded as the guide to practice which, when sufficiently well established, provides material for the economic survey of farm practices. A good example of the possibilities of investigating the economic aspect of manuring of cash crops is provided in the series of experiments on the manuring of wheat discussed in this article. On the other hand, the economics of manuring of grassland were not determined in a general way until Fawcett (9) carried out a survey of the management of 206 dairy farms which showed that the high per acre utilization of fertilizers was associated with high per acre production and low cost of fertilizers per pound of butterfat produced. Thus practice in this case followed the numerous simple experiments and demonstrations which in themselves were sufficiently convincing to warrant the general adoption, in the North Island, of phosphatic manuring. Farmers were convinced that the practice was highly remunerative because of their experience, although there was very little evidence to indicate the extent to which the practice paid.

In the opinion of the writers the most useful avenue for the more detailed investigations into the use of fertilizer on grassland is in the study of time, methods and frequencies of applications. Obviously, such investigations must be carried out in places where the particular type of fertilizer under investigations is known to give a ready response. (It would be useless for instance to study the effect of potash on a soil not responsive to potash applications.) The findings of such investigations would be fairly generally applicable to all soils of a similar type and under fairly similar climatic conditions to that under investigation.

The importance of a study of the effects of fertilizers on the yield of pastures at different seasons is emphasized by the growing demand for a more uniformly distributed supply of our dairy products to the home market. That some fertilizers can be used in such a way as to influence production in off seasons of the year has been exemplified by the work at the Department of Agriculture Experimental Farm at Marton (10).

It is fully realized that fertilizer practices are only one aspect of the business of farming and that they must be considered in relation to the system of farming as a whole. The scope of this chapter does not permit of consideration being given to other factors. It is certain, however, that the well-being of New Zealand is intimately concerned with the use of artificial fertilizers and the more proficient the farmer can become in their use, the greater will be the prosperity of this country.

Acknowledgment

The statistical information quoted in this article has been compiled from the following sources:—

The New Zealand Journal of Agriculture.
New Zealand Official Year Book.
Statistical Reports on Factory Production.
Statistical Reports on Trade and Shipping.

In addition a large amount of valuable information has been obtained from a thesis entitled 'Fertilizers in New Zealand, 1867-1929' submitted by Mr. L. W. McCaskill to the University of New Zealand for the degree of Master of Agricultural Science.

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Bibliography

The Biblography of literature cited will be found in the Appendix.

CHAPTER XX

SHEEP FARMING

BY E. J. FAWCETT

I. Introduction. II. Factors Influencing Sheep Distribution—A. Climate—B. Topography and Soils—C. Markets. III. Distribution of Sheep Flocks—A. Density by Land Districts—B. Breeds: 1. Cross-bred; 2. Half-bred; 3. Breed Distribution. IV. Statistics—A. Movement of Total Numbers—B. Analysis of Flocks—C. Number of Flocks—D. Size of Flocks—E. Lambing—F. Relationship to Cattle—G. Wool Yields —H. Killings of Sheep and Lambs—I. Wool Production—J. Mortality. V. Management—A. Wool Farms—B. Fat Stock Farms—C. Hill Country Farms—D. Graduations in Sheep Farms—E. Sheep Farming in Relation to Dairying—F. Sheep in Relation to Agricultural Holdings—G. Cattle in Sheep Farm Management—H. Labour—I. The Farm Plan—J. Machinery. VI Capital Position. VII. Income. VIII. Conclusion.

I. INTRODUCTION

SHEEP FARMING has represented the most important primary industry in New Zealand right throughout the development of the Dominion. Prior to the introduction of refrigeration, practically the only exports possible were wool, tallow and hides, and thus we find as far back as 1881 that the total flocks numbered approximately 13,000,000 sheep.

The ability to export meat to Great Britain consequent upon the perfecting of refrigeration technique, opened up a new era in the Dominion's economic history, and sheep numbers rapidly increased. To-day, sheep farming represents a highly specialized occupation, necessitating as it does a sound business knowledge combined with the ability to interpret and apply the results of research in management and breeding principles.

The price depression which became acute in 1930 has affected the sheep industry[1] to a more marked degree than any other branch of primary production, with the result that the value of exportable sheep products has taken second place to dairy products in the external trade of the Dominion. Although the possibilities of rapid expansion are not so great in respect of meat products as in dairy produce, the history of past development shows ability to change the nature of the supply fairly rapidly and very materially. The continuance of the increasing attention to lamb production in farm and stock management may be expected to result in full exploitation of any overseas demands for meat of this type.

II. FACTORS INFLUENCING SHEEP DISTRIBUTION

Sheep farming has many and diversified ramifications. Animal types vary to such an extent that sheep can be used to exploit a wide range of conditions, gross returns to the farmer varying according to the class of sheep used and the system of management practised. Nature has imposed

1. Chiefly in respect of Wool.

limiting factors which may be discussed under the broad headings of climate, topography and soils.

A. Climate

From a climatic viewpoint, practically the whole of New Zealand, with the exception of mountain peaks and ranges of excessive altitude, is suitable for sheep farming in one or other of its varied forms. On high country of the South Island, where snow is often experienced during the winter months, and where pastures are of an inferior type, it is essential that a hardy breed of animal be used to withstand climatic and feeding conditions. Carrying capacity on this class of country varies from one sheep to three acres to as low as one to seven or eight acres. The underlying principle of management is to produce wool, and merinos are therefore used on account of their ability to withstand hard climatic conditions, and the higher value of the fine-quality wool produced.

Rainfall as a limiting factor plays but a small part in the distribution of sheep flocks, the only area where stocking is precluded being a limited portion of the arid and semi-arid plains of Central Otago. Even here, the introduction of irrigation is gradually narrowing the submarginal area. Where rainfall is uniform, dairying has replaced sheep farming to a large extent provided the configuration of the land is suitable, thus gradually driving sheep back to higher altitudes in such districts.

B. Topography and Soils

As indicated under 'climate' above, sheep may be pastured on country ranging from sea-level up to snow-line through judicious exploitation of the various sheep types. The configuration of the country does not, with the exception of extreme cases, represent a limiting factor in sheep farming, but the distribution and density of sheep flocks is affected by the potential density of dairy cows as influenced by topography of the country, rather than by the features of the land itself. Thus we find large areas of the North Island of an altitude up to 1,600 feet mainly stocked with dairy cows although eminently suited to sheep farming. If the incidence of dairying is ignored, it can be broadly stated that a combination of configuration of the country, with its wide range of soil types and varying climatic conditions, determines the class of sheep which are most advantageously farmed, and the type of farm management practised, rather than limits the scope of sheep in one form or another as producing units.

C. Markets

In a country such as New Zealand, with its scattered population and no great industrial centres, the local market does not exert any appreciable influence on the distribution or density of sheep flocks. The demand of the larger cities affects local prices to some extent, but supplies are usually

drawn from a wide radius. In each of the counties there are odd farms catering for the early lamb trade, but, as a general rule, no special type of management is practised to meet local markets.

In respect of export trade, freezing works have been established at strategic points to cater for the requirements of districts, the object in the past being to reduce transport of livestock to a minimum. This endeavour has led to the erection of unnecessary works, to the cost of many sheep farmers who have been financially interested in the venture.

III. DISTRIBUTION OF SHEEP FLOCKS

A. Density by Land Districts

Although sheep flocks are spread over the whole of the improved areas of occupied lands, the range of density shows wide variation. It should be understood that large areas of individual counties are unsettled, and that actual density on used land is higher than indicated, but in the absence of definite zoning of sheep flocks, a true presentation of density cannot be given. The relative position of the land districts is indicated, however, in Table LXXXVII, the only upsetting factor being the varying ratios of productive to unproductive land.

Table LXXXVII

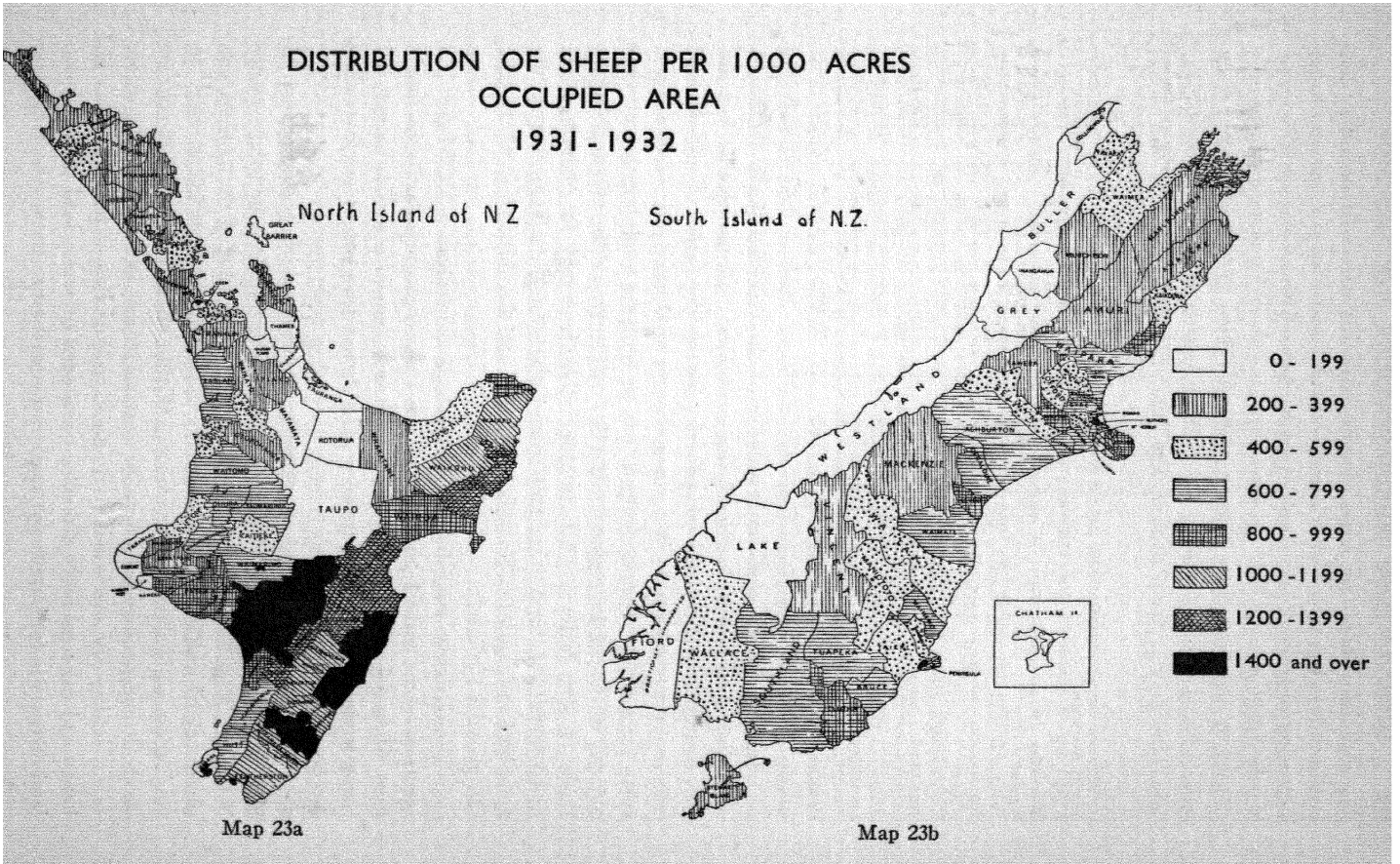
Numbers of Sheep Shorn per 1,000 Acres: Season 1933-34

NORTH ISLAND.		SOUTH ISLAND.	
North Auckland	304	Nelson	306
Auckland	330	Marlborough	413
Gisborne	1,037	Westland	54
Hawkes Bay	1,342	Canterbury	537
Taranaki	516	Otago	409
Wellington	1,083	Southland	624

The influence of cattle (dairy and others) on the density of sheep population and the relative importance of sheep and cattle stocking can be given on a land-district basis, and forms an appropriate background for a clearer understanding of the replacement of sheep by other stock.

Table LXXXVIII is based on total area of land occupied, and it will be noted that certain land districts have a very low stocking capacity due to unproductiveness of large tracts of country held by private owners. This does not, however, affect the validity of stock ratios. It will be appreciated that where stock units in terms of sheep exceed one per acre of land occupied, the suitability of the district for dairying determines the density of sheep flocks to a large extent.

The whole of the North Auckland district has a well-distributed rainfall with intermittent droughts in certain areas. The average carrying capacity in stock units is about 174 per 100 acres, which is comparatively high in view of the undeveloped state of large areas of gumland, ironstone and intractable



Map 23a

Map 23b

clay regions. This is accounted for by extensive areas of heavy flats and fertile valleys having a high carrying capacity, and used for dairying to an increasing degree. Thus sheep represent but a fifth of the stock units of North Auckland.

TABLE LXXXVIII

Land Districts	Total Sheep Units per 100 Acres	Percentage of Stocking by Sheep and Cattle		
		Sheep	Cattle	Total
North Auckland	174	20·4	79·6	100·0
Auckland	189	19·6	80·4	100·0
Gisborne	194	55·8	44·2	100·0
Hawke's Bay	202	66·3	33·7	100·0
Taranaki	224	25·8	74·2	100·0
Wellington	209	54·6	45·4	100·0
Nelson	68	48·1	51·9	100·0
Marlborough	55	77·5	22·5	100·0
Westland	27	21·0	79·0	100·0
Canterbury	70	79·1	20·9	100·0
Otago	53	78·1	21·9	100·0
Southland	102	63·8	36·2	100·0
Dominion	122	50·3	49·7	100·0

Statistically the stock unit position of the Auckland land district is very similar to North Auckland, but conditions determining this fact are very dissimilar. Included in this district are the large areas of undeveloped pumice country of Taupo, Rotorua and parts of Whakatane. Undeveloped areas account for approximately 50 per cent. of the total, but the carrying capacity of the coastal regions of the Bay of Plenty and the middle Waikato Basin is very heavy. This country is ideally suited for dairying, and sheep-farming naturally assumes second place, with the exception of the more broken counties of Kawhia and Raglan and the northern portion of the Coromandel Peninsula.

The Gisborne land district, with a total unit capacity of 194 per 100 acres, is of an entirely different nature from those previously discussed. Both Gisborne and Hawke's Bay land districts are of a similar nature, the latter having a stock-unit capacity of 202, and for present purposes they can be discussed together.

The land is comprised of coastal hill country which is looked upon as ideal for sheep-farming. Although broken by fertile flats, dairying assumes but minor importance. Analysis shows a fair proportion of the total stock in the form of cattle, but these are in the main used on hill country in conjuction with sheep management. Within these favoured hill-country sheep-farming zones, a wide range of management is found, varying from farms selling dry sheep and store stock, to the other extreme, where fat lambs and fat stock only are sold. The area of waste land in these two land districts is comparatively small to the total area occupied.

When we study the land district of Taranaki, on the western seaboard, it is found that the opposite conditions prevail to those found on the eastern coast. With an average sheep-unit capacity of 224 to 100 acres, only 25·8 per cent. is represented by sheep—the remaining 74·2 per cent. being almost wholly dairy cows. In certain counties in this area sheep are practically unknown, with the exception of a few being run for house mutton on dairy farms, and it is only when the foothills and back country are studied that we find sheep in any quantities.

The Wellington land district is very large, and embraces all classes of country from very rich dairying flats to low-carrying capacity hill-country sheep farms. Thus we find, of the average of 209 stock units per 100 acres, 54·6 per cent. is represented by sheep and 45·4 by cattle. The proximity to the markets of Wellington has also an influence on the utilization of certain classes of country where, though quite unsuitable, dairy cows are run for town supply. The hill-country of the eastern portion of the Wellington district is a continuation of the good coastal country of Hawke's Bay and Gisborne, but is definitely intersected with large tracts of land suitable for dairy cows. Thus we find sheep being relegated to areas of a higher altitude in such localities. On the west coast from Palmerston North to Wanganui, there are large tracts of flat, fertile country most suitable for dairying, but used as specialized stock-fattening farms.

The South Island is quite distinct from the North Island in many of its characteristics. It has on the whole a very much larger area of land which has not been exploited owing to the unsuitability of its location. The Nelson land district has for instance a stock-unit capacity of 68 per 100 acres, of which 48·1 per cent. are in the form of sheep. This region is made up on the average of definitely low-quality land, with the exception of restricted areas, notably in the Waimea Plains. There are also very large areas which are entirely unexploited.

The Marlborough land district resembles Nelson to a considerable extent, particularly as it has a large proportion of land of a very low-production capacity. Sheep, however, are relatively more important than cattle—77·5 per cent. of the total capacity being represented by the former.

Westland is comprised mainly of undeveloped areas of the west coast of the South Island, and it is only of recent years that serious attention has been directed towards the possibilities of developing livestock farming in this region.

The land district of Canterbury embraces the well-known Canterbury Plains, and for the greater proportion of its area has a definitely low annual rainfall, which owing to its seasonal precipitation, makes Canterbury the main cropping region of New Zealand.

From a sheep farming viewpoint it can be divided into two fairly distinct zones, namely, high country, where the class of sheep used range

from half-bred to pure-bred merinos, and the plains where stock-breeding and fattening is carried on in conjunction with rotational cropping. Here we find extensive areas of mountain range and infertile country entirely unsuited for any class of stock. A stocking capacity of 70 sheep units per 100 acres is a reflection of the percentage of unproductive land in the district. Of the total stock units, 79·1 per cent. are represented by sheep.

The land district of Otago has somewhat the same characteristics as Canterbury, particularly with regard to the ratio of unproductive to productive land. The low-lying country is mainly of an undulating nature, particularly in the southern portion. Although cropping is carried out to a considerable extent, it does not assume such large proportions as on the Canterbury Plains. Of the total stock-unit capacity of 53 per 100 acres 78·1 per cent. is represented by sheep.

Southland is the heaviest stock-carrying district of the South Island, having a capacity of 102 sheep units per 100 acres, of which 63·8 per cent. are sheep. Here we find the dairy cow coming in as an important component of total livestock. Sheep farm management of Southland is to a great extent bound up with rotational cropping, and the production of supplementary feed necessitated by a colder climate.

B. Breeds

The breeds of sheep used in New Zealand can be grouped under two headings:—

(1) Registered pure-breds and sheep of a distinctive breed but not entered in stud-stock books.

(2) Cross-breds.

Of the above groups, cross-breds represent by far the greater proportion of the total flock of the Dominion, the average position of the various breeds over the last 10 years being as follows:—

Table LXXXIX

Breeds of Sheep in New Zealand

Percentage Distribution on the Average, 1924-1933

Breed.	Per Cent.
Cross-bred	71·66
Romney	13·20
Half-bred Merino	5·47
Merino	4·00
Corriedale	3·73
Southdown	0·60
Lincoln	0·42
Border Leicester	0·40
English Leicester	0·34
Other breeds	0·10
Shropshire	0·08
Total	100·00

During the past 10 years there has been definite movement in the percentage representation of different breeds or types within the total sheep flock. The trends of particular interest are the decline in Lincoln, Border and English Leicester, and the upward tendency in Southdown and Corriedale. These breeds, however, represent such a small percentage of the total that such movements are not generally noticeable. There have been fluctuations in the major type also, these being of a compensating nature as between half-bred and other stock. These trends are shown in detail in Table XC.

TABLE XC

Breeds of Sheep in New Zealand

Changes in Relative Percentages of Total Sheep, 1923-1932

Year	Cross-bred	Half-bred	Lincoln Border Leicester English Leicester	Merino, Romney, Shropshire, Other Breeds	Southdown Corriedale
1933	67·50	8·10	0·80	18·00	5·60
1932	67·85	7·40	0·77	18·64	5·34
1931	69·97	6·34	0·84	17·60	5·25
1930	73·47	4·34	0·85	16·58	4·76
1929	72·88	4·80	0·95	16·74	4·63
1928	71·48	4·94	1·14	17·79	4·65
1927	72·22	4·79	1·04	17·72	4·23
1926	73·50	4·79	1·25	16·32	4·14
1925	72·06	5·55	1·49	17·23	3·67
1924	72·05	6·09	1·39	17·23	3·24
1923	71·12	5·69	1·86	17·91	3·42

Before studying breed distribution in greater detail, it is desirable that some definition of the two important groups of cross-bred and half-bred be given.

1. *Cross-bred.*

The term 'cross-bred' is used to define any long-woolled sheep which has been produced by (1) crossing any of the long-woolled breeds with each other; (2) crossing any long-woolled breed with the progeny from the first cross; (3) crossing any long-woolled ram with Down or Ryeland ewes; (4) crossing any long-woolled ram with the progeny from (3) above; (5) mating cross-breds with each other.

The wool produced by any of the above crosses is termed 'cross-bred,' and ranges in quality from 34's to 50's. In the South Island particularly, there is a further breakup of 'cross-breds' into 'three-quarter-bred,' this term being applied to the progeny of any long-woolled ram with 'half-bred' ewes, or by mating 'half-bred' rams with any long-woolled ewe. The wool produced from such crosses falls within the 'cross-bred' type, with a range of from 46's to 50's quality.

2. Half-bred

This term covers: (1) The progeny of any distinct breed of long-woolled ram mated with merino ewes; (2) the progeny of merino rams mated with any breed of long-woolled ewe; (3) the progeny from the mating of half-bred with half-bred. The wool produced by sheep from the above crossing is termed 'half-bred' and ranges from 48's to 56's quality.

The progeny of merino rams mated with half-bred ewes, or of half-bred rams mated with merino ewes are commonly termed 'quarter-bred,' but the wool produced falls within the 'half-bred' range, and is usually from 54's to 56's quality.

3. Breed Distribution

The distribution of breeds throughout the Dominion can best be studied from three aspects, namely, (1) stud sheep which are entered in flock-books; (2) sheep of a distinctive breed, but not entered in flock-books; (3) cross-breds and those not otherwise enumerated.

Stud sheep which are entered in flock-books amounted to 406,573, and represented but 1·47 per cent. of the total Dominion flock as at April 30, 1933. Of this total, the Romney Marsh breed is of greatest importance in both islands. The main point of difference between North and South Island is that the North is mainly concerned with Romney and Southdown studs, with Lincoln and Ryeland of small moment, whereas in the South Island, Merino, Romney, English and Border Leicester, Southdown and Corriedale are all of considerable importance.

It can be assumed within reasonable limits that the incidence of stud registrations reflects the type of flock sheep aimed at, and the systems of management employed in the respective districts.

The preceding sentence is found to be materially correct when the distribution of sheep of distinctive breeds is studied. Thus we find that of flock sheep of this type, Romney characteristics predominate in the North Island. The incidence of Southdown blood is of minor importance so far as numbers are concerned, whilst the other fine-wool breeds are negligible.

In the South Island distinctive breeds are more prevalent than in the North, the effect of Merino on the composition of the flock being very apparent. This is particularly reflected in the enumeration of half-breds, which, whilst present in the North to a limited extent, only assume real importance under the harder conditions of the South Island. These conditions also suit the Corriedale breed. Romney Marsh, on the other hand, is relegated to fourth place so far as distinctive breeds are concerned.

The great bulk of the Dominion's sheep flock enumerated as 'cross-breds' are necessarily of a mixed nature, with gradations in breeding from comparatively pure strains to sheep of very uncertain breed. It is this wide

variation in over two-thirds of the total flock which presents a problem to those aiming at wool improvement. The farmer himself can and does assist in this respect through the culling of his flock, but it is the stud breeder who is mainly responsible, and to whom the average farmer looks to supply him with rams of a pure-wool type.

The determining factor in breed distribution is the utility of sheep types as determined by their adaptability to climatic conditions, and to the production of meat and wool according to the aim of any particular system of farm management practised.

It is true that stud breeders influence the incidence of certain breeds in isolated instances, and also sentiment may enter into individual farmers' decisions in choosing flock rams. These considerations are, however, of small moment when compared with the major question of utility.

Under normal conditions meat and wool assume approximately equal importance in the gross revenue from sheep in the Dominion. The rapid development of the fat-lamb trade has, however, exerted an overriding influence on sheep types, the aim being to produce a ewe which, whilst carrying a heavy fleece of saleable wool, is capable of producing and mothering a lamb which combines rapid growth and fattening propensities.

The degree of success attending such an aim depends to a considerable extent on the class of feed available, which in its turn is dependant on climatic conditions. The latter factor determines the class of foundation stock carried over large tracts of country. Thus it is found that Merinos are particularly adaptable to the hard conditions of the high country of the South Island, and it was on the progeny of Merino ewes crossed with long-woolled rams that the famous 'Canterbury lamb' trade was built up. Merinos, however, are not peculiar to Canterbury, but are scattered throughout the hill country of the South Island, from the Kaikouras to the Lake District. The early history of the fat-lamb trade in the South Island is bound up with the utilization of recognized English breeds of long-woolled sheep, but with the standardization of the trade, breeding principles have also become well defined throughout both islands.

Although the influence of finer-woolled breeds still persists in the South, the Romney and Romney cross is favoured in certain localities, particularly in the lower country of Marlborough, Nelson and Westland. Even in Canterbury, Romney strains have been introduced of recent years in increasing numbers owing to an insufficient supply of Merino ewes. This has been accompanied by a greater use of Southdown rams in the production of fat-lamb carcases.

In the Otago-Southland areas, fine-woolled sheep of the Merino, Corriedale, Half-bred, and Southdown types still predominate, but again Romneys are present in increasing numbers.

In the North Island, favoured as it is with a more equable climate, the fine-woolled breeds have never been an important factor in sheep management. A plentiful supply of easily-grown pastures, consequent upon the felling of large tracts of bush, has made the establishment of the quick-growing, heavy-framed, and long-woolled sheep a simple matter, and thus the Romney Marsh has held undisputed sway as a foundation for practically all flocks. The use of Southdown rams is extensive in the production of fat lambs from long-woolled ewes, and of recent years Corriedales have been used to some extent.

IV. STATISTICS

A. Movements of Total Numbers

The enumeration of sheep flocks of the Dominion has been well recorded practically from the first settlement by Europeans. Although the size of the sheep flock during the latter half of the last century is not of great importance at the present day, the development as demonstrated by such movements is of considerable historic interest. Thus we find that in 1858, New Zealand recorded 1,523,324 sheep. Ten years later the figure stood at over 8,000,000, and in the next decade rose to 13,000,000. In the late 'seventies and early 'eighties a condition of depression prevailed, and the sheep flock fell by over half a million between 1878 and 1882. The introduction of refrigerated transport at this stage opened up a new era in the history of sheep-farming, and since that date the flock of the Dominion has increased with fluctuations up to 1932. The trend of development is shown in Table XCI:

Table XCI

Number of Sheep in New Zealand by Quinquennial Periods, 1882-1933

1882	12,408,106
1887	15,155,626
1892	18,570,752
1897	19,687,954
1902	20,342,727
1907	20,983,772
1912	23,750,153
1917	25,270,386
1922	22,222,259
1927	25,649,016
1932	28,691,788
1933	27,755,966

B. Analysis of Flocks

When speaking of the movement in sheep numbers, it is generally accepted that the total flock provides an accurate index. This supposition is not correct, and in fact can be quite misleading to the casual observer. The history of the sheep industry shows that, during price depressions,

mature stock is killed off in increasing numbers to provide much-needed ready money. The same practice pertains to wether hoggets, and in extreme cases may even pertain to ewes.

So long as the ewe flock is maintained, the powers of recuperation are intact, and with a slight improvement in wool prices, the total flock can be rapidly built up.

Therefore, the position of the sheep flock at a particular date should be studied on a breeding-ewe basis rather than on total sheep. The movement of the component parts of the total flock as shown in Table XCII are of great importance, portraying as they do the trend of the aim in management as well as the results of economic stress. Prior to 1922, the Dominion's meat trade was dominated by mutton, but the realization by farmers that it was more profitable to produce larger quantities of rapidly-maturing high-priced meat, in the form of lamb, resulted in the exploitation of the ewe flock, which is now reflected in increased numbers and a complete reversal of the mutton-lamb position as pertaining in, and prior to, 1921.

TABLE XCII

Analysis of Sheep Flocks

Year	Rams	Breeding Ewes	Dry Ewes	Lambs	Wethers	Total
1923	330,055	13,063,003	817,932	6,318,822	2,551,627	23,081,439
1924	332,814	13,076,094	1,046,450	6,513,386	2,807,032	23,775,776
1925	355,579	13,715,223	883,766	6,529,724	3,063,663	24,547,955
1926	370,535	13,948,252	1,079,735	6,294,036	3,212,435	24,904,993
1927	388,274	14,831,730	831,691	6,522,347	3,074,974	25,649,016
1928	396,551	15,534,051	869,127	7,309,634	3,024,647	27,133,810
1929	422,331	16,608,155	882,698	7,849,063	3,289,135	29,051,382
1930	448,617	17,564,175	1,077,672	8,382,907	3,367,916	30,841,287
1931	461,998	17,608,729	1,210,714	7,081,523	3,429,552	29,692,516
1932	469,051	17,063,060	1,268,178	7,160,673	2,730,826	28,691,788
1933	463,619	17,209,697	997,886	6,669,581	2,415,183	27,755,966

The headings under which sheep are enumerated are simple, but the item 'dry ewes' may be somewhat confusing. The enumeration is made as at April 30 each year, after the breeding flock has been culled on quality of wool and suitability for breeding purposes. Culling on wool quality mainly affects two-tooth ewes, this class being culled very heavily in flocks where wool is of major importance. Culled ewes are carried through the winter, and are sold and killed as required mainly for local consumption. 'Lambs' covers replacement ewes and wether hoggets, and a considerable margin of safety has to be allowed for hogget mortality during the winter months. It will be noted that for the years 1931, 1932 and 1933 this margin of safety has been reduced, and accounts for the lowering of the total flock to a large extent. 'Wethers' may be of any age, but as a rule

they are not held beyond four-tooth, except in country mainly suited for dry stock. The drop in replacement 'lambs' plus heavy killings has resulted in a decrease of this class during the past two years.

The percentage movement of the various sheep classes as shown in Table XCIII is of considerable importance, particularly with respect to the ewe flock. It will be seen that the efforts to increase ewes has been successful in that this class of stock has definitely assumed greater significance in the total flock composition during the past 10 years.

TABLE XCIII

Percentage Distribution of Sheep Classes

Rams	Breeding Ewes	Dry Ewes	Lambs	Per Cent.		Year
				Wethers	Total	
1·43	56·59	3·54	27·38	11·06	100·00	1923
1·40	55·00	4·40	27·39	11·81	100·00	1924
1·45	55·87	3·60	26·60	12·48	100·00	1925
1·49	56·01	4·33	25·27	12·90	100·00	1926
1·51	57·83	3·24	25·43	11·99	100·00	1927
1·46	57·25	3·20	26·94	11·15	100·00	1928
1·45	57·17	3·04	27·02	11·32	100·00	1929
1·46	56·95	3·49	27·18	10·92	100·00	1930
1·55	59·10	4·07	23·77	11·51	100·00	1931
1·63	59·47	4·42	24·96	9·52	100·00	1932
1·70	62·00	3·60	24·00	8·70	100·00	1933

C. NUMBER OF FLOCKS

The total number of sheep flocks in the Dominion has shown steady increase for a long period of years. This is but a natural result of the breaking in of virgin land, and subsequently the subdivision of large tracts into farms of a one-family type. In 1914, a total of 22,202 flocks was recorded, and this figure remained comparatively stationary for some years. In 1933, the number had increased to 30,063, and it is to be expected that a steady upward movement may take place with the gradual process of settlement and changes in farming systems.

D. SIZE OF FLOCKS

Contrary to the general opinion, large flocks are the exception rather than the rule, for though the Dominion flock average is in the vicinity of 1,000 sheep, less than 30 per cent. of the total flocks exceed this number.

In Table XCIV, showing the percentage of total flocks of different sizes, it will be seen that the small flock, usually run on a mixed farm in conjunction with cropping, is of great importance in the farming economy of the country.

TABLE XCIV

Size of Flocks

Period	1-200 %	201-500 %	501-1000 %	1001-2500 %	2501-5000 %	5001 and Over %	Total %
1933	29·7	23·7	20·8	18·2	5·3	2·5	100·0
1928–32 ..	24·3	23·9	22·5	20·7	6·0	2·6	100·0
1923–27 ..	24·5	25·6	22·3	19·0	5·8	2·8	100·0
1918–22 ..	25·6	25·7	21·9	18·3	5·5	3·0	100·0
1913–17 ..	25·3	25·5	21·2	18·6	5·8	3·6	100·0
1908–12 ..	29·4	25·3	19·8	16·6	5·1	3·8	100·0

Although flocks of various sizes are more prevalent in some districts than in others, there are no definite regional peculiarities in this respect. The most noticeable feature is the incidence of the larger flock classes in Poverty Bay and Hawke's Bay, where the nature of the country is not conducive to close subdivision. In Table XCV the percentage incidence for the various-size classes is shown for the six land districts, the figures being based on an average of the five years 1929 to 1933.

TABLE XCV

Size of Flocks by Land District

District	1-200 %	201-500 %	501-1000 %	1001-2500 %	2501-5000 %	5001 and Over %	Total %
Auckland ..	33·1	28·0	20·6	14·6	3·0	0·7	100·0
Poverty Bay, Hawke's Bay	12·8	14·8	22·1	30·6	12·5	7·2	100·0
Wellington, West Coast	18·8	21·3	23·3	25·3	8·0	3·3	100·0
Marlborough, Nelson, Westland	40·0	28·7	17·0	10·4	2·5	1·4	100·0
Canterbury, Kaikoura	21·4	27·1	24·4	19·6	5·5	2·0	100·0
Otago	25·0	23·4	24·0	20·8	4·8	2·0	100·0
Dominion ..	24·3	23·9	22·5	20·7	6·0	2·6	100·0

E. LAMBING

The average lambing percentage is based on the number of lambs tailed in relation to the total ewes put to rams. The Dominion average has shown considerable fluctuation over a period of years, but the general level has not changed. Differences for individual years are mainly due to seasonal conditions of which moisture precipitation and temperature at, and subsequent to, lambing are of major importance.

TABLE XCVI

Dominion's Lambing Percentages

Year.	Per Cent.
1926	84·57
1927	86·76
1928	86·09
1929	88·65
1930	83·77
1931	86·79
1932	88·82
Average	85·20

Under an extensive ewe management as practised on the majority of sheep farms, a low-lambing percentage is to be expected. Under more intensive conditions, as applied on the mixed agricultural and sheep farms of the Canterbury Plains and Otago, and on specialized fattening farms of both islands, a great deal more care is exercised at tupping and at lambing. Generally speaking, the lambing percentage varies inversely as the size of ewe flock, and this is reflected in the averages of lambing by sheep districts based on five years' figures and shown in Table XCVII.

TABLE XCVII

Average Lambing by Sheep Districts

District.	Per Cent.
Auckland	87·58
Napier-Gisborne	82·34
Wellington-West Coast	89·72
Marlborough-Nelson-Westland	76·22
Canterbury-Kaikoura	90·07
Otago	87·46

F. RELATIONSHIP TO CATTLE

As cattle play an essential part in sheep farm management, particularly on hill country, it is necessary to indicate their importance numerically. Figures available are an approximation only, as beef and dairy cattle are somewhat confused, as also are young stock which may be used for either purpose. Table XCVIII shows the position as nearly as it can be ascertained.

TABLE XCVIII

Beef Cattle

Year.	Number.	
1931-1932	1,577,000	(approximately)
1930-1931	1,702,000	„
1929-1930	1,597,000	„
1928-1929	1,437,000	„
1927-1928	1,351,000	„

G. Wool Yields

The average yield of wool, as shown in Table XCIX, is based on the total produced from mature sheep only. Although it is a common practice to shear lambs in some districts, and under certain conditions, the inclusion of lambs and their wool would give a false conception of the average weight of fleece. It would appear that there has been a slight tendency towards an increase in average yield from 1921 onwards, but as in the case of lambing, seasonal variations of climate may account for considerable fluctuations in the weight of wool shorn.

Table XCIX

Average Yield of Wool[2]

Year.	Lbs.
1916-1917	7·85
1917-1918	7·32
1918-1919	7·45
1919-1920	7·25
1920-1921	7·48
1921-1922	7·39
1922-1923	7·72
1923-1924	7·57
1924-1925	7·98
1925-1926	7·38
1926-1927	7·65
1927-1928	7·84
1928-1929	8·03
1929-1930	7·66

There is a wide range in average-fleece weights between the various land districts, and between the North and South Islands. It will be seen in Table C, which is based on a 12 years' average of wool yields by land districts, that the average for the North Island is higher than for the South, this being accounted for by the predominance of heavy-boned, coarse-woolled sheep. Hawke's Bay and Wellington have a material advantage over the remainder of the North Island. The country in these districts is hilly in the main; farms are usually self-supporting in the matter of flock replenishments, and every endeavour is made to build up a foundation-flock of high-grade stock. In the other districts, particularly the low country of Taranaki and Auckland, stock is 'brought in' to a greater extent, such stock mainly representing cull ewes from hill farms.

In the South Island, the influence of fine-woolled stock is reflected in fleece yields. The low averages in Nelson and Westland are due to a combination of poor soil and inferior stock, whilst the variations in other districts are due to the varying utilization of fine-woolled types combined with the incidence of long-woolled sheep on low-country mixed farms.

2. Later figures not available.

TABLE C

Average Yield of Wool by Land Districts

District.	Lbs.
North Auckland	6·75
Auckland	7·27
Gisborne	7·80
Hawke's Bay	8·28
Taranaki	7·66
Wellington	8·32
Nelson	5·96
Marlborough	7·52
Westland	6·07
Canterbury	7·25
Otago	7·07
Southland	6·74

H. KILLINGS OF SHEEP AND LAMBS

As indicated in the discussion on flock composition, important changes have taken place in the production programme of the sheep industry during recent years. The conscious transition from a mutton to a lamb-producing country has been in operation since the beginning of the present century. Although for individual seasons the number of lambs killed exceeded mature sheep, it was not until 1921 that lamb killings decisively took the lead, and it is safe to assume that this movement will be maintained. The position as disclosed in Table CI is of particular interest so far as sheep-killings are concerned, showing as it does the heavy slaughtering of capital stock which took place during the 1919-1920-1921 depression and the similar movement operating in 1931 and 1932.

TABLE CI

Killings of Sheep and Lambs

Season.	Sheep. (000 omitted)	Lambs.
1916-17	4,200	3,480
1917-18	4,230	2,740
1918-19	5,000	3,010
1919-20	6,180	3,340
1920-21	5,320	3,620
1921-22	4,900	5,150
1922-23	3,580	4,600
1923-24	3,360	5,270
1924-25	3,910	4,970
1925-26	3,570	5,210
1926-27	3,810	5,540
1927-28	3,700	5,980
1928-29	3,500	6,200
1929-30	3,990	6,640
1930-31	4,260	8,200
1931-32	5,230	8,830
1932-33	4,360	9,850

I. WOOL PRODUCTION

Total wool produced is but a reflex of sheep shorn and the average weight of fleece, and therefore in itself presents no peculiar feature of

management, with the exception that it is influenced to some extent by the incidence of shearing of lambs. Total production for the past 10 seasons is shown in Table CII:—

TABLE CII

Total Wool Produced (Estimated)

Season.	In Millions of lbs.
1924-25	233
1925-26	236
1926-27	256
1927-28	262
1928-29	272
1929-30	273
1930-31	271
1931-32	283
1932-33	288
1933-34	300

J. MORTALITY

It is generally accepted by the industry that a certain percentage of mortality in the sheep flock is unavoidable, and to a great extent this is true. It is only when the aggregate deaths are considered that the wastage assumes such tremendous significance. It is not possible to assess the annual death rate for the various sheep classes. Mortality is higher in some classes than in others, and takes place at well-defined periods and through clearly-understood causes.

The two classes of sheep which are not prone to a high death-rate are dry ewes and wethers, as both represent mature animals usually killed off before old age begins to operate in the weakening of constitution. Breeding ewes, on the other hand, are subjected to the strains of lambing up to probably six or seven years of age, and are expected in many cases to produce lambs under a wide range of climatic and food conditions without specialized attention. Thus it is found that ewes have a definite mortality risk prior to and during lambing.

Lambs have two well-defined periods of risk, namely, immediately following and resulting from docking and castration, and again in the late autumn and winter when passing through the transition stage from lambs to two-tooth sheep, when they are known as hoggets. The risk consequent upon docking and castration can be, and is, obviated to a large extent by improved and expert operation, but the rearing of hoggets becomes a matter of extreme efficiency in management if the death rate is to be materially reduced.

In addition to the well-defined periods of risk enumerated above, a small percentage of deaths is incurred through woolly sheep getting entangled in second growth or cast in hollows, etc., and occasionally trouble is experienced when newly-shorn sheep are caught in a period of unseasonal weather.

Over a period of 10 seasons the sheep mortality is estimated to average about 2,000,000, or about 7·5 per cent. annually.

V. MANAGEMENT

An attempt to discuss sheep farming and management in an article of this nature is bounded on the one hand with the great bulk of detailed data which may with advantage be included, and on the other hand with the lack of actual facts of management which would facilitate a concise statement of the position as it is found on the sheep farms of the Dominion. An attempt must therefore be made to cover the vast field in a general way, indicating the problems rather than indulging in a lengthy, detailed statement.

It has been mentioned previously that the adaptability of the sheep as an animal through the exploitation of one or other of the breeds available, makes it possible to farm sheep on a wide range of soil types and formations, and under wide variations in altitude and climate.

New Zealand, with her thousands of miles of coastline running in a narrow strip almost north and south, supplies a wide range of coastal temperatures. This fact, combined with a backbone of mountain ranges running practically the whole length of the South Island, and for a considerable portion of the North, provides a gradation in climatic and topographical conditions which make it possible and essential to utilise all classes of sheep and to employ management methods suited to such variants.

The two extremities of management are represented by specialized wool-production farms on the one hand and by specialized fat-stock farms on the other. Between these two extremes lies the whole range of conditions and management. It is intended, therefore, to treat the extremes in the first instance, and then to follow with a discussion of certain of the more clearly-defined stages lying between the two.

A. Wool Farms

The specialized wool farms of New Zealand are all situated in the high country of the South Island, and particularly in the MacKenzie and the high ranges of Central Otago. These sheep runs have snow risks, are very rugged, and are sparsely covered with fodder plants. Merino and half-bred sheep are used, and management, as interpreted in the temperate zones, is comparatively simple. Management of such stations presents its own difficulties, however. The main objective is to maintain a flock at a uniform level, the flock to be comprised of the highest possible percentage of mature dry sheep and wethers in particular. Thus the aim is to keep the breeding flock at the minimum compatible with the provision

of replacements. Mortality is naturally heavy, and the normal death-rate of from 10 to 15 per cent. may be aggravated by periodic disasters in the form of out-of-season snowstorms. A periodic heavy loss occasioned in this way means that the owner must again build up his flock from his own resources, as it is usually impossible to buy in suitable and acclimatized stock.

Outside the difficulties of maintaining the flock and breeding for wool improvement and constitution, the shepherding of the flock over sparsely-stocked areas presents difficulties of organization and specialized training of men and dogs.

The reward of the high-country wool-farmer is an average fleece of from 5 to 6 lbs., but of a quality commanding a comparatively high price. The only other source of income is from occasional sales of cull ewes to the breeding-farms of the plains.

B. Fat-Stock Farms

Fat-stock farms of the highest efficiency are situated on land of high fertility, and usually located in regions where climatic conditions are particularly suited to the exploitation of seasonal grass growth. These farms are usually small, but have a very high seasonal carrying capacity, ranging from three to five ewes per acre. The food supply is maintained almost solely by top-dressed pastures, supplementary food usually being grown on larger farms of lower-carrying capacity.

Ewe management on these farms is comparatively simple in nature, but demands constant attention prior to and during lambing. The ewe flock is bought in the early autumn, frequently from the same source, as it is essential that the purchaser can rely on the flock being of reasonable age and having been carefully tupped. After lambing has taken place, the ewes are run on specially-prepared pastures, and practically the whole of the lamb crop is milk-fattened. As soon as the lambs are disposed of the ewes are fattened and sold, the whole farm being cleared of stock to allow pastures six weeks' to two months' spelling before the next flock is purchased.

The main factors in management on farms of this type are: (1) judgment in buying suitable stock; (2) knowledge of lambing troubles and ability to cope with them when they arise; (3) discretion in handling the flock from lambing to sale of lambs; (4) intimate knowledge of pasture response to top-dressing, and of pasture recovery after grazing; and (5) constant personal contact with the whole cycle of events.

C. Hill-Country Farms

Hill-country farms producing wool and meat of various grades can be viewed as the foundation of the sheep industry. Meat may be in the

form of fat lambs or fat dry stock, and of store lambs, ewes and wethers. Such farms represent the great bulk of the North Island sheep-country, and also large areas of the south. In the North Island such country is broadly similar in type, and differs mainly in the pasture association present. Practically the whole of it has been developed out of bush or fern. The same types of grass mixture have been used throughout, but the passing of time has resulted in a movement known as 'deterioration' of the pasture association until a comparatively static state has been reached, the present covering representing the pasture growth most suited to the state of fertility which prevails. Thus, although the English grasses sown still persist in some degree according to soil types and locality, native and inferior grasses have become dominant features over large portions of the island. In favourable seasons ryegrass, cocksfoot and white clover represent a fair proportion of the feed available in such areas. It is evident that these species could be rejuvenated by systematic top-dressing, but it is questionable whether such a practice would be economic, even on a restricted scale. In the South Island, hill-country pastures are on the whole inferior to the North, and the type of stock used varies accordingly.

The stocking system practised on farms of the hill-country type is fairly uniform, the proportion of the various stock classes carried varying according to the state of the pastures. It is a generally accepted fact that the proportion of ewes to other stock is a true indication of the state of the farm. Table CIII depicts the actual stocking position on a number of hill farms of the North Island, and illustrates the movement of hoggets and wethers as the ewe percentage varies. This example can be accepted as typical of medium to better-quality hill-farms of both islands.

TABLE CIII

The Variation in Percentage of Stock Classes

Ewe Range	Number of Farms	Ewes	Hoggets	Wethers	Rams	Total
Per Cent.		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
41/50 ..	4	46·76	35·16	15·80	1·28	100·00
51/60 ..	17	55·27	35·80	7·52	1·41	100·00
61/70 ..	2	63·82	31·57	2·22	2·39	100·00
71/80 ..	1	71·35	26·07	0·67	1·91	100·00
Average ..	24	55·48	34·42	8·56	1·54	100·00

The disposal of stock from farms of this nature tends to become standardized, according to ewe capacity. The following average for the farms concerned in Table CIII can be taken as a general indicator of the position, the figures being on a per hundred wintered basis and allowing for a death-rate of 7 per cent.

TABLE CIV

Class.	Number.
Ewes (cull two-tooth and upwards)	10·0
Lambs	7·6
Hoggets (stores)	11·6
Wethers (rising four or six-tooth)	6·5
Total	36·0

This class of farm is self-supporting in replacements, the only stock bought being rams.

As the aim is to improve the flock as a foundation for fattening farms in low country, the choice of rams becomes of paramount importance, both from a wool and a constitution viewpoint. As rams are in most cases purchased from low-country studs, it becomes necessary to give them special treatment in their off season, and this is frequently done by the provision of specially-prepared pastures or supplementary crops.

The ewe flock and its maintenance presents definite problems of management, which necessitate efficiency of a high order if the hill-country farmer is to be really successful. The fact that flocks of this nature are self-supporting in replacement makes it essential that the ewe be studied from a wool-quality viewpoint and for breeding propensities. The term breeding in this instance covers surety in bearing a lamb which will be of the right type for fattening or for inclusion in the flock at a later date, and ability subsequently to rear the lamb satisfactorily. Judgment in culling the ewe flock is therefore absolutely essential. As it is undesirable to perpetuate bad-wool quality, heavy culling of two-tooth ewes is practised, before inclusion in the breeding flock. Such culls are then treated as dry stock and fattened or sold to fattening farms.

Culling on breeding propensities is done on the first lambing performance, and thus there is a comparatively heavy discard of four-tooth ewes. From the age of two years to full maturity, the percentage of ewes discarded from the flock becomes less, and again such sheep are disposed of mainly for fattening purposes.

The final stage of ewe displacement on hill-farms is the disposal of aged animals at a stage when the condition of their teeth endangers their efficiency on the comparatively hard feed available but while they are still suitable for one or two seasons on low-country breeding and fattening farms.

On farms of the type under discussion, lamb management resolves itself into extensive supervision during lambing itself, the usual practice being for a shepherd to ride round the ewe flock once or twice a day, and to assist ewes and lambs as much as possible. No special provision can be made for the feeding mother, but lambing paddocks should provide reasonable shelter. Surplus lambs are sold in a condition determined by the quality of the

country. The percentage turned off direct to freezing-works varies from nothing to a high proportion; but on the average, a fair percentage of store lambs are sold to low-country fattening farms.

The lambs kept for replacement purposes then present a management problem at the hogget stage. The condition in which hoggets are brought through the winter determines to a great extent their future efficiency as breeding ewes, apart altogether from the death-rate likely to be encountered if proper care is not taken.

As a general rule, supplementary feed is not grown, and the top-dressing of hogget pastures is not a common practice. To ensure satisfactory results, it is essential that the wintering ground for hoggets be specially prepared, and the usual policy is either to shut the paddock up for a period during the growing season and then eat the roughage off with cattle and dry stock in time to catch the autumn growth of grass, or else to spell the pasture from midsummer until required in the autumn. No matter what care is taken in the provision of fresh, clean and adequate pastures, the danger of parasitic stomach trouble is always present. On the whole, it can be said that the successful rearing of hoggets presents the greatest difficulty of hill-country sheep farming, as the degree of success attained largely determines the standard of the whole flock.

So far as wether management is concerned, this presents no difficulties. The percentage of wethers run is determined by the quality of the farm, and the necessity for dry stock to keep the country in order. The age at which they are disposed of depends upon the possibility of fattening, and whether wool represents a major consideration in the farm economy.

D. Gradations in Sheep Farms

Between the pure fattening and hill-country farms discussed, lies the whole gradation of types which merge one into the other, depending upon the suitability of each holding for breeding and fattening purposes. Individual farms may consist of a range of country enabling the farmer to use fully the whole of his surplus stock from the hills on low-lying land which is capable of cultivation or top-dressing, and which acts therefore as a fattening farm. On good fattening country it is also common for farmers to hold old bought-in ewes for more than one season, or to provide part or the whole of their replacement breeding stock from their own resources. Any type of sheep farm presents the same major stock management problems noted in one or other of the special types, the variation in management depending upon the quality and configuration of the land, and therefore developing into stock-food management rather than a diversification of stock management itself.

E. Sheep Farming in Relationship to Dairying

Dairy farms where some sheep are carried warrant passing consideration at this stage. Individually, such farms are not important from a sheep viewpoint, but collectively, the dairy farms of the Dominion represent a large absorption of certain classes of stock. On such farms sheep are run for two main purposes: (1) To act as followers after the dairy herd has eaten the flush of grass, and (2) as meat for the household. Although any class of sheep may be used, it is general for dairy farmers to buy in either old in-lamb ewes or cull lambs and hoggets. In either case, the aim is to fatten the surplus by midsummer, or as soon as the summer flush of grass is over. The association of sheep and cows runs through a complete gradation from the simple example quoted above, to the other extreme, where dairy products represent but a minor portion of the farm's saleable commodities.

In 1932-33 some 7,300 holdings were enumerated as mixed dairying and sheep farms, and represented a total of approximately a quarter of a million cows and over 2,000,000 sheep. These farms are mainly situated in the North Island, and depend almost exclusively on pasture for stock food. Thus the sheep-management problems met with are similar to those discussed in connection with either stock-fattening farms or poorer country where the flock is self-supporting, management being complicated to some extent by the added necessity of providing suitable dairying conditions.

F. Sheep in Relation to Agricultural Holdings

For the season 1932-1933, some 5,240 farms were enumerated as being mainly devoted to mixed agriculture and sheep farming. This definition covers most of the grain-growing holdings of the South Island where the use of the plough is necessitated in the rotational-cropping system adopted, which includes pastures of a temporary nature. Included in the area cultivated is a considerable acreage of supplementary crops such as rape, turnips and swedes, which are used mainly for sheep-fattening purposes. A large proportion of the sheep shorn represent bought-in ewes from the surrounding hill-country, but in addition to the fattening of part of this stock and its progeny, the agricultural farmer of the south buys in store stock in the form of lambs and wethers, and these are also fattened on the root crops and temporary but high-production pastures of the plains. On such holdings the cow can be disregarded as a producer of saleable commodities, being kept for house purposes only. It is impossible to estimate the annual sheep and lamb turnover of these farms, but it is recognised that the agricultural farms of the south are a very important factor in the fat-stock trade of the Dominion.

Ewe management varies somewhat from the pasture-farms of the north, as they can be kept to a greater age through the use of supplementary food. Thus it is found that most farmers have a breeding-flock as a foundation, and augment with hill-country ewes from which two or more crops of lambs may be expected under reasonable management. On these farms, as has been previously mentioned, Southdown and Corriedale rams are extensively used for the production of a suitable lamb carcase.

G. Cattle in Sheep Farm Management

The efficient management of sheep on grassland is essentially bound up with pasture management. It has been noted that conditions, particularly on hill-farms, are not ideal from a soil-fertility viewpoint, for the maintenance of first-grade pastures. The tendency for much of the land in use to revert to second growth, and the gradual deterioration of pasture associations consequent upon the removal of soil fertility, presents a difficult management problem to the sheep owner. The position is aggravated by the fact that the use of fertilizers on low-carrying country is uneconomic. The problem is the maintenance of a middle course between continued deterioration and non-economic methods. A long and arduous experience in hill-country pasture management has therefore resulted in the utilization of cattle as the best machine for pasture and second-growth control.[3]

H. Labour

Sheep management in New Zealand is mainly of an extensive nature, in that the intensive methods of folding and shepherding common in Great Britain and on the Continent are quite unknown. The Dominion is, nevertheless, a country of small sheep farmers, with but a few really large flocks held by individual men.

The fact that so many flocks are small tends to simplify the labour problem, as on most farms carrying up to 1,000 sheep, outside labour is not essential except for special occasions such as shearing. Sheep farming is to a large extent a family enterprise with intermittent help. In this respect it resembles the dairy industry, but the fact is not so well recognized. Sheep farm labour is of two types:—

1. Permanent.
2. Temporary.

Permanent labour consists of the owner and members of his family, and permanently-employed shepherds. Their duties embrace the general work of the farm in the way of pasture management, upkeep of fences and buildings, and all duties connected with routine stock management.

3. See Chapter XXIII.

Temporary employees are mainly concerned with special duties connected with mustering and shearing. The shearing staff on large holdings is usually a unit under the control of a contractor, although the terms and rates of pay are fixed by arbitration. The wool-classer may be independent and directly responsible to the owner.

In respect to shearing, the permanent staff or special men employed in mustering and drafting are expected to pen the sheep and to clear the yards subsequent to shearing, but in the shed itself, the head shearer and his staff reign supreme. In the North Island particularly, shearing is undertaken extensively by Maori gangs.

The same conditions of employment apply to a considerable extent to crutching, but this operation is more often carried out by permanent labour as the work entailed is not so great.

I. The Farm Plan

In discussing the plan of sheep farms, no definite standardization can be adopted. The differences in holdings are so great that each has to be considered from its individual viewpoint, but certain accepted principles apply in most cases.

No matter what the size of the holding, the homestead naturally forms the central unit, and sheds and yards are situated in reasonably close proximity to it. On large farms, however, out-station yards may be used to obviate the necessity of mustering all the flock to the homestead for certain management practices such as docking and marking of lambs.

Radiating out from the homestead are holding paddocks for convenience of handling stock during shearing, etc., and also specially-treated paddocks for rams and for holding killing sheep for home use.

It is recognised by sheep farmers that closer subdivision of sheep pastures facilitates the handling of the flock, particularly during tupping and lambing, and for hogget-rearing. It is also well known that pastures can be kept in better condition where it is possible to overstock at any time when rapid cleaning up is necessary, and these factors have led to a more systematic subdivision of sheep pastures as occasion permits.

In planning subdivision of hill-country, great care is always taken to so arrange the fence line that the natural movement of sheep from back-country to homestead is not restricted unduly. Forethought in the location of fences is amply rewarded by the time and trouble saved in mustering, which automatically reacts to the advantage of the flock itself.

J. Machinery

Machinery peculiar to sheep farms is confined to shearing-shed plant, and consists of shearing machines and wool-presses. The number of plants

in use represents but a small percentage of the total flocks. Whereas in 1932 a total of 30,449 flocks were recorded, only 7,853 shearing-machine plants were enumerated, and a total of approximately 10,000 wool-presses.

This position is explained by the fact that hand-shearing is still practised on many farms. In addition small flocks are often assembled in neighbouring sheds for shearing, the small flockowner paying the owner of the shed for its use. The use of portable plants which have been introduced to a greater extent of recent years is also a contributing factor, the owner of the plant moving around small holdings as required.

The total number of plants recorded has increased during the last decade, a total of 5,317 only being in use in 1922.

VI. CAPITAL POSITION

A statement of the capital position of the sheep industry must be viewed as an estimate only, as there are no available records of equity or mortgages in respect of land or stock. Although the subject is of great interest and extreme national importance, it can therefore be discussed only in broad terms. The difficulties of such a discussion at the present time are aggravated by the long period of price-depression experienced. Consequent upon low prices for primary products, owners' equity has disappeared so far as earning capacity is concerned, and individual farmers have been forced into emergency measures of finance to enable them to maintain their holdings and in many cases to obviate complete abandonment. Thus the capital position cannot be justly viewed from the present realization value of land and stock, but must rather be assessed on the actual capital involved and still looked upon as being represented in capital goods. The questions as to whether such an assessment can ever be realised, or whether the sheep industry will be able at a later date to earn interest on the capital represented, present problems of vital importance to private individuals and financial institutions which must be left to the future to decide.

The capital goods of the industry are comprised of land and its improvements, and the stock carried on the land concerned.

The area devoted to sheep and cattle varies from tussock country to the most fertile reclaimed swamp. Some 14,000,000 acres devoted to sheep are known as native grass and tussock land. This area is of a definitely low actual and potential production capacity, and requires a reasonable commodity-price level to pay any interest on the capital which may be represented. In addition to the above, approximately 12,000,000 acres of sown pastures are wholly devoted to sheep and cattle. This area, combined with 750,000 acres under cultivation and carrying roots and green fodder, is responsible for the more diversified types of sheep farming and particularly for the production of fat stock. The total area of various

classes and quality of land devoted to sheep and cattle is therefore in the vicinity of 26,750,000 acres. This area and its improvements, plus the 28,691,788 sheep and 1,577,000 cattle of beef type carried in 1932, represents the security for capital absorbed in the form of mortgages, stock loans, current accounts or equity.

In view of the land quality and the unknown acreage of any specific grade, capital values of the total land used cannot be assessed directly. The stock carried must therefore be taken as a basis of estimation. As previously discussed, the total flock is comprised in the main of foundation-breeding ewes, the remainder being replacements, or variable quantities of dry stock of different types, and representing saleable products from the ewe flock itself.

It can be accepted as a general principle that in all classes of sheep-farming, with the exception of specialized wool-production farms, the ewe is the major factor determining the level of gross income. It is therefore sound to use the total ewe flock as a basis to assess the total capital value which may be ascribed to the land devoted to sheep farming. The reliability of an approximation so obtained depends entirely on the ability of a ewe to produce goods to a value sufficient to meet working expenses, the requirements of labour, rates, interest on the value of stock per ewe, and interest on the capital value of land and improvements which is assessed per ewe wintered. In practice, the ewe is used as a basis of computing values of land for both rating and sale purposes.

It is reasonable to take the pre-slump season 1928-1929 as a basis on which to estimate the capital invested. For that season the value of all wool, mutton, lamb and beef produced on sheep farms amounted to approximately £29,500,000, based on declared export values. This does not include by-products of freezing-works and abattoirs, but does include handling charges from farm to f.o.b., particularly in the case of wool. If an arbitrary deduction of 10 per cent. is made to cover incidental costs, the remainder, namely, £26,550,000, approximates the total gross income to farmers from the sheep industry for that season. If this latter figure is accepted as a reasonably correct basis of computation, the gross average return per breeding ewe was £1/11/6. From data collected from sheep farms during prosperous years, the costs of farm working and maintenance, rates and interest on stock amounted to 12/- per breeding ewe, the whole farm cost being debited to ewes only. This does not include wages of permanent employees, or management allowance to the owner. An assessment of 7/6 per ewe to cover these items allows of a total labour reward of approximately £6,250,000, or £225 per annum to each flock-owner, irrespective of the size of flock, or the diversification of farming practice adopted by registered owners. This assessment may or may not be reasonable, but

if accepted leaves a surplus of 12/- per ewe as interest on the capital invested in land and improvements. If an interest rate of 6 per cent. is taken, the capital value per ewe on which interest could be paid under the conditions prescribed would be £10, giving a total capitalization of £166,000,000 to land and improvements devoted to sheep-farming. This sum represents £5/14/- per stock unit for the total mixed flock of 1928-1929, and approximates the values ascribed to land on a mixed stock basis during the period under discussion.

The value of stock can be assessed on standard values ruling prior to the price depression. For the purposes of this estimate, it is not desirable to break up stock classes into pure-bred and others, and an average value has been given to each stock class, irrespective of quality.

The capital position of the industry can be summarised in round figures as follows:—

Land and improvement	£166,000,000
Breeding ewes	16,600,000
Dry ewes	600,000
Lambs (hoggets)	5,900,000
Wethers	2,500,000
Rams	800,000
Cattle	7,600,000
Total	£200,000,000

If this estimate be accepted as reasonably correct under normal price conditions, the seriousness of the present depression may be gauged from a brief study of the relative gross incomes of 1928-1929 and 1930-1931. This position is indicated in the following section dealing with income from the sheep industry.

VII. INCOME

A reasonable assessment of either gross or net income from individual sheep farm types cannot be given, owing to the non standardization of stock ratios. Neither would any assessment serve a useful purpose, as the position of the whole industry is in a state of flux.

The killing off of capital stock plus restrictions in expenditure on maintenance has created a false position, which can only be rectified by a general upward movement in farm-produce prices. Some indication of the position can however be given on the basis of gross income per ewe as computed in the previous section on capitalization. In 1928-1929 the gross income from all products was estimated at £1/11/6 for every breeding ewe. On the same basis of estimation, this figure fell to £1/2/6 in 1929-1930, and dropped again to 18/- in 1930-1931. The two latter figures are not as sound as that for 1928-1929, as they include the realized value of approximately 1,000,000 head of capital stock each season. If this item is allowed to remain as justifiable income, the income level for 1930-1931 was

43 per cent. below that of 1928-1929. When assessing the surplus per ewe available for interest on land and improvements, a total of 19/6 per ewe was allowed for rates, maintenance, interest on stock and labour reward. This is 1/6 higher than the average gross income per ewe in 1930-1931. The 'spreading' of this lesser income has been effected in different ways according to the peculiarities of individual cases. The first item to be attacked was interest on owners' equity in the farm and stock. Interest on equity has never been recognized as such in the majority of instances, and this but restricted the spending power of the farming community. The next item to suffer was the amount earmarked as labour reward. Maintenance also has been neglected, and finally rating bodies and mortgagees have been forced to accept less in an attempt to save the capital invested in the industry over a long period of years.

VIII. CONCLUSION

The foregoing brief descriptive summary of the sheep industry aims only to show the trend of events in its development, and to indicate some of the management problems connected with an extremely complicated industry. Owing to its diversification, it has not been subjected to detailed analysis as in the case of dairying, and any discussion of the problems involved are of necessity broad in nature rather than specific. The industry is in a sound position so far as its farm organization is concerned, and owing to its diversified output it is to be expected that it will show signs of recovery from the present price depression earlier than will the dairying industry. This might be expected also from the fact that, in the past, a rise in the price of wool has usually heralded at least partial recovery.

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CHAPTER XXI[1]

DAIRY FARMING

BY E. J. FAWCETT

I. General Considerations—A. Introduction—B. Factors Affecting Location and Extension of Dairying Districts: 1. Climate; 2. Transport—C. Expansion of Output: 1. General Trend; 2. Availability of Suitable Land. II. Statistical Data—A. Number of Cows in Milk and Dry—B. Area Employed—C. Production Data. III. Farming Practice—A. Size of Farms—B. Pasture Types—C. Artificial Fertilizers—D. Cultivated Crops—E. Pasture Management: 1. Top-dressing; 2. Subdivision of Pastures; 3. Cultivation; 4. Control of Grass Growth. IV. Capital Employed and Land Tenure—A. Land and Improvements—B. Stock—C. Equipment. V. Layout of Sheds and Farms—A. Sheds—B. Farm Layout—C. Machinery: 1. Milking Shed; 2. For Grassland Farming. VI. Herd Management and Labour—A. Breeds—B. Production: 1. Carrying Capacity; 2. Per Cow Production; 3. Per Acre Production—C. Stock Replacement—D. Cow Testing—E. Labour. VII. Major Sources of Farm Income—A. Butterfat—B. Pigs—C. Vealer Calves. VIII. Conclusion.

I. GENERAL CONSIDERATIONS

A. INTRODUCTION

THE growth of the dairy industry over the past 14 years represents perhaps the most important single feature in the economic development of New Zealand during that time.

Rapid progress has been made possible through the policy of encouraging grass-farming and the realization that land of comparatively low fertility can be made to maintain highly-productive pastures, provided rainfall is adequate and well distributed over the year. Where such conditions prevail in conjunction with equable temperatures and soil providing a free root-bed for pasture plants, Nature has done her best to set the stage for the establishment of pastures of a type most suited to milk production. These conditions prevail over large areas, particularly in the North Island. Farmers have realized this fact, and by systematic top-dressing, adoption of improved pasture-management methods, and the breeding of high-grade dairy animals have built the industry up to the position it now occupies.

When speaking of the main dairying centres it is generally accepted that the districts known as Taranaki and Waikato are indicated. Although this is substantially correct, some qualification is necessary.

With the exception of small settlements in the interior of the North Island, commercial dairying is practised in districts having an altitude of under 1,200 feet. If that portion of Taranaki lying to the east of Mount Egmont, and covering Stratford and parts of Eltham and Inglewood counties be excepted, all of the well-known districts are less than 650 feet above sea-level. In addition to the two districts mentioned above, there are well-defined dairying centres, at Katiaia, in Mongonui County, the valley of

1. See also Dairy Industry Commission Report, 1934.

the Hokianga River, the low country of Hobson, Otamatea and Rodney, bordering the Kaipara Harbour, and at Whangarei—all in the North Auckland Land District. In the Auckland Land District there are intensive dairying centres in the Bay of Plenty, in addition to the lower Waikato Basin.

Wellington Land District has a scattered dairying population along the sea coast, intensifying in the Rangitikei, Manawatu, Kairanga and Horowhenua Counties, on the west coast. There are also clearly-defined dairying districts along the Wairarapa Valley, particularly at Carterton, Masterton, Eketahuna and Pahiatua.

In Hawke's Bay Land District, dairying is concentrated mainly in its southern counties of Woodville and Dannevirke, with some activity on the Hawke's Bay flats surrounding Hastings.

The Gisborne Land District has no large dairying centres, although factories are situated at intervals along the coast, where alluvial river flats are utilized for cows.

In the South Island, the industry is more scattered. It occupies some of the more fertile valleys in Nelson and Westland Land Districts, but is mainly situated along the eastern seaboard. In the vicinity of Christchurch there are some moderately intensive dairying areas, but the greatest density of cow population on an extensive scale is to be found in the southern counties of Otago and Southland. Although the Canterbury Land District has the largest number of cows in the South Island, the area over which they are spread is very great, whilst the counties of Taieri, Bruce, Clutha, Southland and Wallace carry over 38 per cent. of the dairy cows of the island.

Outside of the low-lying land bordering the sea coast, and those inland districts specially mentioned, dairy cows are distributed over the whole of the occupied area of the Dominion, but are mainly kept for house supply of milk, cream and butter, whilst surplus cream is sent long distances to factories during flush periods of the year.

B. Factors Affecting the Location and Extension of Dairying Districts

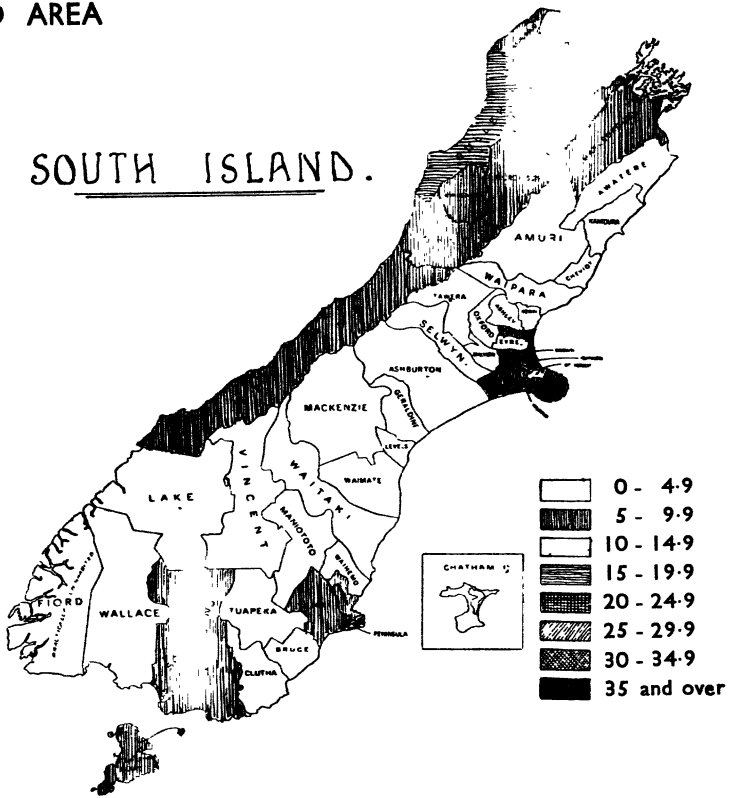
1. *Climate*

It is generally said, especially by visitors from overseas, that the high prices paid for dairying land in New Zealand represent the capitalization of climatic conditions. This is undoubtedly true to a great extent, as, without the conditions of climate experienced, New Zealand could never have attained the position she now holds as an exponent of grassland farming and an exporter of grassland products. It can be said, that if the topography of the country is suitable, the temperature mild, and rainfall

DISTRIBUTION OF DAIRY COWS PER 100 ACRES CULTIVATED AREA



Map 24a



Map 24b

adequate and evenly distributed, all land is potentially capable of being converted into high-class butterfat-producing farms. It may not be always economically sound, however, to expend the labour and capital necessary to attain such a state of development.

A great portion of New Zealand is comprised of mountain ranges of comparatively high altitudes, and this portion need not be considered in relation to the dairy industry. The temperature of the sea coast and much of the undulating country away from the sea is quite suitable for dairying, and in these regions topography and rainfall become the limiting factors.

As mentioned previously, dairying is practised mainly on country of low altitude. Hence, whilst the rainfall of the North Island is generally suitable, the area available for economic expansion is limited. Much of the country with suitable temperature, topographical and rainfall conditions, is submarginal in character, at any conceivable range of prices. The South Island, on the other hand, has large areas suitable from the topographical and temperature viewpoints, but rainfall is the limiting factor.

The major climatic factor in limiting the area of dairying land under a grassland programme is undoubtedly the total precipitation and distribution of rainfall. It has been amply proved in practice that heavy seasonal precipitations are not suited to modern grassland management, and thus we find dairying development taking place in regions where, under average conditions, a reasonable rainfall is experienced every month, and where it is spread evenly over the month. The number of days on which rain falls at each period of the year is therefore a vital factor.

2. Transport

Transport need only be considered as it affects supplies between farm and factory, and conveyance of goods to farm.

(a) *Farm to Factory.*—The most far-reaching development in overcoming transport difficulties from farm to factory has undoubtedly been the general adoption of home separation on farms supplying butter factories. Before transport facilities were improved, roads determined the location of cheese factories, and thus we find even to-day, the manufacture of cheese is mainly concentrated in regions where roading was reasonably good twenty years ago. Recent improvements in road and rail facilities have made possible a considerable expansion in the area available for dairy production. This is particularly applicable to cream deliveries, since the small bulk of cream enables it to be transported at low costs for considerable distances. Hence, factories can be placed at strategic positions. The collection of cream is usually undertaken by transport contractors, the cost being met in some cases as a deduction from factory payouts, and in some cases as a factory expense. In thickly-populated areas daily collections are

made, whilst in more scattered regions they are seldom less frequent than every second day during the flush period. Motor launches are employed in several instances, but are being replaced by road transport wherever possible. Delivery of milk to cheese factories is almost entirely made by individual farmers.

(b) *Transport of Goods to Farm.*—The cost of conveying stores to farms does, in many cases, represent a hampering factor in production. This applies more to bulk goods, and, in particular, to fertilizers. Farms within reasonable distance of a railway are not affected materially, but as soon as coastal shipping or road transport over long distances has to be employed, the use of artificial fertilizers is restricted. Recognizing the vital necessity of an increased manure usage, the Government gives special railway facilities to farmers in the conveyance of fertilizers. These concessions affect all farmers using lime or fertilizers, no matter what the nature of their operations. Lack of cheap transport facilities materially hampers developmental policies on land which demands heavy and constant top-dressing for pasture establishment and maintenance, and this fact is likely to retard the breaking-in of pumice and gumlands of the North Island which are not at present served with railways.

C. Expansion of Output

1. *General Trend Towards Expansion*

The expansion of the dairy industry in New Zealand has been continuous since 1901, with but minor exceptions.

During the post-war years there have been two well-defined expansion periods. From 1919-20 to 1923-24 a very rapid increase in production took place, owing mainly to an increase in the number of cows milked. For the three following seasons cow numbers remained comparatively stationary, and production appeared to have reached a more stable state, but, beginning with and subsequent to the season 1926-27, another rapid movement took place. Management of herds and pastures has improved greatly since 1920, resulting in improved carrying capacity of dairy farms, and increased production per cow. These have been the two main factors contributing to expansion, and have shown such elasticity that any prediction of the future becomes difficult.

2. *Availability of Suitable Land*

It is generally accepted that there is not much land suited to dairying that is not so used. Nevertheless, in the past the industry has expanded on to land of definitely low fertility, and this fact would urge caution in predicting the future. There are three possible methods of development, of which one or all might be adopted as they have been in the past, provided

the economic situation warrants the conversion of more lands to dairying or the better utilization of land already embraced within dairy farms.

(a) A change over from sheep to dairying on land within dairying districts, or in districts which have not hitherto exploited dairying.

In both islands there are large areas intermingled with dairy farms which are at present used for sheep-raising and lamb-fattening. Land utilized in this way is usually held in blocks larger than are suitable for dairying, and in many instances is not so highly improved. Generally it has been held by the present occupiers for long periods, and the cash indebtedness represented is not high, so that a fair net income can be earned without the adoption of more intensive methods; or else it is owned by men who are financially strong, and who prefer sheep farming to dairying. Subdivision must take place before dairying can become general on such holdings, and this must be a slow process. Acquisition by the State entails a large capital outlay, and extensive operations of this type are not practicable at the present time.

The factors controlling the conversion of sheep farms to dairying in sheep farming districts are similar to those pertaining to sheep farms in dairying districts, but in addition conditions are complicated by irregularity of rainfall. This applies particularly to the East Coast regions of the North Island, and much of the South Island, and presents a difficulty in the expansion of dairying in sheep farming districts.

(b) Breaking-in of land at present lying idle, but which is capable of producing to some extent under suitable conditions.

The history of the dairying industry shows that the range of natural soil fertility under which expansion may take place is extremely wide. There are many instances of land in the North Island which to-day is looked upon as a good dairying type, but which 10 to 15 years ago was considered almost worthless. In view of this fact, the possibilities of the future are vague, as there are large tracts of country either unoccupied, or occupied and undeveloped, which have the same natural advantages as much of the land now in dairy farms, and which may be brought into production as finance and transport facilities are improved. The settlement of this class of country demands a considerable amount of capital, and a study of past development indicates the desirability of facing this problem as a community undertaking, if it is to be faced at all, so that settlers when finally placed may be able to extract a reasonable living from the commencement of private ownership. Much of this land is submarginal under present economic conditions, and if development takes place cheaper methods must be devised or individuals or the State be prepared to lose developmental capital.

(c) Subdivision and exploitation of semi-developed dairy farms. This heading suggests two eventualities:

(1) Subdivision of dairy farms which are too large for economic management by the present occupiers.

(2) Maximum exploitation on farms where the ratio of area to available labour is sound.

Since 1920, increased efficiency in the utilization of occupied areas has resulted in a greater carrying capacity of pastures on both sheep and dairy farms. Despite the advances made in the past, there is still a considerable scope for further improvement, the factors controlling the rate of advance being finance and labour. Production on many comparatively large dairy farms is retarded by both these factors, though obviously lack of working capital controls the supply of labour to a great extent. There are, however, many farms of a size where, under existing management, it is not economic for the farmer to employ more labour, as it is not possible to increase production sufficiently to show a profit over the cost of labour. In cases of this nature some immediate source of income other than butterfat is required to warrant extra labour, so that the major proportion of the expense may be met whilst the dairying side of the farm is being built up by the spare-time employment of the additional farm hand. Subdivision of and increased production from farms above an economic area must be gradual, as in the past, but there yet remains a source of greatly-increased output from farms of a reasonable size where labour is adequate. To illustrate the possibilities of development on such farms, it need only be stated that the average per acre production of all land devoted to dairying is estimated at 80 lbs. of butterfat, whilst under similar conditions of land and climate, instances of production from 120 to 200 lbs. per acre are common. There are numbers of examples of over 200 lbs. of butterfat per acre, the highest cases recorded on commercial dairy farms reaching about 300 lbs.

Hence, to further increase the volume of output materially, it is apparent that we must rely mainly upon the study of improved management methods, and the dissemination and practice of the knowledge so obtained, rather than upon an extension in the area of land devoted to dairying. This can and is being done through the medium of a vigorous instructional policy, aiming at the raising of production on those farms which are not exploited to their maximum, but where conditions are such that greater production is economically possible.

II. STATISTICAL DATA

A. Number of Cows in Milk and Dry

With minor exceptions, the total number of dairy cows in New Zealand has shown cumulative increases each year, the total herd having increased by over 170 per cent. from 1914 to 1934. Progress was rapid from

1919 to 1923, this period being one of active settlement consequent upon demobilization of troops after the war. This, combined with high prices for butter ruling at that time, created a heavy demand for dairy farms. To meet the heavy demand for dairy cows during this period, numbers of station cows of dual-purpose type were used for dairying purposes temporarily, and were enumerated as such. When the fall in butterfat prices took place, these animals reverted to beef purposes, and consequently the increases in total cows became less marked. From 1924 to 1927, it appeared as though dairy cow numbers were becoming stabilized, but the enumeration taken in January, 1928, recorded a considerable advance. Since that date the trend has been continuously upward, and further increases are to be expected if market restrictions on the sale of butterfat do not develop. The vital statistics of the dairy industry in New Zealand are given in Table CV and cover the rapid-development period, 1919-20-1933-34. The figures presented show the number of cows in milk and dry, average per cow production, and the total production of butterfat. The figures are also given on an index basis.

TABLE CV

Showing Increase in Total Cows: Average Butterfat Production per Cow, and Total Butterfat Produced

	Total Cows in Milk and Dry		Butterfat per Cow—N.Z. Average		Butterfat Production	
	Total in Thousands	Index 1919–20=100	Average in lbs.	Index 1919–20=100	Total in mil. lbs.	Index 1919–20=100
1919–20	893	100·0	152·04	100·0	136	100·0
1924–25	1,323	148·1	182·09	119·8	241	177·4
1929–30	1,441	161·2	218·05	143·5	314	234·9
1930–31	1,602	179·1	201·05	132·2	322	237·5
1931–32	1,702	190·5	199·65	131·4	340	250·7
1932–33	1,846	206·6	215·10	141·5	397	292·9
1933–34	1,933	216·3	220·80	145·3	427	313·9

In addition to dairy cows, approximately 60,000 breeding bulls of dairy type are now maintained, equal to 3·1 per cent. of total cows. Considerable attention has been paid to the breeding of stock in the past decade, particularly on the sire's side. A very large percentage of the dairy farms throughout New Zealand now use pedigree bulls, and education on these lines has been so intense that even a pedigree bull will not be accepted unless it can be shown that the animal is from high-producing stock.

B. AREA EMPLOYED

The area actually carrying the dairy herds of the Dominion, plus replacement stock and bulls, is estimated at 5,000,000 acres. There are considerable areas in addition to this which may be a burden upon the

industry, particularly partly or undeveloped land embraced within dairy farms, but the area concerned cannot even be estimated. The increases in cows and production registered during the past 14 seasons have been made without an appreciable extension in area dependent upon cows, but mainly by the improvement of such areas. The land from which total production is effected is not all held as dairy farms, as mixed and sheep farms all carry a few cows for their family requirements. The 5,000,000 acres estimated above is the dairy land equivalent, which is responsible for production.

C. Production Data

The practice in New Zealand is to pay the dairy farmer on a butterfat basis, whether he is supplying a cheese,[2] butter or any other factory, and it has, therefore, become general to speak in terms of butterfat production rather than gallons of milk. In assessing total production, the amount of butterfat contained in milk and cream consumed by the local population, or by calves, in addition to wastage through spilling, etc., has to be estimated. A considerable amount of investigation has been undertaken to establish standards for these channels of consumption, and the production figures given in Table CV are considered as nearly correct as is possible at the present time. The utilization of total production is given in Table CVI. Other dairy products include ice cream, Glaxo, and dried whole milk. In addition to whole milk or butterfat products, a considerable amount of casein and skim-milk powder is manufactured annually.

III. FARMING PRACTICE

A. Size of Farms

Dairy farming can be separated into three broad classes:—

1. Farms wholly devoted to dairying, but which supply only part of the family income. Farms falling within this category are mainly of small area, carrying up to 15 cows. They are usually situated near towns or works of a seasonal nature, where the owner has a whole or part-time employment. Cows are milked to augment income, and may be attended to by both male and female members of the household.

2. Mixed sheep and dairy farms, or agricultural and dairy farms. In this group, mixed sheep and dairy farms vary between those from which surplus cream above farm requirements is sold, to farms from which the major portion of the farm income is derived from cows. Farms of this type are comprised almost wholly of pasture land, and have a wide range of areas. In the case of mixed agriculture and dairying, the proceeds from dairy produce are usually secondary to sheep and cash crops, this class of farm being not nearly so important, from a dairying viewpoint, as mixed farms of the grassland type.

2. There has been strong propaganda for a change of the basis of payout to cheese suppliers from a butterfat basis to one which takes account of the cheese-making qualities of the milk supplied.

TABLE CVI

Utilization of Total Estimated Butterfat Production in the Dominion

(The Estimation is for All Butterfat as at the Pail)

	Butterfat for Butter	Butterfat for Cheese (including Whey Butter)	Butterfat in Milk Consumed	Butterfat in Cream Consumed	Butterfat for Other Dairy Products	Butterfat in Milk fed to Calves and in Milk and Cream Spilt and Wasted	Total Butterfat
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1919–20	62,529,400	57,625,002	10,481,353	1,296,210	1,189,405	2,716,763	135,838,133
1924–25	160,090,656	61,020,797	11,704,612	1,447,488	1,902,311	4,819,711	240,985,575
1929–30	219,334,751	72,304,066	12,688,458	1,569,159	1,890,361	6,281,363	314,068,158
1930–31	223,733,816	75,478,174	12,863,258	1,590,776	1,900,000	6,440,123	322,006,147
1931–32	237,385,977	79,631,084	12,998,445	1,607,494	1,397,837	6,796,344	339,817,181
1932–33	282,003,967	90,877,774	13,099,374	1,619,976	1,526,242	7,941,374	397,068,707
1933–34	308,009,466	93,366,960	13,203,745	1,632,883	1,952,203	8,533,985	426,699,242

3. Dairy Farms.—The greatest proportion of dairying is done on specialized dairy farms, both in dense dairying districts and in districts where there is a definite gradation from dairy to sheep farms.

For the season 1933-34, a total of 71,837 suppliers sent milk or cream to factories of various kinds. These suppliers represent all classes of farms, with a wide range in the size of the milking unit. The total herds in the Dominion are estimated at 75,000, and are distributed as shown in Table CVII:—

TABLE CVII

Distribution of Herd Sizes

Herd Range	Percentage of Total Herds Represented	Average Size of Herd	Percentage of Total Cows in Milk Represented	Percentage of Total Butterfat Represented	Percentage of Total Area Devoted to Dairying Represented
1– 9 ..	44·0	4·0	7·2	7·1	7·3
10–19 ..	10·7	14·0	6·1	6·8	6·2
20–34 ..	18·8	26·6	20·7	21·7	20·7
35–49 ..	12·0	41·1	20·4	20·8	20·4
50–74 ..	8·8	60·3	22·0	21·9	21·9
75 and over	5·7	99·3	23·6	21·7	23·5
	100·00 = 75,000 herds	Average = 24·2	100·0 = 1,816,000	100·0 = 426,699,242 lbs.	100·0 = 5,000,000 acres

From these figures it will be seen that only approximately 45 per cent. of the total herds contain 20 cows or more. This group represents the great bulk of true dairy farms, although on many of them sheep rapidly begin to assume importance. In this connection it is worthy of note that well-known dairying counties all have a low average area per holding, even when total area of all holdings in the county, whether improved or otherwise, are included, and whether they be wholly devoted to cows or are of a mixed type. The following statistics of some North Island counties illustrate this point:—

TABLE CVIII

Average Farm Areas and Stocking of Some Typical Dairying Counties in 1934

County	Average Area per Holding (Acres)	No. of Holdings	Dairy Cows per 100 Acres	Other Cattle per 100 Acres*	Sheep Shorn per 100 Acres
Taranaki	106·86	1,030	30·73	14·72	12·80
Inglewood	174·68	601	22·41	13·48	31·91
Waimate West ..	110·78	456	46·61	16·48	8·3
Hawera	139·92	767	27·73	14·25	72·82
Waikato	198·23	1,612	22·81	13·70	29·62
Waipa	146·74	1,533	31·94	18·43	42·89
Hauraki Plains ..	148·54	726	37·15	15·66	5·67
Piako	167·08	1,400	38·93	19·16	34·76

*Note.—'Other cattle' include young dairy stock and bulls.

B. Pasture Types[3]

The pastures of New Zealand can be broadly divided into 'sown' and 'native' grassland. The latter, which is of no economic importance so far as the dairy industry is concerned, accounts for over 14,000,000 of the total 31,500,000 acres of grassland in the Dominion. Although in some districts where cows are wintered away from the farm for a period of two or three months native grass may be used, it can be accepted that commercial dairying is confined to flat or undulating country of a comparatively low altitude, where the type of pasture maintained can be controlled.

Permanent pastures have been established by:—

(1) Surface sowing after deforestation, the land being gradually cleared of dead timber.

(2) The clearing of dead timber from country which has been felled and surface sown, followed by cultivation and cropping, and ultimately sown with a permanent seed mixture.

(3) The ploughing of native pastures, followed by cultivation and cropping, and ultimately sown with a permanent seed mixture.

The composition of seed mixtures used for surface sowing, or following cultivation, has been extremely varied, but under intensive management as practised on dairy farms, two definite associations have materialized as ideals to be aimed for according to locality:—

(a) A well-balanced perennial rye-white-clover association in localities subject to frost and comparatively hard winter conditions;

(b) A well-balanced perennial rye-white-clover-Paspalum association in localities not subject to frost or hard winter conditions. The latter type may also contain a percentage of Lotus Major.

In both of these associations, other grasses may be found subsidiary to the dominant strains. The perennial rye-white-clover type is common in all districts, but particularly in localities south of Auckland, with the exception of dairying districts bordering the sea coast of the Bay of Plenty. The latter type is gradually spreading in these and northern districts, as the value of Paspalum becomes more widely recognized as an ideal forage plant under controlled grazing conditions. Temporary pastures do not play an important part in the industry. In the North Island they are unknown, whilst even in the South the endeavour of every dairy farmer is to maintain permanent pastures.

The range of pasture productivity is very wide, depending on the degree of purity in perennial strain within the pasture association; on moisture precipitation and its seasonal distribution; on the natural quality

3. See Chapter XVIII.

of soils from both physical and fertility viewpoints; and upon the degree of management efficiency of the farmer.

The question of strain is becoming recognized as of outstanding importance in efficient pasture management. Research work carried out at the Plant Research Station, Palmerston North, has proved beyond dispute that the pedigree of pasture plants is just as important as is the pedigree of high-production cows, and that no farmer can hope for maximum economic results from his pasture management unless the material on which he is working is of a type which gives the maximum yield for the money and effort expended upon it. As a result of this work, it is to be expected that, as seed supplies from pedigree grass strains become available, a gradual replacement of inferior pastures will take place which will in the future have an incalculable effect on carrying capacity. Coincident with the establishment of improved pastures, the manurial programme as at present carried out, or which is likely to develop, will play its part in obtaining maximum production of grass.

C. Artificial Fertilizers[4]

Fertilizers used as a top-dressing undoubtedly constitute the main plank in grassland management on dairy farms at the present time. Provided topography, climatic conditions, and physical qualities of the soil are suitable, ideal milking pastures can be established over wide areas, and the ultimate results obtained in butterfat production depend mainly upon the manurial policy adopted.

The increase in total quantity of artificial fertilizers used for top-dressing pastures has been closely associated with increased production. It is estimated that in 1920 only about 50,000 tons of fertilizers were used on dairying pastures, whereas in 1929-30 the amount had risen to approximately 300,000 tons.

Table CIX

Area of Grassland Top-dressed and Amount of Fertilizers Used

Season	Approx. Area Treated (Acres)	Fertilizers, in Tons
1926–27	1,414,264	179,748
1927–28	1,834,366	237,602
1928–29	2,534,496	307,897
1929–30	2,650,748	335,276
1930–31	2,432,438	*
1931–32	2,454,321	*
1932–33	2,438,114	*
1933–34	2,249,170	*

*Figures not available.

There is no enumeration taken for dairy pasture top-dressing separately

4. See Chapter XIX.

from sheep pastures, but the following figures indicate the trend in practice. It will be noted in Table CIX that low produce prices have been responsible for a diminution in the area treated during the past four seasons.

The greatest proportion of fertilizers used is in the form of phosphate, but during recent seasons attention has been directed towards composite manuring in the form of nitrogen and potash following phosphatic applications. Work carried out by the Department of Agriculture indicates that distinct advantages may be derived from nitrogenous applications at certain times of the year, with the primary object of encouraging grass growth when most urgently required. The correlation of fertilizer utilization to grass growth can be illustrated by showing its correlation to butterfat production over a representative sample of farms, assuming that grass has a definite relationship to production.

TABLE CX

Correlation of the Use of Fertilizers to Production

Butterfat Production per Acre, in Pounds	Total per Acre Expenditure for Fertilizers	Cows Milked per 100 Acres	Cost of Fertilizers per Pound of Butterfat
Range	£		d.
Under 75	0·282	29·2	1·193
75– 99·99 ..	0·364	36·2	1·014
100–124·99 ..	0·413	45·9	0·882
125–149·99 ..	0·539	51·9	0·943
150–174·99 ..	0·512	59·2	0·764
175–199·99 ..	0·669	66·2	0·859
200–224·99 ..	0·735	71·0	0·839
225–249·99 ..	0·550	79·0	0·553
250 and over ..	0·942	86·9	0·803

D. CULTIVATED CROPS

With the increasing adoption of the principles of grassland farming, the plough has been relegated to the background to a considerable extent. Whereas turnips and supplementary fodder crops of an annual nature were at one time looked upon as an essential winter provision, they are now entirely dispensed with on many farms. During the last decade, the area of supplementary crops per 100 cows milked has dropped by over 50 per cent. in those counties which are mainly devoted to dairying.

A recent survey of a group of farms having a total area of 12,859 acres, and carrying 5,292 cows, shows an average area of 5·3 acres per 100 cows under cultivated crops, or 2·2 per cent. of the total area. Thus it will be appreciated that roots and annual forage crops do not play a very important part in the economic structure of specialized dairy farms. Management tending towards the elimination of the plough has been welcomed by dairy farmers, the main reasons being:—

(1) The family labour unit is incapable of great elasticity for field work.
(2) The dairy farmer does not want to be hampered by horse work and by caring for the team.
(3) The tendency towards smaller farms demands that the greatest number of milking cows be carried compatible with the family labour unit available.
(4) The grass area utilized by horses can be devoted to cows to better advantage.

E. Pasture Management

It is necessary at this stage to draw attention to the fact that whilst New Zealand is quoted as an example of efficient pasture management, there is no standardized method adopted, although general principles are well understood.

The trend in pasture management can best be discussed under the following sub-headings:—

1. *Top-dressing*

It is probable that the greatest proportion of the estimated 5,000,000 acres devoted to dairy cows has been top-dressed once or more during the past three seasons, whilst a large proportion has been treated each season with one or more applications. Prior to the season 1928-29, practically the whole of the artificial fertilizers used were in the form of phosphates, the major portion of which were of the water soluble type, although the so-called guanos and basic slag played an important part. There have been decided alterations in top-dressing practice of recent years. Whereas it was originally accepted that one application of phosphate per year was all that was needed, to-day we find many farmers top-dressing the same field two or three times during the season. Late winter and early spring is still the most popular period for phosphate applications, but late summer and autumn top-dressing is now extensively practised on at least part of the farm, with the object of obtaining better winter growth for early-calving cows. Where climatic conditions are suitable, the tendency is to use phosphates at any time, with the object of forcing grass when it is required. The value of out-of-season grass cannot be measured, but it is undoubtedly of great significance in a country depending more and more on grass growth for its stock-food requirements.

2. *Subdivision of Pastures*

Consequent upon improved methods and increased quantities of fertilizers being used, it became apparent that grass growth could not be controlled whilst grazed in large areas. For some years past there has been

a steady movement towards a lowering of the area in each field by means of subdivision. This movement has not been so rapid as could have been wished, owing mainly to the labour and cost involved, and to the irregular shape of many farms combined with unsuitable water supply. The desirability of working in small fields is fully recognized, and the trend in this direction is quite noticeable. On partially-developed farms it is found that the best pastures are fenced in small areas, the quality of pastures decreasing with increasing size of field. On fully-improved farms, where pasture growth is exploited to the maximum, approximate standards have been obtained from experimental work carried out by the Department of Agriculture. These standards[5] may be summarized as follow:—

(a) Fields should be of such a size that they are eaten down in two to three days' grazing.
(b) Stocking should be at the rate of from 12 to 18 cows per acre, according to the fertility of the land.
(c) A good even grass growth three to four inches high will give two grazing days of 24 hours each for 12 to 18 cows per acre.

3. *Cultivation*

Under a system of intensive stocking and manuring, it is found that cultivation of the sward is essential to secure maximum results. A great deal of research work has been done by private individuals and by implement manufacturers to devise the most suitable type of implement under New Zealand conditions. A number of types of heavy harrows have been evolved, the main object being a cutting action rather than a drag, whilst the spreading of animal droppings has not been forgotten. On well-managed grass farms the constant cultivation of the sward with harrows of this type constitutes a routine operation. In the case of farms where systematic grazing is not carried out, an endeavour is made to harrow several times during the year.

4. *Control of Grass Growth*

The combination of systematic manuring, closer subdivision of pastures and cultivation has resulted in a condition of growth the control of which constitutes the great problem in pasture management. The normal seasonal growth gives a bulk of feed which cannot be consumed by the animals which could be carried over the winter without supplementary feed. The problem is, therefore, to obtain a correct balance of stock to grass so that conservation during the flush growth enables a higher wintering capacity, and thus a complete utilization of the grass produced. The necessity of cutting grass to control growth, and the saving of this grass in the form of hay or ensilage has been an additional cause of the diminution in cropped

5. In farm practice it is found that some modification of these standards is necessary and desirable.

area on dairy farms, as a greater winter provision of cured grass has done away with the need for roots and forage crops. Thus we find that, whereas in 1925-26 some 224,777 acres of grass and lucerne were cut for hay and ensilage, and yielded approximately 400,000 tons, in 1933-34 506,318 acres were cut, yielding approximately 1,160,000 tons. Silage has now become a most popular form in which to conserve surplus grass. Under intensive management methods, the practice is to shut up any field which is beyond that stage of growth best suited for grazing, and thus we find that from a third to half the farm may be closed to stock during the spring flush. The tendency is to cut earlier than has been the practice hitherto, thus securing a more leafy and consequently more nutritious silage or hay, and at the same time allowing the aftermath to come away rapidly before drier summer conditions retard recovery of the stubble. This is, of course, of great importance so far as summer and early autumn grazing is concerned, particularly where a large percentage of the farm is being cut and conserved for winter food supply.[6]

The trend in management of grass growth is towards a heavy concentration of milking cows for a short period so that maximum consumption is secured before fouling can take place, and the pasture plants are subjected to a minimum of strain. As soon as the field is cleared to a stage below good milking pasture, the cows are removed to a fresh paddock, and the young and dry stock of the farm are placed on the eaten-out pasture to clear up the remainder. There is a difficulty experienced here, in that a dairy farm does not carry sufficient stock other than milking cows to enable a rigid cleaning-up programme to be carried out. In an attempt to overcome this drawback, some farmers carry ewes to act as followers, the practice proving quite successful from a pasture control viewpoint. As soon as the follow-up stock have been removed, the field is topped with the mower to remove roughage and then harrowed, manured if necessary, and closed to await its subsequent grazing term.

IV. CAPITAL EMPLOYED AND LAND TENURE

A consideration of the capital represented by dairy farms of the Dominion is of the utmost importance in discussing the economic aspect of the industry. Unfortunately, no records are available to facilitate an accurate statement, but there is sufficient evidence on which to base a reliable estimate. It is recognized that dairy land in New Zealand probably carries a higher capitalization than similar quality land in any part of the world. Although dairying land has sold at high prices for many years, an acceleration in credited values took place at the end of the war. This movement reached its zenith in 1920-21, when the guaranteed price for

6. Of late years considerable stress has been laid on the importance of adequate winter feed if the cows are to 'come in' in good condition.

butterfat was thirty pence per pound. With the loss of the guarantee in the following season, inflation of land values ceased and the drop in price to fourteen pence halfpenny in 1921-22 caused new landowners to seriously consider their position. There is no doubt but that the total assumed value of dairy land in 1921 was considerably higher than in 1929. In other words, a gradual deflation set in with a return to semi-normal conditions. The capital position at that time was particularly serious owing to the low standard of production on newly-acquired farms. The necessity to meet interest indebtedness and other fixed charges was, to some extent, responsible for the efforts made to increase production which resulted in the doubling of total output in nine seasons. It must be remembered that all dairying land, or land dependent upon dairying for its maintenance, was not bought at high prices. The assumed value of farms which had been held previous to inflated values rose in sympathy with actual sales, and thus the accredited value of dairy farms was represented by owners' assumed equity in many cases. This assumed value has become real value with the passing of time, particularly as rateable values have been adjusted on the basis of sales, and such readjustments have become recognized as security for borrowing purposes. Therefore, the present capital position of the industry must be considered on the basis of assumed value rather than actual money represented by purchase price. The fact that all land embraced within dairy farms has been improved is some justification for this position. The capital represented by the dairying industry can best be discussed under the headings of:—

A. Land and Improvements; B. Stock; C. Equipment.

A. Land and Improvements

In discussing the value of dairy farms it is accepted for present purposes that the value quoted covers land, fences and water facilities, house, sheds and stationary machinery such as milking plant and separator. The following assessment of the capital represented by the industry covers all these items, the details of which are discussed as subsections. The accredited value of farms roughly varies from fifteen to eighty pounds per acre according to location and stage of development. There are considerable areas of land devoted to dairying which have a lower value than quoted above, those areas being portions of mixed farms on which some cows are carried. The average assessed value of all dairy land and improvements is approximately twenty-five pounds per acre, or a total of £125,000,000 as the capital represented in the industry under this heading.

B. Stock

Livestock on dairy farms in 1933-34 was comprised of 1,932,511 cows; 60,478 bulls of service age; approximately 365,000 heifers rising two-year

old; 380,000 heifer calves; 116,000 breeding sows and boars; and in the vicinity of 50,000 horses. Practically the whole of this stock has been bred on dairy farms (horses excepted) and can be given a conservative valuation of £20,000,000.

C. Equipment

Moveable equipment embraces machinery such as mowers, hay rakes, sweeps, stacking plants, drays, manure distributors, and harrows, etc., harness, milk and cream cans, buckets and tools of all descriptions. It is estimated that a total sum of £6,000,000 is represented by this class of equipment.

The total estimated capital represented by the dairy industry can therefor be summarized as follows:—

Land and stationary improvements	£125,000,000
Stock	20,000,000
Equipment	6,000,000
	£151,000,000

V. THE LAYOUT OF SHEDS AND FARMS

A. Sheds

The details of milking sheds and yards have received a great deal of attention during recent years. In planning, essentials which must be considered are the relationship of shed to milk and engine room so that the layout conforms to regulations; economy in labour utilization; economy in cost of erection.

The situation of the milk room and power unit in relation to the milking shed itself is of great importance in facilitating attention from the operator. The whole unit is therefore housed under one continuous roof so that the attendant can step from one to another with a minimum of effort, being under cover at all times.

Whether an electric heater or a fired copper is used for providing hot water, it is essential that the supply be as near the separator and milking machines as possible. The boiler and washup tubs are therefore situated in the milk room itself or under a verandah adjacent to the milk room. In the case of a shed supplying whole milk to a cheese factory, the layout is somewhat modified as a milk stand takes the place of the milk room in a shed where separation is done. In this case the power room is close to the milking shed, the vacuum tank and releaser being placed in a position suitable for delivery of milk to the milk cans. Bails and dummies are so arranged that the operator has room to move between the pair of cows in one compartment. In modern sheds the walk-through type of bail has completely superseded the old back-out type. The door at the head of the

cow is operated by a lever from the back of the bail so that on completion of milking the cow is released immediately into the race running at the back of the shed. In many instances there is no race at all at the back of the shed, cows on completion of milking being liberated into a yard or into the main farm race. Where this is the practice, an undesirable condition of mud and poaching is found which is entirely done away with by the provision of a concreted race three feet wide which delivers milked cows into the open farm race and then straight back to pasture. This provision is of tremendous importance in obviating unpleasant conditions and conserving labour. Concrete floors to yards and sheds are now looked upon as an essential feature. To facilitate washing down, floors are built with a fall to a common gutter leading to a drainage sump. The yards are not roofed, but it is seldom essential for the attendant to go into the yard to bail up. Cows become so trained that they enter the bail themselves as soon as one becomes vacant.

There are unfortunately many milking units which are not all that could be desired, but the objectionable shed is rapidly disappearing. Inspection and instruction combined with the general desire on the part of farmers to improve working conditions, are all tending towards an improved environment for the production of milk products.

B. Farm Layout

The layout of a farm is to a great extent controlled by its shape, but the one principle kept constantly in mind by the more intelligent farmer is to so arrange subdivision that stock need not be taken through one field to get to another. Therefore the central race or road has become a feature of all small dairy farms. In locating the shed and yards, consideration is given to water supply and drainage, but it should be placed in a strategic position in relationship to the subdivision of the farm. Wherever possible it is placed on the centre line so that the main race may be projected through the centre of the farm with fields opening off the race on either side. Modifications of this scheme are necessary in many instances, but the object is to reduce the total area of the race to a minimum whilst maintaining the principle of all fields opening off it. The location of the shed in relation to the race is determined by the direction of prevailing winds, the object being to have the open side of the shed protected, the milk room being placed at whichever end provides that the wind is from the milk room to the shed, thus preventing, as far as possible, the contamination of milk or cream by odours from the shed.

C. Machinery

Machines in use on dairy farms can be discussed under two headings :— 1. Machinery of the milking shed. 2. Machinery suited to grassland

farming. Figures available showing the utilization of machinery in milking sheds, are given in Table CXI, but the trend in demand of certain types of machinery occasioned by improved grass farming can only be discussed in general terms.

1. *Machinery of the Milking Shed*

(a) *Milking Machines.* There are at least seventeen makes of milking machines on the market, of which only one is imported, New Zealand patents and manufacturers controlling the position. Although minor improvements are certainly being made, there have been no radical changes in design or operation of recent years.

On farms where dairying is the sole source of income milking machines are practically universal. On mixed farms or on farms where only a few cows are milked hand milking still persists.

TABLE CXI

Machinery in Milking Sheds

Season	Total Milking Machines	Total Separators	Total Electric Motors	Total Internal Combustion Engines
1919–20	8,806	26,678	275	13,981
1924–25	15,561	44,656	3,451	19,894
1929–30	20,415	48,302	16,456	19,169
1930–31	22,547	47,112	22,520	22,136
1931–32	23,222	51,334	24,164	20,974
1932–33	24,350	54,200	26,757	21,667
1933–34	25,178	55,625	29,164	21,758

(b) *Separators.* The introduction of home separation and cream collection by dairy factories has had a far-reaching effect in the extension of dairying into districts badly roaded or some distance from factories. The use of these machines has enabled farmers milking a few cows mainly for house supply to become factory suppliers and thus we find separators are more numerous than the number of commercial farms would suggest. The Swedish Alfa Laval Company, with its numerous gradations of size of machines, dominates the market, the English Lister being its chief competitor.

(c) *Power Plants.* Power units on dairy farms are either internal combustion engines or electric motors. Consequent upon the reticulation of the greater portion of the North Island dairying districts, electric motors have replaced internal combustion engines on many farms, and all new installations or replacements are electric wherever current is available. The average nominal horse power of all motors is 1·74. Units below one-horse power are mainly used for pumps or separators. Whilst a one-horse power

motor is sufficient for a two-cow plant and separator, a four-cow plant needs a two-horse power unit to allow a margin of safety.

Approximately 80 per cent. of the electric motors installed are of Swedish manufacture, mainly owing to the fact that the supply was available from that source when required, and their performance has been satisfactory. English motors are now available at competitive prices.

2. *Machinery Suited to Grassland Farming*

The big movement in machinery improvement is in implements essential to management in grassland farming. There are no figures available to indicate actual usage, but all specialized dairy farms are equipped or will be equipped with improved machinery as occasion permits. The primary essentials in grassland management machinery are:—Reasonable price: simplicity of action and a minimum of frictional parts; and strength and durability, with spare parts easily replaceable.

(a) *Manure Distributors.* The development in top-dressing of dairying pastures makes a manure distributor an essential part of the equipment of a farm. The use of highly concentrated finely ground manure, particularly nitrogenous fertilizers which are inclined to cake, has led to a great amount of research on improved types of distributors. The outstanding feature is the introduction of roller or slide feed in place of the star feed type, the simultaneous crushing and distributing action being an advantage.

In addition to the general conditions previously laid down for farm machinery, manure distributors should have the following qualifications:—

(1) Ability to distribute any fertilizer in any weather.
(2) Accuracy in delivery of quantity and in evenness of spreading on flat or undulating land.
(3) Sensitive adjustment to facilitate light applications of concentrated fertilizer.

Of recent years there has been a definite effort to adapt manure distributors to operate from motor vehicles, with a fair measure of success. As high as twenty acres per hour can be treated with these machines, and further development is expected.

(b) *Harrows.* Consequent upon the recognition of the necessity for grassland cultivation, there has been a decided movement away from the rigid frame harrow to flexible types, which are more efficient spreaders of animal droppings owing to their adjustability to surface irregularities. At the same time they ensure cultivation over the whole surface.

The specifications looked for in flexible grassland harrows are:—

(1) Maximum contact with the surface irrespective of contour.
(2) Tines spaced to evenly cultivate, and to spread all manure.
(3) Tines which will cut rather than drag.

(4) Ability to clear itself.
(5) Ability to regulate severity of cut.
(6) Weight must be sufficient to maintain a cutting contact.
(7) The harrows should be built in units allowing additions to be made to suit any power.
(8) Ease of resetting or replacing tines.

(c) *Mowers.* Under heavy manuring and rotational grazing conditions where all grass is being fed to its best advantage or conserved as winter feed, the mower is constantly in use and its strength and durability are of paramount importance. It is expected to cut light roughage after grazing as well as pasturage in different stages of growth. The mower must therefore be adaptable to all classes of work from very light to dense, short succulent grass, and must be capable of being set close to the ground.

(d) *Collecting Machinery.* A rapid change over from hay to ensilage as a means of conserving surplus grass has brought the problem of effective and rapid collection in its train. The conversion of short grass into ensilage complicates the position as it is more difficult to collect than mature material. Improvements are continuously being effected in sweeps and hoists, the essentials in collecting machinery whether of the elevator or sweep type being:—

(1) A minimum labour requirement.
(2) Ability to collect cleanly, direct from the swathe.
(3) Ability to collect any length material.
(4) Delivery at the stack, pit or silo in a form requiring the least possible handling.

Stack silage is the most common method of conservation, the grab hoist being the general method used for elevator purposes. It is cheap in construction, portable, and fairly light in labour requirement.

VI. HERD MANAGEMENT AND LABOUR

A. Breeds

The breed composition of the milking herds of New Zealand has changed considerably of recent years, the outstanding movement being a rapid increase in light-weight Jersey strains,[7] whilst heavier breeds have not maintained their position even so far as numbers are concerned. Consequently the percentage of the total represented by Milking Shorthorns and Friesians has shown a marked decline.

The main factors contributing to the increase in light-weight milking animals are:—

7. The change has been a gradual one. The usual method has been to breed from Shorthorn cows by a Jersey bull, and then to breed from the offspring by a Jersey bull, and so on. Hence, after the third such breeding the offspring are, to all intents and purposes, Jersey cattle.
The change has been more marked in the Waikato than in Taranaki and Southland. Jersey milk, with its high butterfat content, is more suitable for butter-making, while the heavier breeds, which are more numerous in Southland and Taranaki, have a lesser butterfat content in their milk, and so such milk is more suitable for cheese-making.

1. Ability to carry a larger number of effective milking cows per given area.
2. High butterfat content of their milk, which is particularly suited to butter manufacture.
3. Early maturity.

The heavier breeds are still favoured in some districts, especially those where cheese is the main dairy product. They are more suited to heavy land where a large bulk of grass is produced, and to the colder climate of the South Island.

Of the total dairy animals, approximately 2·9 per cent. were registered pure-bred in 1928, against 2·3 in 1924.

The percentage of the total dairy animals of the Dominion represented by main dairy breeds are given below for the years 1924 and 1928. No enumeration has been made since the latter date.

TABLE CXII

Breeds of Dairy Cows

Breed	1924	1928
Jersey	47·5%	63·3%
Milking Shorthorn	34·9%	22·1%
Friesian	14·8%	12·0%
Ayrshire	2·8%	2·6%
Total	100·0%	100·0%

B. PRODUCTION

The term 'production' has in the past been used mainly in connection with the production of individual animals or of the herd. Of recent years it has been realized that the average production of herds and the standard attained by isolated cows are not complete measurements of management efficiency. When total production is coupled with the area dependent upon the herd, a direct measurement of efficiency is provided. Therefore in modern dairy farm parlance, 'production' is generally applied to the standard of production which is reached per acre of land farmed. The factors which directly control the standard of production per acre on dairy farms are:—

1. The carrying capacity of effective milking cows per unit of area.
2. The average standard of production attained by the herd.

In the final analysis the combination of these two factors determines per acre production. There is a certain amount of controversy as to the relative effect of increased carrying capacity and increased herd averages on the final standard of per acre production achieved. The two factors are so interdependent that any measurement of effect is difficult. It has been constantly illustrated in practice that high herd averages are definitely

associated with high carrying capacity, or, in other words, that in the process of improving land to effect a higher carrying capacity, conditions are created which automatically tend to increase production from all the animals carried. The fact that these two features are so interdependent makes it impossible to create a stable condition in one whilst improving the other. There is, however, sufficient evidence to prove that on land not fully developed, an improved carrying capacity is the first essential in raising per acre production, improved average yield per herd becoming to some extent automatic. As carrying capacity nears saturation, the significance of herd average increases in importance until it becomes the major consideration.

1. *Carrying Capacity*

During the period 1921-22 to 1933-34, the average carrying capacity of effective milking animals over all land devoted to dairying has increased from approximately 28 to 40 cows per 100 acres. As indicated elsewhere, this has been achieved by an improved standard of grass production, combined with subdivision of pastures and more economic utilization of pastures by milking stock. Although a great deal yet remains to be done in the direction of pasture conservation, the balance between winter and early summer stocking is distinctly improved and grass is not wasted to the same extent as was the case some years ago. Despite the fact that carrying capacity has been so increased on a ration comprised more and more of green pasturage or grass in a preserved state, the range in capacity is extremely wide. Table CXIII gives some indication of the position on 2,547 farms which represented approximately 10 per cent. of the total cows in New Zealand as at the date of investigation.

TABLE CXIII

Frequency of Different Intensity in Carrying Capacity

Range of Cows per 100 Acres	No. of Farms in Each Group	Percentage Distribution	Average Cows per 100 Acres	Average Cows per Farm	Average Size of Farm. (Acres)
0–10	137	5·38	6·67	36·00	540
10– 20	328	12·88	15·15	43·03	284
20– 30	440	17·27	24·79	46·92	189
30– 40	537	21·08	34·94	49·28	141
40– 50	481	18·89	44·43	53·70	121
50– 60	325	12·76	54·03	58·28	108
60– 70	169	6·64	64·03	56·61	88
70– 80	65	2·55	73·58	64·38	87
80– 90	35	1·37	83·30	45·77	55
90–100	17	0·67	94·32	69·12	73
100–110	10	0·39	103·90	57·90	56
110–120	1	0·04	110·90	51·00	46
120–130	1	0·04	124·00	62·00	50
130–140	1	0·04	134·00	134·00	100
Total ..	2,547	100·00	—	—	—

Although this tabulation relates to the position in 1931, the range of variation shown is still typical of the position. It will be noticed that of these 2,547 farms, approximately 18 per cent. have a carrying capacity of milking cows of less than 20 per 100 acres. These farms may represent low quality land, small areas where cows are incidental to other sources of income, or larger farms where a small portion is used for milk production, the remainder being unproductive, but a burden on the dairy herd. Going to the other extreme, some farms recording very high carrying capacity have a hidden area which should be debited to the herds as they represent farms where the practice is to winter all cows away for a period of from two to three months. Wintering away is a regular custom in certain districts where winter soil moisture is excessive, or on farms where a heavier carrying capacity is aimed at during the lactation period, in an attempt to increase per acre production. The cost of wintering stock is approximately two shillings per head per week, and where suitable grazing can be obtained and attention assured, the additional density made possible during the lactation period makes this a sound proposition.

As an illustration of stocking on farms of the better type, Table CXIV should be studied. This sample of 386 farms is taken from good dairying districts, farms having a large percentage of unproductive land being omitted. Likewise, there are no "wintering away" farms in this group. It will be seen from both tabulations that low density of milking cows is associated with small herds on large holdings, cow density and average size of herd tending to vary inversely with size of farm.

TABLE CXIV

Carrying Capacity of Typical Dairy Farms

Range of Cows Milked per 100 Acres	Farms in Each Group	Percentage Distribution	Average Cows per 100 Acres	Average Cows per Farm	Average Area of Farms. (Acres)
10–20	13	3·37	16·9	40·9	243·8
20–30	45	11·66	25·6	36·3	141·3
30–40	127	32·90	35·1	38·6	110·0
40–50	102	26·42	44·2	39·3	89·0
50–60	64	16·58	53·3	46·8	91·9
60–70	29	7·51	63·6	45·7	71·0
70–80	4	1·04	71·9	51·2	71·3
80–90	2	0·52	83·4	53·0	65·0
Total ..	386	100·00	—	—	—

Dairy farms which are independent units effecting replacement within the herd, carry a considerable amount of supplementary stock during the milking season. The average over the whole of the farms in New Zealand amounts to 47 head of other dairy animals to every 100 milking cows, this number being made up as follows:—

Heifers, rising two years old	20·0	
Heifer calves	22·0	
Stud bulls, two years old or over	3·5	
Young bulls	1·5	(estimated)
Total	47·0	

Although calves do not represent a serious factor in their early stages, they must be considered especially in the late summer and autumn when growth is rapid. At the close of the milking season the number of mature animals is reduced by culling preparatory to drafting in-calf heifers into the herd. During the winter months, yearling heifers must be well fed to prepare them for service in the latter part of August. Therefore, in discussing carrying capacity of dairy farms it must be remembered that in addition to milking cows, stock equal in numbers to 25 per cent. of the total milking herd is wintered, this figure rising to 47 per cent. at certain times of the year.

2. Production of Butterfat per Cow

For many years past the slogan of Herd-testing Officials, breeders and leaders of the dairy industry has been: 'Increase your cow yields.' The combined efforts of all these agencies have undoubtedly had their effect, and are reflected to a great extent in the improved average production of the Dominion, which has been rising with minor seasonal fluctuations each year. The trend in per cow production (in pounds of butterfat) has been given in Table CV.

This average is based on all dairy cows, whether in milk or dry as at the 31st of January each year, and is, therefore, a reliable index of the trend in production. Cow performances have an extremely wide range, even within individual herds, whilst within districts individual cow yields may range from 150 to 1,000 lbs. of fat per year. Whereas a few years ago, 250 lbs. was the recognized standard aimed at in herd averages, the fact that 300 lbs. is the common objective to-day indicates the psychological effect of

TABLE CXV

Frequency Distribution of Herd Averages

Range of Herd-Production Average lb.	Percentage of Total Herds Represented	Average Production per Head lb.
Under 150	3·6	107·7
150–200	15·9	175·2
200–250	36·4	225·4
250–300	34·2	275·2
300–350	9·2	318·6
350 and over	0·7	366·7

advancement upon farmers, and is an encouraging sign for the future. On specialized dairy farms the common range of herd averages is from 150 to 350 lbs. per cow. The frequency of recurrence in herd averages is indicated by Table CXV, covering an estimated position for all cows in the Dominion.

This wide range of herd performance on commercial dairy farms is an indication of the variations in both farm and herd management. Cows in the lower groups are undoubtedly inferior agents for the conversion of grass into butterfat, but it can be accepted that most, if not all, of them are capable of higher production if provided with a greater quantity of more nutritious grass. A provision of better milk-producing pastures is more rapidly attainable than is a compensating improvement in the inherent capacity of herds, and the gradually increasing application of accepted modern grassland management methods is undoubtedly supplying this requirement. It is now recognized by farmers that cows of high-production strain are wasted on low-quality pastures, and we therefore find improved grassland management and careful consideration of breeding principles being practised simultaneously in the constant endeavour to raise herd averages.

3. *Per Acre Production*

It has been previously stressed that butterfat produced per acre of land devoted to dairying is the accepted measure of development and efficiency in management. This statement needs to be qualified to the extent that increased per acre production should be accompanied by a decreasing or at least a stationary cost per unit of production.

It has been stated under previous headings that per acre production is the final result of a combination of factors. The relationship of these factors is illustrated in Table CXVI, which is a summary of the data from 550 farms situated in the North Island,[8] and applying to the 1933-34 milking season.

TABLE CXVI

Per Acre Production and its Controlling Factors

Butterfat per Acre Range lbs.	Farms in Each Group	Cows Milked per 100 Acres	Average Butterfat per Cow lbs.	Average Area of Farms Acres
Under 75	68	29·2	195	191·7
75– 99·99	87	36·2	238	143·5
100–124·99	108	45·9	245	137·1
125–149·99	105	51·9	264	116·5
150–174·99	84	59·2	272	91·3
175–199·99	53	66·2	282	82·1
200–224·99	29	71·0	296	83·2
225–249·99	10	79·0	302	75·4
250 and over	6	86·9	324	85·6

8. Though most of the above discussion has been based on the North Island, it must be remembered that the North Island produces over 80 per cent. of the dairy produce.

The conditions governing the standard of per acre production can then be summarized as:—

(a) Carrying capacity, measured by the number of effective milking animals per given area. This, in its turn, is governed by the stage of development reached in grassland management, and the type of cow carried.

(b) The herd performance, measured by butterfat produced per cow, which is governed by quantity and quality of grass available, and the manner in which its consumption is directed, plus the type of cow used in its conversion into butterfat.

(c) The standard of development reached in the preceding factors is to some extent associated with the area of land operated upon by individual farmers. Although there are exceptions to the rule, the highest stage of development is found on small areas.

In considering possible development of the future, the area represented by farms in each production group is of great importance. It is found in practice that increased per acre production is most readily obtainable on those farms grouped round the modal point, and as farms comprising the groups at this point are on the average larger than those of higher production, an increase of fat per acre from them materially affects the general average for all farms.

C. Stock Replacement

The exploitation of the potential ability of land to carry milking stock has complicated the problem of cow replacement. During the past 14 years this exploitation has necessitated an average annual addition to our herds of over 6 per cent. measured by the base year, and this fact has had a retarding influence on the production quality of the average cow, as the choice in replacing culled animals has been narrowed. As noted previously, heifers rising 2 years old amounting to 20 per cent., and heifer calves amounting to 22 per cent. of the total cows, are carried on dairy farms for replacement and increase purposes. The higher percentage noted for heifer calves is the normal provision for wastage. The aim in cow replacement is to draft into the herd heifers rising 2 years old which have been bred from cows with a production standard above the average for the herd. This, combined with the endeavour to calve heifers as nearly 2 years old as possible, restricts the choice of heifers considerably. The law of averages determines that 50 per cent. of the herd is on or above the average level of production. Of this 50 per cent., half are likely to drop bull calves. Therefore, the chances are that only 25 eligible heifer calves will

be obtained from every 100 cows. Of these 25, some will be from diseased cows which calved irregularly, or from cows calving very late in the spring. As the endeavour is to commence lactation in July, heifers from cows which calved in September, October or possibly November, are not most suited for inclusion in the herd. Owing to the combination of these factors, replacement stock has not always been of the best type, thus hampering development in the general herd average. The necessity of carrying a large quota of young stock for replacement purposes is materially retarding carrying capacity of effective milking cows, and consequently the standard of per acre production. The operation of this fact has led to modifications in replacement practice under certain conditions. The average net replacement varies round 14 per cent. of the milking herd, giving an average life of approximately seven years. Replacements are necessitated through a number of causes, true culling for low production and old age accounting for approximately 59 per cent. of the total, whilst the remaining 41 per cent. represents accidents and disease.

There is a general endeavour to make dairy farms self-supporting, but this rule is departed from on small farms where it is essential to carry as many effective milking cows as possible, on farms where, owing to winter soil-moisture conditions, stock is wintered away, and on farms where the herd average is low and bought-in heifers are used to more rapidly increase production. Heifers are available from farms where, owing to good pasture or a stabilized position, it is possible to rear a surplus beyond requirement, or from farms run by dealers who buy calves and dispose of them as in-calf heifers.

Culled stock is disposed of in various ways, the chief being: (1) Sold direct to meat-works as boners; (2) sold to dealers who sell to works or fattening farms; (3) fattened on the farm and sold to works or to butchers. The practice of putting cull cows in saleyards for disposal is disappearing, and instances of culled animals being passed on to other farmers are less frequent than was formerly the case.

D. Cow Testing

The systematic testing of dairy cows on yield has now become an integral part of management on many farms. The original conception of testing cows was the provision of a measure which would facilitate intelligent culling of inferior stock. Undoubtedly this purpose has been fulfilled in many instances, but factors beyond the immediate control of farmers have mitigated against culling on test to a great extent. Deaths and forced culling through disease and calving difficulties have assumed a significance which narrows down the number of sound but low production cows of which the farmer can economically dispose, and thus the use of

testing data is restricted. The great service rendered the dairy industry by cow testing has been the provision of a measure by which any farmer is able to study his farm and herd management. The element of competition introduced through the press and agricultural publications, as well as direct competition fostered by the Herd-testing Federation and individual associations, has spurred farmers on to greater effort and improved management, and thus testing has become a factor of incalculable value in the life of the industry.

E. Labour

Dairying in New Zealand is organized mainly on the basis of the family farm. In the earlier history of dairying in the Dominion, and particularly before the introduction of the milking machine, extensive use was made of female and juvenile labour. However, in post-war years there has been a steady reduction in the real amount of such labour employed, part of the explanation being the increasing use of labour-saving machinery.

The following table, giving the results of an investigation into 1,654 farms, shows the comparatively uniform number of cows milked per male unit of labour, with a slight tendency to increased labour efficiency on small farms with high herd averages. This latter factor is reflected also in the butterfat produced per unit of male labour and in butterfat per acre:—

Table CXVII

Labour Efficiency

Butterfat per Acre Range (lbs.)	Average per Unit of Male Labour			Average		
	Cows Milked	Area (Acres)	Butterfat Produced (lbs.)	Area of Farms (Acres)	Cows Milked per 100 Acres	Butterfat per Cow (lbs.)
180–over	19·4	30·70	5,833	76	62–over	300
160–179·9	19·0	32·35	5,500	80	67–61	290
140–159·9	18·5	34·40	5,167	84	52–56	280
120–139·9	18·2	37·18	4,833	90	47–51	266
100–119·9	18·0	40·91	4,500	102	42–46	250
80– 99·9	17·9	46·30	4,167	120	37–41	233
60– 79·9	18·0	54·76	3,833	144	31–36	213
40– 49·9	18·2	70·00	3,500	176	22–30	192
Under 40	18·2	105·57	3,167	214	Under 22	169

As a direct result of improved farm and stock management, and the use of labour-saving machinery, the general level of labour efficiency on dairy farms has been raised materially during the past decade. Taking butterfat production as the measurement of this increase, we find that the index of production per unit of male labour recorded as being employed principally on dairy farms, has risen by over 60 per cent. in the last 14 years.

VII. MAJOR SOURCES OF FARM INCOME

It has been mentioned previously that the organization of dairy farms in New Zealand goes through a range of intensity gradating from true dairy farms when the total income is primarily derived from cows, to the other extreme, where cow products account for a minor portion of total receipts.

True commercial dairy farmers realize on their produce in the form of butterfat, and derive additional income from the disposal of culled stock (which may or may not show a credit balance in the stock account), from pigs, and from vealer calves. In many instances, poultry products represent a sideline, but are not generally looked upon as a part of the farm organization.

For the purpose of this article, the only items which need be discussed are butterfat, pigs and vealer calves.

A. Butterfat

Over the period 1921-1930, the average payout for all butterfat supplied to factories has been 17d. per lb. This period excludes the last war-control season, 1920-21, when the payout was 30d. per lb. In 1930-31, the payout was about 1/- per lb, in 1931-32 it was about 11d. per lb., and in 1932-33 and 1933-34 about 9d. per lb.

Irrespective of the general level of payout in any one season, there are irregularities in payout for fat converted into the same commodity between districts, and for fat converted into different products in any one district. The variation in payout for butterfat directed to butter or cheese within a district depends on the disposal value of those products, whilst the district range for butterfat converted into the same product is mainly due to factory organization and marketing procedure. It is not uncommon to find a range of over 1d. per lb. in payout between factories in the same district, manufacturing the same type of commodity.

B. Pigs

The exploitation of pigs as consumers of skimmed milk and whey is not as thorough as might be expected. Although most farmers recognize their value, many do not keep them at all, whilst others give them but perfunctory attention, in spite of the fact that on some dairy farms where pigs are given the attention they deserve, returns above expenditure amounting to £5 for every cow milked have been obtained from pig products.

There are two distinct systems practised on farms keeping pigs:—

(1) The farmer breeds pigs to sell as weaners as well as for fattening purposes on his own farm.

(2) The farmer keeps no breeding pigs, but buys in weaners as required.

The proportion of sows breeding two litters a year is small, the aim being to produce the largest number of fattening pigs when milk is plentiful, and thus save the cost of keeping stores through the winter.

Prices to be obtained for stores carried through the winter, and fattened in the early spring, are higher than at other times of the year owing to local demand, and the practice of wintering on roots and meat-meal is likely to develop.

The aim in breeding is to produce a moderately long-bodied animal which has rapid-fattening characteristics, and for this purpose a Tamworth-Berkshire cross is favoured.[9]

C. Vealer Calves

Prior to the season 1927-28, it was customary to kill all surplus calves on the farm, and dispose of their skins only. The trade, which is known locally as 'The Bobby Calf' trade, developed during that season, and has extended rapidly each year since. Under this system of disposal, calves are collected by motor lorry and delivered at freezing-works, where they are slaughtered and packed as boneless veal. The main regulation governing this trade is that calves must be at least five days old before slaughtering, and that the carcasses be reasonably matured. In the season 1927-28, about 160,000 calves were slaughtered for veal, the number rising to 614,000 in 1932-3, the greatest proportion being of 'The Bobby Calf' type. In addition to the saving of labour on the farm itself, this system of disposal ensures a maximum return for surplus calves, and has been generally adopted on farms within reasonable range of freezing-works, but the restrictions on meat exports introduced in 1934 are likely to seriously hamper this trade.

VIII. CONCLUSION

The dairying industry of New Zealand has been developed over a wide range of soil conditions, the controlling factors being topography, temperature, and rainfall. In its early stages it was realized that where suitable conditions prevailed, cows could be kept on grass alone throughout the whole year. This, combined with the fact that a family could be maintained with the investment of a very little capital, led to its rapid expansion. The demand for dairying land created a position where high prices were paid for farms, which in its turn necessitated increased production at reduced costs, to enable interest charges to be met. In striving to safeguard the capital position, a system of grassland farming has been developed, demanding the minimum of labour and maintenance costs. Under a condition of high prices for butterfat such as that prevailing during the nine years prior to the season 1929-30, large sums of money have been expended on improvement of farms and herds, resulting in an increased

9. See next chapter (XXII) for a fuller discussion.

carrying capacity per unit of area, the cows carried being of an improved type for the economic conversion of grass into butterfat. These two factors combined have resulted in an increased production per unit of area farmed, and in conjunction with labour-saving machinery have facilitated a greater labour efficiency.

Improved carrying capacity has been effected by an extension of the practice of top-dressing, followed by the more complete utilization of herbage produced, either in the form of green grass or grass conserved as hay and silage for winter use. Subdivision of pastures has materially facilitated the better utilization of grass produced. The improvement in average-cow production has been brought about by herd-testing, breeding from proven animals, and the provision of adequate food in a more nutritious form.

The extended application of knowledge gained has had a cumulative effect in increasing production, and has placed the farmers of New Zealand in a position which enables them to further augment their output under suitable conditions. The rapid and acute drop in the prices of dairy produce during the latter end of the 1929-30 season, and its continuance, has placed an entirely different complexion on the industry. Undoubtedly the normal expenditure on maintenance has been temporarily restricted, but a Dominion-wide recognition of the fact that the surest and most economic method of reducing costs is to increase per acre production, has resulted in a rapid increase in total output. It is as yet too early to foresee the outcome of a lowered price level, but the country's dependence on the dairy industry to meet a large percentage of the interest on its external debt is fully recognized. So also is the fact that with lower prices a greater bulk of produce is required to meet those charges, and that the spending power of the community is adversely affected. Therefore, so long as external markets are open, every endeavour of the individual and the State must be towards an increased output.

Whilst increased production is the aim of farmers, research in manufacturing methods is being exploited to improve quality and reduce manufacturing costs, and thus ensure producers the highest possible return under adverse price conditions. The fact that farmers, factory directors and the Legislature are alive to the criticisms at present levelled at our dairy produce engenders confidence in the future, and will eventually ensure that everything possible is done to meet the demands of our markets. Although the dairy industry, in company with other branches of primary production, is at present shrouded in a cloud of depression, the organization of the farmer is in a better condition than it has ever been from a production viewpoint, and the industry is in a position to take advantage of any price movement in its favour.

CHAPTER XXII

THE UTILIZATION OF SURPLUS DAIRY BY-PRODUCTS BY PIG RAISING

BY C. P. MCMEEKAN

I. General Relationship of Pig Raising and Dairying—A. By-products Available—B. Special Characteristics of Dairy By-products—C. Pigs for Utilizing Dairy By-products. II. Relation of Pigs to Dairying in New Zealand—A. Pig Population and Distribution—B. Pig-Cow Ratio—C. Production, Local Consumption and Export—D. Incomplete Utilization of Dairy By-products. III. Husbandry Systems—A. Home Breeding: 1. Weaner Costs; 2. Weight of Weaners—B. By-products Available—C. Feeding Systems—D. Management Systems: 1. The Sow-Cow Ratio; 2. Methods of Disposal; 3. Time of Farrowing; 4. Housing and Layout; 5. Management of Second Litter—E. Type of Pig. IV. Returns from Pig Raising. V. Future of the Industry.

I. THE GENERAL RELATIONSHIP OF PIG RAISING AND DAIRYING

EXAMINATION of the principal butter and cheese producing countries of the world shows the intimate relationship which exists between pig-raising and dairying; all such countries are producers of pigs, and within each, pigs are invariably more concentrated on the dairying areas. Denmark, Irish Free State, Holland, and New Zealand, in varying degrees, all illustrate this situation. Denmark provides the outstanding example. While supplying approximately one-third of the British imports of butter, and holding the position of the largest exporter of butter in the world, Denmark also supplies roughly one-half of the British trade in pig products. In 1932, out of a total import of bacon amounting to 11½ million cwts., Denmark supplied 7¾ million cwts., valued at nearly £21,000,000.[1] She has developed her pig industry side by side with and subsidiary to her dairy industry, until her exports of pig products rival her butter exports, both in volume and in value.

The basic features of the association of pig-raising with dairying may be discussed under the following heads:—

A. BY-PRODUCTS AVAILABLE AND NECESSITY FOR UTILIZATION

Resulting from the production of butter and cheese, the by-products, separated milk, whey and buttermilk, are available for other purposes. On dairy farms practising home separation of milk, the sales of cream provide the greater part of the revenue. The cream, however, represents only about 10 per cent. of the weight of the milk from which it is produced, and although it accounts for 97-98 per cent. of the butterfat produced by the herd, there remains in the separated milk a trace of the butterfat and the bulk of the non-fatty solids. These solids, amounting to 9·5 per cent. in an average sample, have a high food value. In its liquid form, separated milk

1. An. Report, N.Z. Meat Producers' Board, 1933.

is not saleable, while extraction of the solids on the farm is not economically possible. Thus its value to the farmer depends upon its successful utilization as a food for some productive animals, such as calves, pigs or poultry. Cheese-making utilizes more of the solids of milk than butter manufacture. Nevertheless, fully 40 per cent. of the original milk solids pass into the whey, and although they have a lesser food value than those of separated milk, they still have an appreciable recoverable value when properly utilized.

Similarly, buttermilk, resulting from the churning of cream, contains most of the non-fatty solids of the cream, and has a composition approximating that of separated milk. Roughly, 260 gallons of buttermilk are available from each ton of butter produced.

The presence of such large quantities of by-products, combined with the fact that their nature prohibits their being disposed of into drains or streams, makes their utilization by some productive animal not only desirable but essential.

B. Special Characteristics of Dairy By-Products as Animal Food

Dairy by-products considerably enhance the value of other foodstuffs in animal production, though in dairying countries such foods are generally considered for economic reasons as enhancing the value of dairy by-products. Thus, purely from a dietetic viewpoint, separated milk is more valuable for growing than for fattening animals. Its relative high protein content makes it a useful supplementary food for young growing animals. As a fattening food it is theoretically too rich in proteins, but this can readily be corrected by feeding with it suitable cereals such as barley, maize, wheat or oats and their offals. The food value of buttermilk undiluted with water is much the same as separated milk. Whey is less valuable than either of these. It is deficient in protein by reason of the extraction of casein in the cheese-making process, and it also contains less mineral constituents. While it is not, therefore, a safe food as a sole source of diet for stock, its deficiencies can be easily made up by the addition of suitable protein-rich supplements such as meat-meals and good pasture.

As animal foods, all are subject to the disadvantage of their large bulk relative to the amount of food nutrients contained. This factor not only limits their usefulness to particular animals, but also, in the absence of large supplies of cheap and suitable supplements, considerably reduces their effective utilization.

C. The Usefulness of Pigs for Utilizing Dairy By-Products

Pigs are the most convenient animals for disposal of these foods. They fatten quickly, and by good management their numbers can fairly easily be adjusted to the supply of available by-products.

It can be shown that, after making allowance for the maintenance of

breeding stock, about 42 lbs. of pig flesh (dead weight) can be produced from the separated milk remaining after the extraction of 100 lbs. of butterfat from the whole milk. This figure is the same for both porker and baconer production, the lesser-food requirement of the former per lb. of live weight gain being offset by the greater sow feed overhead. It can also be shown that 48 lbs. of pig flesh can be produced from the buttermilk resulting from the manufacture of a ton of butter. The possible returns from whey work out at fully 21 lbs. of pig flesh per 100 lbs. of butterfat in the milk. From a farming point of view, the immediate cash returns from the rational fattening of pigs on unsaleable skim milk is of material advantage to dairy farmers, since no additional labour is entailed, and the greater part of the returns represent profit. In addition there are other advantages, particularly in countries such as New Zealand, where stock can be fattened out of doors. Firstly, the pig returns to the farm a considerable amount of manurial residues; it passes off in excreta and urine, substances not utilized for fattening and growth, in a form readily available as fertilizers. Thus, part of the fertility of the farm depleted by the cows is returned by the pigs. Secondly, the pig is a soil improver, not only by virtue of its manure, but also by its consolidation, and in some cases its tillage efforts. Thirdly, it can utilize grass, thereby providing a means of utilizing food in places not of material value to other stock. Fourthly, the price of pig products is independent of the price of dairy produce, and it sometimes happens that a lean year in butterfat prices can be eased by good prices for pigs.

II. RELATION OF PIGS TO DAIRYING IN NEW ZEALAND

A. Pig Population and Distribution[2]

The association of the pig industry with dairying is shown by the following statistics of the pig population of the main dairying districts:—

Table CXVIII

District Percentage of Total Dairy Cow and Pig Population, 1934

	Pigs	Dairy Cows*
North Auckland	17·1	18·8
Auckland	34·4	30·8
Taranaki	10·3	13·6
Wellington	13·9	13·8
Totals	75·7	77·0

*Cows in milk and dry.

Of the Dominion's pigs, fully 75 per cent. are found in the four chief dairying centres. The total pig population is roughly 660,000, distributed between the various land districts as follows. The table shows dairy cow population and the relationship of pigs to dairy cows:—

2. Ag. and Past. Prod. Statistics, 1934.

TABLE CXIX

Pig-Dairy Cow Population, 1934

	Total Pigs In Thousands	Total Cows* In Thousands	Pigs per 100 Cows
North Auckland	112·8	364·1	30·7
Auckland	227·9	595·3	38·3
Gisborne	22·6	62·8	36·0
Hawke's Bay	20·0	66·2	30·2
Taranaki	68·3	262·8	26·0
Wellington	91·9	267·0	34·4
Nelson	16·8	35·3	47·6
Marlborough	6·8	18·4	37·0
Westland	6·2	16·3	38·0
Canterbury	46·8	88·6	52·8
Otago	23·9	66·4	36·0
Southland	16·3	89·2	18·3
Totals	660·3	1932·4	34·0

*Cows in milk and dry.

The industry has developed almost solely as a side line to dairying, separated milk and whey providing the bulk of the pig rations. Differences in the ratio of pigs to dairy cows in the various districts indicate differences in the extent to which pigs are exploited as consumers of dairy by-products. Two features here are worthy of notice. These are the relatively low pig population of Taranaki and Southland, and the high figure of Canterbury. The former are due to the predominance of cheese-making in these districts, whey being the major feedstuff, and the latter is achieved with the assistance of large supplies of cereal supplements available in a grain-growing area.

B. PIG-COW RATIO

With a dairy cow population rapidly nearing the 2,000,000 mark, and a pig population of 600,000, it is evident that the pig industry is still largely undeveloped. Compared with Denmark, which carries a ratio of nearly 250 pigs per 100 dairy cows, our figures are extremely low.

TABLE CXX

The Pig-Dairy Cow Population for the past Eleven Years[3]

Year	Pigs Totals 000's	Dairy Cows (in Milk) 000's	Pigs per 100 Cows
1924	414·3	1184·9	35
1925	440·1	1195·5	37
1926	472·5	1181·5	40
1927	520·1	1181·5	44
1928	586·9	1242·7	47
1929	556·7	1291·2	43
1930	487·8	1388·9	35
1931	477·0	1499·5	32
1932	513·4	1582·6	32
1933	591·6	1723·9	34
1934	660·4	1816·4	36

3. N.Z. Year Books.

Although dairy cow population has increased markedly during this period, and pig population showed a slight fluctuating increase, the proportion of pigs to cows is not yet as high as in the years 1925-29.

C. Production, Local Consumption and Export

The industry is not of large dimensions, the bulk of the produce being consumed locally. The following table shows the total killings for local trade and for export over the past 10 years:—

TABLE CXXI
Destination of Pig Products

Year	Local Trade	Export Trade*	Total Killings†
1924	315,210	4,943	320,153
1925	323,430	35,753	359,183
1926	345,749	60,757	406,236
1927	369,658	74,663	444,321
1928	360,633	147,601	498,233
1929	357,587	159,297	516,884
1930	396,176	133,400	529,576
1931	369,270	132,406	501,670
1932	329,575	152,877	482,450
1933	266,627	323,980	590,607

*Annual Report, Meat Producers Board.
†N.Z.O.Y.B.

Pork and bacon are practically of equal importance in the local trade, while the export figures represent mostly porkers which are shipped to Britain as frozen pork. A small proportion is converted into bacon in Britain, it being impossible to ship mild-cured bacon satisfactorily to distant markets at the present time, due to technical difficulties.

The production over and above local requirements was negligible prior to 1927-28, when an increase in exports was obtained under the stimulus of a Government subsidy. Though an opportunity undoubtedly existed, and still exists, for the building up of an extensive export trade with Britain in frozen pork, little advantage has been taken of this opportunity, exports remaining relatively stationary at the 1927-28 level until the end of the 1932 season. While British imports increased by over 30 per cent. during this period, and while New Zealand supplied nearly 60 per cent. of the trade in 1929, her share had dropped to 33 per cent. in 1932. Meanwhile other countries, notably Australia and Argentine, have secured a marked increase in their share of the trade.

Due to the influence of pig-recording schemes, and the development of co-operative pig marketing, and accelerated by the low price of other dairy farm produce, renewed interest occurred in pig raising during 1933 and 1934.

D. Incomplete Utilization of Dairy By-Products

As indicated by the above unfavourable comparison with Denmark, it is evident that as a dairying country New Zealand is not making the use of pigs in the utilization of dairy by-products that she might. This is further emphasized by the large increase in production achieved in but a single year. Even this production is nowhere near the possible limits. On a basis of the figures given previously of the pig flesh value of separated milk and whey, without taking into account the productive value of other available foodstuffs, approximately 72,500 tons of pig flesh, or fully 1½ million carcasses of an equal number of baconers and porkers, could be produced from the by-products available from our present production of butter and cheese.

There are many and diverse reasons for the incomplete use of these foods, the chief of which are summarized as follows:—

(1) Failure on the part of dairy farmers to realize the value of by-products for the production of marketable pig flesh, with the result that large supplies are wasted annually.

(2) Dislike of the pig as an animal, due to poor husbandry methods prevailing.

(3) The ability of farmers in the past to make a financial success of dairy farming, despite the waste of or little return from by-products.

(4) The relatively high price of supplementary foodstuffs necessary for optimum utilization of separated milk and whey, due to various factors; actual shortage of supplies, grain duties and separation of dairying from grain-growing areas.[4]

(5) The seasonal nature of the dairy industry, and the consequent difficulty of carrying autumn litters over the winter with little or no milk supplies, and in the absence of substitutes at an economic price.

(6) Regarding pigs as the least inconvenient means of disposal of otherwise troublesome waste products, rather than as the most efficient means of converting valuable food materials into profit.

(7) Lack of organization in the industry, lack of a satisfactory marketing system, lack of standardization of type in grading methods, and lack of interest generally in the economics of pig-feeding.

4. For full discussion, see Callaghan, 'Pig Industry of N.Z.' *Bull.* 17, N.Z. Dept. Sc. and Ind. Res., 1930.

(8) Failure of farmers to realize the potentialities of an export trade. Reliance upon a home market which for many years has reached saturation point, with no real endeavour to build up an export trade which offers the only hope of expansion.

III. HUSBANDRY SYSTEMS AND FACTORS AFFECTING RETURNS

It is difficult to convey an adequate picture of pig-husbandry methods in the Dominion, for no uniformity of practice exists. This is due mainly to the facts that (a) on many farms the pig does not form an integral part of the farm management policy, and methods are entirely haphazard, (b) much practice is uninformed, (c) much is still frankly in the experimental stage, and (d) the whole business is still relatively young.

As a result of scientific investigations so far accomplished, combined with practical experience in the field, the following husbandry factors have been shown to have a considerable influence upon returns from pig raising on the dairy farm.

A. Home Breeding

Here two factors of fundamental importance are involved: (1) the cost of weaners and (2) the weight of weaners.

1. *Weaner Costs*

Economic investigations have emphasized the necessity for economy in the cost of weaners. The cheaper the weaner the first cost of fattening, the greater the returns from by-products. Although, next to that of purchased foodstuffs, the cost of weaners is the principal item of controllable cost in pig raising, the characteristic weakness of present systems of management is the disproportionate part which it plays in total production costs. This situation is due to prevalence of the former of the two methods of weaner production practised in New Zealand—(a) buying in, and (b) home breeding. Buying in, where no or insufficient breeding stocks are kept, and pigs fattened are purchased as required, is the regular policy of many farmers. As such, it is definitely unsound, for, due to the demand, weaners are seldom procurable at a price which permits of an adequate return from feed utilized. On the average, more than double the price per lb. is paid for a weaner carcass than is ultimately obtained for the fattened product, leaving but little margin of profit. To increase the turnover per pig in such cases, the animal is often converted to bacon weight, a situation which makes the position worse, since baconers are less economical feeders than porkers, and carrying a dear weaner to a heavier weight makes the return per unit of food proportionately lower. The maintenance of such a policy clearly indicates that on such farms the pig is regarded as a means of milk disposal rather than of milk profit.

The alternative method, home breeding, provides an economic method of weaner production and is the only regular means of obtaining pigs for fattening at a price which permits the efficient cashing of dairy by-products. Due to the policy adopted in the past, however, even the breeding of weaners has been an expensive business, and probably accounts in part for the prevalence of buying in. Statistics of recent years show that over 80 per cent. of a total of 70,000 breeding sows produce but one litter per year. This is undoubtedly an uneconomic policy, representing an enormous loss, not only in increasing production costs, but also in reducing the total number of pigs fattened. A two-litter-per-year policy will reduce the cost of weaners by at least 40 per cent.

Home breeding has an additional advantage; the farmer can breed his pigs to fit in with the seasonal nature of his feed supplies. He is always sure of a supply of fatteners at a regular price when he wants them, and is independent of the market, where prices fluctuate markedly as a result of seasonal demand. If not breeding, he is forced to buy at a time when most farmers, in a like predicament, are coming on to the market. Milk supplies are increasing, and must be disposed of; pigs must be purchased despite the price.

2. The Weight of Weaners[5]

The work of pig-recording clubs over the past six years has established the fact that the weight of a pig at weaning time has a very definite bearing upon profitable fattening. It bears a distinct relationship to the subsequent rate of growth of the animal. Thus it has been shown that, under average farm conditions of feeding and management in New Zealand, the weight of a pig at 8 weeks, or weaning age, is related to its subsequent weight at 16 weeks, so that its weight at 16 weeks, or 'porker' age, is roughly $2\frac{1}{2}$ times the weaner weight. In other words, the heavy pig at weaning time not only maintains its advantage during the fattening period, but increases it. The importance of this lies in the additional time necessary to fatten small weaners. Whereas the 40-lb. weaner at 8 weeks will make marketable-porker weight of 100 lbs. at 16 weeks, the small 20-30 lbs. weaner, under similar management, requires a further 3-6 weeks' feeding to do so.

Since the production of heavy weaners is dependent upon sound breeding, feeding, and management methods, the importance of home breeding has thus received additional emphasis. As a result, not only has this system of weaner production increased amongst progressive farmers, but also there have been marked developments during the past few years of methods designed to secure the best results from breeding stock.[6]

5. Annual Reports, Waikato Pig Recording Club, 1928-33; Canterbury Pig Recording Club, 1928; Manawatu-Orua Pig Recording Club, 1933.

6. The average weaning weights obtained from sows recorded by the Waikato Pig Recording Club for the years 1928-9 to 1932-3 were 25 lbs, 31 lbs., 40 lbs., 35 lbs., 35 lbs. Av. No. sows, 150.

B. By-Products Available

Since skim milk or whey form the greater part, if not the whole, of the ration under farm conditions, returns from pigs depend largely, apart from other factors which play a part in either case, upon which of them is used.

It is generally estimated that in normal times, and under average farm conditions, skim milk is worth 1d. per gallon, or 2d. per lb. of butterfat, or roughly £2 per cow. Whey is considered to be capable of yielding only half this return.

Under present conditions of low prices, these values are probably too high for average estimates, though farmers who pay careful attention to the pig department of the farm show better figures. There is no reason why, under good management, 2d. per lb. fat should not obtain, with pork at 4d. per lb.[7]

C. Feeding Systems

The returns from pigs are affected largely by the methods of feeding employed. The general feeding methods play a big part: time of feeding, number of times, regularity, general care and cleanliness, access to water and minerals, exercise, whether indoor or outdoor, access to pasture and type of same, provision and use of home-grown feeding stuffs, and the method of feeding supplements. While, on the average farm, little or no attention is paid to these points, the feeding methods of farmers obtaining good results from pigs are in conformity with recognized principles. In addition to these, the most important feeding factors influencing returns are:

(1) Whether dairy by-products are fed alone.
(2) Whether concentrate supplements are employed.

The whole question involved here is hinged upon the economics of concentrate feeding, a question of utmost importance to New Zealand, since it imposes a definite limit upon our potentialities as a pig-producing country. While it is well recognized that the food value of dairy by-products can, as already mentioned, be considerably enhanced by the feeding of appropriate concentrate meals, it is equally well recognized by the farmer that the practice is not justifiable unless it will enable him to obtain a greater net return from his skim milk and whey than he already obtains without its use. The profitableness of meal feeding is dependent primarily upon the relationship of the price of meals and the price of pork and bacon. Since cereal concentrates in the dairying districts of New Zealand are generally too expensive for conversion into animal products, the supplementing of separated milk in pig raising plays but little part in production methods. The problem is exactly the opposite of that of the other pig-producing countries of the world; they are nearly always concerned with the minimum amount of dairy by-products which can be fed to advantage to supplement

7. 'Return from Pig Raising on Dairy Farms.' Riddet and McMeekan, *N.Z. Jnl. Agr.*, Feb., 1934.

cereals, since in these countries the cereals represent the surplus feed and by-products the scarce feed. We are concerned with the minimum amount of cereals to be fed with a maximum of milk or whey, the latter being our surplus food and the former our scarce feed. While this is so, and while the feeding of meals with separated milk in the most desirable ratio for maximum utilization—viz., 2-3 lbs. meal per gallon of separated milk—is definitely unprofitable under normal conditions of meal and pork prices, a specialized and limited use of meals occupies a definite place in many feeding systems.[8] This is due to the fact that the question cannot be tackled alone from the point of view of meal and pork prices, since certain feeds are essential to growth, apart altogether from the question of economics. Again, the feeding of meals possesses certain advantages, the precise financial effects of which are difficult to estimate. The time taken to fatten a pig enters largely into the question for varied reasons:—

(a) Even small amounts enhance the value of the milk fed. Although the consumption of milk daily is not reduced by a low plane of meal feeding, the total fattening period is shortened and a saving effected in total milk required per pig. This results in a greater turnover and a quicker turnover per pig. Both these affect production costs, reducing the overhead charges on each pig fattened.

(b) The shortening of the fattening period by the use of limited amounts of meals may be of particular value when milk supplies fall at end of season, in enabling pigs to be profitably marketed, that would otherwise have to be specially handled either by carry-over or marketing at light weights. In this way, the judicious use of meals plays a part in the successful fattening of two litters per year—a practice often impossible on milk alone.

(c) It often happens that prices fall at a certain period of the year, or that a fall in price is anticipated. If the farmer can adopt a method by which he can produce a greater rate of increase in a limited time, it often pays him to do so, though at ordinary times that system of fattening may not be profitable.

(d) Even limited amounts have an effect upon the quality of the carcass. The firmness, texture and flavour of the flesh and fat can be improved, and the underline made more even—quality is an important factor in the maintenance of a stable market.

8. Scott, M. J., 'Pig Production and Results of Feeding Trials.' *Bull No. 2*, N Z. Dept. Sc. Ind. Res., 1928.

Accordingly, limited supplementary feeding has become an established practice amongst many farmers. It is seldom maintained throughout the life of the pig, but is rather reserved for special periods along the lines discussed above. In particular, it is employed during the suckling period, in the feeding of both sow and litter, as an aid to the production of heavy and quick-maturing litters.

The same principles apply to the supplementing of whey, with the difference that here some means of supplying its protein and mineral deficiency is essential if adequate growth is to be obtained, whey being an extremely 'slow' food when fed alone. This is secured by the use of meat meals, the by-products of meatworks. These are specially manufactured for the purpose, and their use has become fairly general amongst whey-feeding farmers of recent years. Again, however, the question of economics limits the use of these supplements to small amounts, which, while making good the deficiency of flesh-forming constituents, still fails to provide an effective remedy against the relatively low dry-matter content of the whey. As with skim milk, cereal meals cannot play their normal part in this respect. It must be emphasized, therefore, that the use of supplements plays but little or no part in the pig raising methods of the majority of farmers. Price factors force us to ignore nutritional ideals and gross returns for economic returns, a situation which places a definite limit upon the pig-productive capacity of our dairy by-products. Compared with Danish methods, where cereals are fed at the rate of 1 to 2 lbs. of meal per lb. of separated milk, the ratio of meal to by-products, on farms even where they are regularly employed in combination, is particularly low, ranging on the average from 1 : 100 to a maximum of 1 : 30 on a weight basis. Any narrowing of this ratio under normal price conditions is questionable on a profit basis.

D. Management Systems

Strictly speaking, the question of home breeding versus buying-in falls within the scope of management, as do also several aspects difficult to dissociate from feeding methods. Apart from these, the following are of importance:—

(1) The sow-cow ratio.
(2) The method of disposal.
(3) The time of farrowing in relation to milk supplies.
(4) Housing and layout.
(5) The management policy in relation to the second litters.

1. *The Sow-Cow Ratio*

Presuming a home-breeding policy, the proportion of sows carried to dairy cows milked has a considerable influence upon returns.[9] The

9. Riddet and McMeekan, op. cit.

ratio is dependent upon the systems of feeding followed and upon the method of disposal of the pigs. Where concentrate foodstuffs are employed to supplement by-products, and where skim milk is available, the number of sows carried is higher than where by-products alone are fed or where whey is employed. Again, the production of pigs of bacon weight does not allow the carrying of as many sows as where disposal is effected as porkers. It is apparent that the high proportion of sows to cows, common to the more complex agricultural countries, with their wider range of available feedstuffs, is impossible of attainment under our conditions. At the same time, the present ratio of 1 sow to 30 dairy cows is capable of considerable improvement. Farmers showing good returns, and marketing the bulk of their pigs as porkers, carry a ratio, varying from 1 : 7 to 1 : 10, depending upon feeding methods. With bacon production the ratio is somewhat wider, varying from 1 : 10 to 1 : 12, while with whey approximately half these numbers of sows are carried in both cases under similar feeding conditions.

2. Methods of Disposal

Three methods of disposal of pigs are practised—(a) as weaners and stores, (b) as porkers, and (c) as baconers.

Weaner production frequently provides the most profitable trade. The most economic productive period in respect to food consumption is from birth to weaning age. Weaners and stores invariably command higher prices than they are worth from the non-breeding farmer, though the market is limited and usually restricted to particular localities. Usually the whole supply is not cleared, but a proportion kept and fattened according to milk supplies, thereby combining two or the three methods of disposal. The system necessitates the carrying of a larger proportion of breeding sows than where fattening only is employed. The chief disadvantage lies in the fact that while weaners are readily disposed of in the spring, difficulty is experienced in the autumn, involving the wintering of a relatively large number of pigs, with its consequent problems, and their disposal in the following spring as stores.

Disposal as porkers at from 60-120 lbs. live weight, and/or as baconers from 130-160 lbs. live weight, is the principal marketing method followed. The question of their relative profitableness is affected on the one hand by farm practice in relation to milk supplies, and on the other by market price factors. Though the production of lighter-weight pigs is associated with more economical food consumption, this is counterbalanced by the heavier sow maintenance costs, and it is generally concluded, therefore, that where the price is the same there is little difference between the two. In such case the question resolves itself into that policy which fits best with available milk supplies and pig numbers.

Where prices are different, the higher-priced product offers the best return, but the question of milk supplies and pig numbers must still be considered, i.e., though bacon may be higher, if milk supplies are short, disposal may have to be made irrespective of weight. Similarly, if milk is plentiful, pork is higher, but the number of pigs available small, carry through to bacon may have to be employed.

Generally speaking, pork commands a higher price than bacon for the local trade, though export prices are usually on a par with local bacon prices. Pork prices tend to be higher in the spring and winter as compared with the summer. This applies to baconers also, but to a lesser extent. The running of a fair proportion of breeding sows allows for a combination of these methods, often with considerable benefit, not only from the point of view of being able to take advantage of price differences where such obtain, but in allowing a better correlation with seasonal milk supplies. Breeding of a small number of pigs only limits the farmer to bacon production.

3. *Time of Farrowing*

The importance of farrowing dates is due to the facts that (a) supplies of milk and whey are definitely seasonal; (b) profitable pig raising necessitates a two-litter-per-annum policy; (c) the provision of out-of-season feed involves expenditure on milk substitutes, either home-grown or purchased. By the efficient correlation of farrowing dates with milk supplies, so that the amount of the latter at different periods of the year fits in as closely as possible with the number and requirements of the pigs on hand, many of the difficulties can be avoided. Although much practice is indiscriminate in this respect, experience has indicated that farrowing should be confined as nearly as possible to the months of July, August and September, and to January, February and March. It is found that litters born outside these periods are difficult to deal with. Late-spring litters meet a falling milk supply, and the increasing feed demands of sows nearing summer farrowing. They can be marketed only at light weights. Late-summer litters are in a worse position owing to the marked decrease in milk supplies, and have to be wintered with additional costs. Still earlier farrowing, commencing in May, is practised by individual farmers with good results.

4. *Housing and Layout*

Pigs show their best results only under good feeding and management methods; these are possible only where the housing and layout system is efficient. More specifically, returns are influenced in the following ways:—

(a) The large death rate experienced amongst pigs between birth and weaning, amounting to 20-50 per cent. on many farms, the average figure being well over the 20 per cent. mark, is

a cause of considerable loss. Small numbers of pigs reared per sow raises weaner costs, increases overhead charges, and reduces profit. Lack of breeding, faulty housing and bad conditions, under which pigs are commonly kept, factors to which death through crushing, exposure and disease can be traced, are responsible for the greater part of this loss.

(b) The use of the 'creep' method, whereby suckling pigs are provided with food at an early age additional to that supplied by the mother, the efficient utilization of pasture, and the general care and management of sow and litter, all potent factors in heavy-litter and heavy-weaner production, the importance of which has been stated, are dependent upon the type of housing and layout available.

(c) The efficient utilization of the high food value of good, short pasture, combined with the effective exploitation of the fertility-building capacity of pigs, is only possible with a well-planned layout scheme.

(d) Housing and layout have a considerable bearing upon labour requirements. Under efficient management no labour additional to that normally required on the dairy farm is necessary.

(e) Good, thrifty pigs, economical gains, and freedom from disease, together with freedom from unsanitary conditions, which frequently adversely affects not only the efficiency of pig-production, but also milk and butterfat quality, on New Zealand farms, are obtainable only with satisfactory equipment.

(f) The housing and layout must not be too elaborate and costly; overhead charges must be kept within reasonable proportions.

This aspect of pig husbandry received but little attention until recent years, to which is traceable much of the dislike of the pig as an animal. The entire lack of appreciation of the requirements of the pig for normal healthy and profitable development actually makes pig-raising an objectionable task to the majority of farmers. This situation, however, is gradually changing in the more progressive districts, and the past few years have seen the gradual abandonment of the old ill-planned stye methods and the development of well-designed and efficient housing and layout systems on the open-air plan. In consequence, much of the bias against the pig is fast disappearing.

5. *The Management of the Second Litter*

One of the main factors militating against the popularity of the pig on the dairy farm, particularly against the home-breeding policy, has been

the difficulty of dealing successfully with the summer litters. Though admittedly the production of two littters per sow per annum was necessary for economic weaner production, the absence of milk supplies through the winter, the high price of concentrates, the inadequacy of home-grown foodstuffs without purchased supplements, and the consequent high death-rate amongst winter pigs, assisted in making farmers either avoid pigs as far as possible, or altogether, or resulted in an uneconomic single-litter policy.

These difficulties have now been largely overcome, though the means are not as yet extensively practised, by the provision of relatively cheap protein concentrates in the form of meatmeals, by which roots and other home-grown foodstuffs can be profitably utilized for winter fattening purposes.[10] Combined with the rational control of farrowing dates, and the limited use of other supplements by which the majority of the output are fattened during the dairying season proper, and the number carried over reduced to a minimum, many farmers now find little difficulty in profitably producing two litters per year and in turning out the equivalent of two porkers per cow.

E. Type or Quality

The type of pig produced has a direct bearing upon returns, since (a) fat pigs are purchased on a differential price basis according to grade of carcass quality. The margin between first and second grade pigs fluctuates between ¼d. and ½d. per lb., amounting to 3/- to 6/- per bacon-pig. (b) Type affects economy of production. Pigs of a good type are more economically fattened than pigs of a poor type, an aspect involving the question of breeding and strain.

Considering the industry as a whole, with a view to the future development of a large and permanent export trade, type or quality from the point of view of the consumer is a factor of the utmost importance. This has been realised by the industry, as is seen by the establishment during the past four years of, at first optional and now compulsory, pig-grading systems, by which quality has been gradually improved. Type of breeding stock is also receiving attention, pig-recording clubs having been established in the Waikato and Manawatu dairying areas for the purpose of recording the performance of breeding stock, with the aim of isolating and making available for general use the most profitable strains of pigs.

IV. RETURNS FROM PIG RAISING: TYPICAL RESULTS UNDER GOOD MANAGEMENT

The results of a survey of pig-production in the Manawatu district during the 1932 season provide an illustration of the important part which efficient pig raising can play in dairying, particularly under the present

10. 'Pig Feeding." Scott, M J., *Bull No. 17*, N Z. Dept. Sc. Ind. Res , 1930.

conditions of depressed prices for the major dairy products. The survey covered some 60 home-separation farms in all, of which only 11 were able to provide sufficient detailed information for complete analysis. Being farmed by keen men, the production achieved on these farms can be considered to represent that attainable under good management. The following table summarizes the results, which are stated in terms of pig flesh (dead weight) produced. Full details of this investigation may be obtained from the original article.[11]

TABLE CXXII

Pig Flesh Production Figures of Manawatu Farms, 1932-33 Season

Farm Letter	Pig Flesh per 100 lb. B.F. lbs. (1)	Pig Flesh per Cow lbs. (2)	Pig Flesh per Acre lbs. (3)	No. Calves Reared per 100 lb. B.F. (4)	B.F. per Cow lbs. (5)	B.F. per Acre lbs. (6)	Size of Farms Acres (7)
H	48·0	134·2	88·3	0·083	280	184	79
I	45·5	136·6	88·1	0·033	300	194	31
C	43·8	131·3	73·0	0·133	300	167	81
E	43·5	97·2	60·7	0·080	223	140	136
K	40·6	104·6	67·6	0·122	260	167	48
L	40·1	113·7	79·3	0·000	283	198	86
D	38·3	87·2	72·8	0·080	228	198	31
A	36·8	97·2	61·5	0·000	264	167	60
J	28·3	74·4	48·5	0·083	262	171	49
F	27·7	55·8	39·1	0·154	201	141	428
G	22·0	58·3	33·5	0·087	265	152	113
Average	34·9	83·4	55·1	0·10	238·7	158	104

A total of 180,230 lbs. of butterfat and 62,968 lbs. of pig flesh were produced, representing an average production of 34·9 lb. of pig flesh per 100 lbs. butterfat, 83·4 lbs. per cow and 55·1 lbs. per acre. In addition, an average of 1 calf per 1,000 lbs. butterfat was reared. Valuing the production at 4d. per lb. of pig flesh, the average gross returns from pig rearing were 1·4d. per lb. of butterfat and £1/7/9 per cow.

Pig flesh per 100 lbs. of butterfat provides the most satisfactory index of efficiency of pig-production. While it is apparent that fairly wide differences occurred between the different farms, 6 farms of the 11 produced over 40 lbs. of pig flesh per 100 lbs. of butterfat, and 5 over 100 lbs. per cow. Of the remainder, only 3 yielded what are in comparison low returns. When it is remembered that many farms make no use whatever of their dairy by-products, even these latter figures cannot be considered really poor results. It will be noted also that the figures of the

11. Riddet and McMeekan, op. cit.

best farms closely approximate that suggested as being theoretically attainable.

The net cash returns over cost of purchased supplements are set out in the following table.

TABLE CXXIII

Cash Returns Over Meal Costs With Pig Flesh at 4d. per lb. and Meals at £9 per Ton

Farm Letter	Gross Cash Returns	Cash Returns Over Meal Costs		Per lb. B.F.
		Total	Per Cow	
H	£116 16 8	£114 14 8	£2 4 1½	1·9d.
I	45 0 8	43 16 7	2 4 10	1·75d.
E	137 15 4	134 3 4	1 11 5	1·69d.
K	54 1 8	54 1 8	1 14 10½	1·62d.
L	113 14 0	105 12 9	1 15 2	1·49d.
C	98 12 8	82 13 2	1 16 8	1·47d.
A	61 11 4	61 11 4	1 12 5	1·47d.
D	39 5 9	35 11 0	1 6 4	1·38d.
J	39 13 4	39 13 4	1 4 9½	1·13d.
G	63 3 4	61 16 1	0 19 0	0·86d.

The figures show that pigs have contributed considerable revenue on most farms. It must be emphasized, too, that this has been done at little meal cost. With the exception of Farm C, where the rate of supplementary feeding was heavier than on the other farms, three of which used no meal at all, the deduction of meal cost made little difference to the cash return. It must be noted, also, that the meal charge of £9 per ton was higher than actually obtained in most cases.

The figures of column 4, representing cash return per lb. of butterfat, are specially significant, and indicate that under good management the utilization of by-products by pigs can make a substantial contribution towards the farm butterfat cheque. Seven farms show a return of from 1½d. to 2d. per lb. of butterfat. If the average price of butterfat for the 1932-33 season be placed at 10d., 2d. per lb. butterfat from pigs represents a 20 per cent. increase in butterfat returns over the farm which makes no use of dairy by-products.

The argument can legitimately be carried still further, in view of present economic conditions. Most will agree that the cost of butterfat production is at least 8d. per lb. Since skim milk is an otherwise waste product, and its utilization by pig raising necessitates no additional labour and little capital expenditure, the major part of the returns from pigs actually represent profit. When the average price of butterfat falls below 8d. per lb., the man who is producing ½ lb. of pig flesh per lb. of butterfat is actually making more from skim milk than he is from butterfat.

V. THE FUTURE OF THE INDUSTRY

While potentialities for a very marked increase over the present production of pig flesh undoubtedly exist, and while the movement in this direction is likely to be considerably accelerated by the efforts of dairy farmers to restrain the effects of low and of falling price-levels for butterfat by more efficient by-product utilization, any attempt to forecast possible future developments must take cognisance of two fundamental characteristics of the industry:

(a) That under existing and possible future economic conditions dairy by-products must form the bulk of the food.

(b) That the only outlet for increased production lies in the direction of export trade with Great Britain.

The importance of the first has already been stressed. The estimated deficiency of cereal foodstuffs necessary for the full utilization of our dairy feeds is in the vicinity of 400,000 tons, the possibilities of the import of which, at a reasonable cost, are remote.[12] With a local supply of less than 90,000 tons of cereal feed, the use of which in pig raising is uneconomic except in limited amounts, it is obviously unsound to contemplate future pig-production except on a basis of dairy by-products as the major foodstuff. The estimate of possible production previously mentioned is based upon the present available supplies of dairy by-products only, and is thus probably a fair statement of the position. The figure, 72,500 tons, or roughly 1½ million carcasses of an equal number of baconers and porkers, represents a three-fold increase over present production.

Local consumption of pork and bacon is high, and relatively stabilized. The whole of this increase, roughly 1¼ million carcasses, or eight times the normal export, would have to be absorbed by Great Britain, which offers the only market. The situation in this respect is clouded at the present time, since Great Britain is endeavouring to reorganize her own pig industry along lines of increasing self-sufficiency. Already foreign imports have been subjected to quota limitations, and tentative suggestions for similar restriction have been made in connection with our own exports.

Assuming that the United Kingdom will take sufficient of our pig-products to permit of an expansion of the industry, a return to a higher level of prices for dairy produce, however, is likely to slow up the process. In such case the formulation and application of a national pig-development policy, which at the present time is non-existent, could have a materially stimulating effect.

12. Callaghan, op. cit.

CHAPTER XXIII

BEEF PRODUCTION

By I. W. WESTON

I. Introduction. II. Numbers and Distribution of Beef and Dairy Cattle. III. Export and Local Consumption. IV. Relative Importance of Different Beef Breeds. V. Beef Production and Sheep Farming—A. Hill Country Sheep Farming—B. Fat Lamb Farming. VI. Beef Production and Dairy Farming. VII. Beef Production as a Specialized Farming Activity. VIII. Pure-bred Beef Cattle. IX. Summary. X. Future Developments.

I. INTRODUCTION

THE production of beef in New Zealand is carried on by both the pastoral (or sheep farming) and the dairy industries. The former produces almost all the beef from recognized beef breeds, whereas the latter supplies a considerable amount of beef from surplus and cull dairy cattle, mostly of the pure dairy rather than the dual-purpose type. In both cases beef may be regarded, generally speaking, as a by-product of specialized industries. Even in pastoral farming the number of cattle carried is kept at the lowest figure compatible with the control of the rank growth of grass in the spring and early summer, and of fern and other forms of secondary growth by crushing or tramping by heavy cattle. Only in the case of pure-bred cattle of beef breeds, kept for the production and sale of bulls, can beef be said to be a primary product as opposed to a by-product.

II. NUMBERS AND DISTRIBUTION OF BEEF AND DAIRY CATTLE

While both beef and dairy cattle are distributed through all land districts, the main concentrations of beef cattle are found in the areas mainly specialized in sheep farming.

If the totals for each land district are expressed in number of beef cattle per 1000 acres of occupied land, the centres of greatest density are Gisborne, Hawke's Bay and Wellington, which are areas where sheep farming is the predominant industry.

The total cattle in the Dominion as at January 31, 1934, was recorded as 4,300,000 (approx.). Of these, we may assume that about 1,560,000 were beef cattle, this figure making some allowance for bull calves and yearling bulls intended for dairying, but previously included in the total of beef cattle. The balance, about 2,740,000, were dairy cattle of all sorts. While these figures are not precise, they are the best approximation that can be made, and they give a fair idea of the proportions of cattle in these two uses.

TABLE CXXIV

Distribution of Beef Cattle as at January 31, 1934

Land District	Breeding Bulls, 2 years old and over	Cows and Heifers, 2 years old and over	Heifers 1 and under 2 years	Steers, 2 years old and over	Steers and Bulls, 1 and under 2 years *	Heifer Calves	Bull and Steer Calves *	Total
North Auckland	1,113	42,081	16,133	43,969	19,344	15,922	20,169	158,731
Auckland	2,001	66,188	20,549	53,608	21,815	22,943	26,067	213,213
Gisborne	3,509	136,076	29,932	49,848	27,758	36,004	38,336	321,463
Hawke's Bay	1,701	62,076	14,168	38,119	12,498	17,297	19,358	165,237
Taranaki	780	24,042	8,226	16,897	8,525	8,245	9,060	75,815
Wellington	3,980	137,937	31,022	95,773	31,538	35,302	39,725	375,277
Nelson	172	5,301	2,459	6,640	3,155	2,375	3,909	24,011
Marlborough	191	5,576	2,576	4,036	2,739	1,628	2,541	19,287
Westland	219	6,741	2,127	5,850	2,816	2,153	3,153	23,059
Canterbury	480	17,268	6,724	18,442	7,938	6,087	9,272	66,211
Otago	464	14,455	5,662	16,544	7,766	5,647	8,786	59,324
Southland	432	17,146	6,353	15,183	7,438	6,229	9,638	62,421
Totals	15,042	534,887	145,971	364,909	153,328	159,832	190,014	1,565,049

*Some of these bulls will be intended for dairying, but the proportion of the total figure is small enough not to affect the distribution in any important way.

The total of beef cattle comprises pure-bred cattle, cross-bred beef cattle, and dairy-bred cattle used for beef. Unfortunately, no analysis of the breeds of cattle has been made since 1928, so that the present proportion of beef cattle in each of the three categories mentioned cannot be stated with any exactness. In 1928, the numbers under each head were approximately:

Pure-bred beef cattle	11,000
Cross-bred beef cattle	1,200,000
Dairy-bred cattle used for beef	389,000
Total	1,600,000

It would be incorrect to infer from this statement that pure-bred and cross-bred beef cattle supply approximately three-quarters of our total beef production, since the above figures are merely census figures, and do not indicate the proportions of each type which are marketed as fat cattle in the course of the year. When proper allowance has been made for the different age composition of cattle in each group, it is probable that nearly half our total beef production comes from cattle which are not of specialized beef breeds or crosses.

III. EXPORT AND LOCAL CONSUMPTION

The local market is much more important for beef than the export market. The following table indicates the relative importance of the two markets:—

TABLE CXXV

Local Consumption and Export of Beef

Year	Exports	Local	Total	Per cent. of Total Locally Consumed
	in thousands of cwt.			
1926–27 ..	435·5	2,146·0	2,581·5	83
1927–28 ..	641·0	2,298·6	2,939·6	78
1928–29 ..	644·8	1,911·0	2,555·8	75
1929–30 ..	414·0	1,881·9	2,295·9	82
1930–31 ..	364·1	1,728·2	2,092·3	82
1931–32 ..	291·9	1,773·6	2,065·5	85
1932–33 ..	563·3	1,967·8	2,531·1	78
Total— seven years	3,354·6	13,707·1	17,061·7	80

Beef provides the only example in New Zealand of a major pastoral product having a larger local than export market.

IV. RELATIVE IMPORTANCE OF DIFFERENT BEEF BREEDS

The analysis made in 1928 of the different breeds of cattle showed that amongst the pure-bred beef cattle the most numerous were the Aberdeen-Angus and the Hereford, with the beef Shorthorn next:—

Pure-bred Beef Cattle, 1928

Aberdeen-Angus	4,269
Hereford	4,210
Beef Shorthorn	2,620
Devon	116
Total pure-bred	11,215

In recent years Aberdeen-Angus cattle have been increasing in number relatively to the other breeds. This has been due to the efficient way in which they graze steep and difficult country, to the tendency of the Aberdeen-Angus to produce in the first cross, especially when crossed with the Hereford or Shorthorn, an early-maturing polled animal or veal carcase, and, partly perhaps to fashion. In view of the natural and unavoidable deterioration which has occurred, particularly in the North Island, resulting in considerable increased difficulty of control of fern and other secondary growth, the question of a breed of cattle capable of grazing efficiently the more inaccessible country is of great importance. In this respect, the efficiency of the breeds is generally considered to be in the following order: Aberdeen-Angus, Hereford, Shorthorn. In other words, their grazing efficiency may be roughly compared with the merino, half-bred and long-wool sheep breeds. While the Hereford is a better climber than the Shorthorn many farmers consider that it is not so good as the Aberdeen-Angus. The Hereford is sometimes preferred for properties which adjoin bush country but which are not well fenced, since it is less likely to stray out of mustering range and it is, perhaps, better able than the Aberdeen-Angus to recover quickly from a check of feed supply due to drought or wintry conditions. Both breeds are better in this respect than the Shorthorn.

Since 1918 both the Hereford and the Aberdeen-Angus have increased considerably in numbers while the beef Shorthorn has declined. The tendency is shown in the next Table, CXXVI.

The beef Shorthorns show a progressive and rapid decline; the Herefords a small decline in pure-bred stock but a big increase in cross-breds; and the Aberdeen-Angus a big increase in both pure-bred and cross-bred stock. Even so, it will be observed that the Shorthorn cross-bred was at the 1928 enumeration, nearly as important as the Hereford and more important than the Aberdeen-Angus. The decline in the pure-bred Shorthorn stock, however, indicates that this breed is gradually being superseded by the more hardy types on the rougher country. If, however, the present process were reversed and beef cattle were to increase in the better grazing land, it is probable that the Shorthorn cross would play an increasing part.

TABLE CXXVI

*Numbers of Pure-bred and Cross-bred Beef Cattle**

Breed	1918	1921	1924	1928
SHORTHORN—				
Pure-bred	†	8,585	4,319	2,630
Cross-bred	†	810,666	666,487	417,493
HEREFORD—				
Pure-bred	4,993	5,221	4,234	4,210
Cross-bred	289,462	439,533	514,528	426,241
ABERDEEN-ANGUS—				
Pure-bred	2,105	3,583	4,295	4,269
Cross-bred	145,178	200,144	285,941	351,118
OTHERS—				
Pure-bred	119	23	16	116
Cross-bred	49,789	17,094	11,560	8,285

*'Cross-bred' means an animal with a predominating strain of the breed mentioned.
†No reliable figure.

V. BEEF PRODUCTION AS AN ADJUNCT OF SHEEP FARMING

As previously stated the carrying of beef cattle is kept at a minimum on the average New Zealand sheep farm; neither on the hill-country nor on the lamb-fattening farms is beef production so attractive financially as the growing of lamb, mutton and wool. On many hill-country farms there is little if any level land, and beef cattle are the only available substitutes for the grassland harrow and the mower. They must therefore be regarded as implements, a certain number of which are necessary for the 'working' of the farm. Very heavy stocking with sheep, will, of course, largely obviate the necessity for using cattle as mowing-machines; but in such overstocked conditions the sheep will naturally not thrive as they should. Even in the case of flat land where it is possible to use machines, better results are obtained by running cattle amongst the sheep; moreover the labour bill is saved. The result of these considerations is expressed in the comparatively low ratio of beef cattle carried to sheep. Thus in Gisborne eleven sheep, in Wellington fifteen sheep and in Hawke's Bay twenty sheep are carried to one beef beast.[1]

A. BEEF PRODUCTION AND HILL-COUNTRY SHEEP-FARMING

The hill-country properties are the source of production of practically all beef cattle other than stud cattle. The extent to which individual properties carry breeding cows naturally varies according to the quality of the land. On the poor classes of country the percentage of breeding animals

1. The higher rainfall in Gisborne produces a greater flush of feed which, for its control, requires a higher ratio of cattle to sheep than is found in the other districts mentioned.

must be strictly limited on account of the extra drain of the fertility of the land involved in the case of ' wet stock ' and young growing animals. This remark applies equally well to sheep carried. Hill country properties, which vary greatly in fertility, therefore, show all gradations from a full complement of breeding cows to cases where none at all are kept and where, consequently, all necessary cattle must be purchased. All cattle are grass fed throughout the year and in very few cases receive any hay or silage. In hard winters, they lose condition to a considerable extent and after three or four years of this treatment are not suitable material for the production of best quality beef.

Except for specialized production on small areas of good land and for the local market New Zealand does not produce baby beef. The reason is that the large area of hill country in the Dominion demands that, generally speaking, all cattle other than weakly culls shall be kept on the hills until the age of four years in order to maintain the pastures in suitable condition for sheep by keeping down the roughage and controlling fern and other forms of secondary growth. New Zealand is a young country geologically and has a very large proportion of hills which, even where they are not high, are often very steep. In these circumstances, cattle are the essential implements of pasture management. Further, in the great majority of cases it is impossible, for want of sufficient level land, to provide sufficient supplementary feed to carry young stock through the winter in the condition necessary for the production of baby beef. Therefore, even if prices of frozen beef were sufficiently attractive to induce farmers to allow cattle the pick of the feed in summer, the production of baby beef would not be possible except in country otherwise suitable for dairying. Finally, the importance of heavy cattle for the control of secondary growth and pasture management must again be emphasized. In certain districts an area which tends to be neglected by stock rapidly reverts to a condition in which its carrying capacity is virtually nil. A large proportion of heavy cattle will always be essential for hill-country farming in New Zealand.

For the cattle breeder, the first point of good management is the securing of a good percentage of well-grown calves. The percentage varies chiefly with the condition of the cattle and the flush of feed at the time of putting the bull out, combined with the kind of weather experienced at calving-time, the condition of the cattle at that time, and the risks of accident or disease. A shortage of feed may result in a high death-rate and a low percentage of calves with poor constitutions. In such conditions fifty per cent. of calves might be a high figure. On the light country liable to go back to manuka scrub seventy per cent. is probably a good percentage. It takes good management on good country to average ninety per cent. over a period of years.

Under the exceptionally depressed economic conditions prevailing, some farmers are at present breeding in alternate years from only half the breeding herd, using the dry cows for crushing. In this way the number of surplus young stock which at present prices are sold at a loss, are reduced to a minimum while the large proportion of dry cows enables the farmer to control his pasture without holding as many store cattle.

Normally, the death rate of cattle from disease, particularly of dry cattle, appears to be very low. In the case of young growing steers or heifers carried in good condition throughout the year, the death rate may be as low as one per cent. over a period of years. With good management on a clean place, four per cent. for cows and calves may be a normal mortality rate, but where there is risk from bad creeks, unfenced precipices, poisoning, loss by straying, etc., the loss may be as high as ten per cent. On moderately good country with good management, the death rate in the herd is not likely to exceed five per cent; but twenty per cent. or even more may occasionally occur through starvation from drought in the lighter rainfall areas.

Where breeding is practised the age at which surplus cattle are disposed of depends partly on relative prices and partly on the growth of feed, especially in relation to pasture control. Where it is anticipated that the returns from cattle will compare unfavourably with the returns from sheep, there is a tendency to sell off at an earlier age and to keep down the number carried to the minimum compatible with essential pasture control. On a well-managed station in normal times, the annual draft of surplus cattle will usually consist of cull yearlings, cull two-year-olds, perhaps some of the bigger three-year-old bullocks, all of the four-year-olds and the cull cows. The percentage of the older bullocks and cows disposed of as fat will naturally depend both on the property and the season.

B. Beef Production and Fat-Lamb Farming

Fat lambs are produced on the plains, alluvial flats and low hills of better quality. Here again merely sufficient cattle are used to keep the pasture in order for the sheep. On this better class country the problem of crushing out secondary growth with heavy cattle in winter does not arise. Therefore, the lamb fattener purchases store cattle from the spring cattle fairs, or in the summer in forward condition in the hope of being able to sell them profitably in fat condition in the winter, partly by his surplus spring feed in hay or ensilage. In most cases he buys three- or four-year-old store cattle from the hill-country farmer. He does not breed his own stock since cows and young cattle would displace breeding ewes during the winter. The winter carrying capacity determines the maximum carrying capacity of the property since feed is then at its lowest. A ewe flock which

will fatten sixty to eighty per cent. of the lambs prior to weaning is more profitable than beef cattle and therefore every endeavour is made to winter as many ewes as possible.

VI. BEEF PRODUCTION AND DAIRY FARMING

It will be obvious that beef production cannot compete with dairying in the recognized dairying districts and that the beef produced is merely a by-product of an industry specializing in milk production.

The beef derived from the dairy industry takes the form of cull cows and bulls, a small percentage of heifers, a certain number of steers from districts where the dairy farm includes an area of rough country, and surplus dairy calves. A certain amount of this beef is potted and preserved. Of these dairy cattle the dual purpose breeds such as the Red Poll and milking Shorthorn will be superior for beef purposes to such purely dairy breeds as the Jersey and the Ayrshire.

Calves not required may be sold at three days old or more rarely may be kept and sold at vealers at three-six months old. Cull cows may be of any age up to ten years although the average age at culling would probably be about seven years. Bulls may be disposed of at any age according to circumstances.

VII. BEEF PRODUCTION AS A SPECIALIZED FARMING ACTIVITY

Specialized beef production occurs to a very limited extent. It may take the form either of the fattening of three- or four-year-old store cattle on heavy swamp country probably unsuitable for sheep and not developed sufficiently for dairy purposes; or the fattening of bullocks on roots during winter. Sufficient returns to justify the use of good land for this purpose instead of for dairying can be obtained only by specializing to supply the late winter or early spring markets when prices are highest.

Specialized cattle farming also takes place in certain high rainfall areas which revert readily to second growth and which, for this reason, are not suited for dairying. Store cattle are bought, and sold in one or two years' time. Very few sheep and dairy cattle, if any, are carried. On the west coast of the South Island, on properties adjacent to bush in which cattle may range, the breeding and ultimate sale of fat cattle for the early spring markets on the west coast or at Christchurch may be practised. Finally, in the South Island, cattle may be used to graze areas of tussock country unsuited for sheep.

VIII. BREEDING OF PURE-BRED BEEF CATTLE

This is carried out only on first-class country, the products being stud bulls, bulls for sale to the hill-country farmers and surplus females. This

branch of cattle farming is limited by the local market and the competition of dairying for the use of the land.

IX. SUMMARY

The main features of New Zealand beef production as at present practised may briefly be stated as follows:—

(1) Beef is a by-product of the pastoral and dairying industries except in the relatively minor case where pure-bred beef cattle are kept for the production and sale of bulls.

(2) It is possible that not much more than half the beef produced is derived from recognized beef breeds.

(3) The problem of pasture-management on hill country demands that a large proportion of the beef cattle used must be heavy cattle.

(4) For reasons given, baby beef production is impossible on hill country and uneconomic on the flat country.

(5) Four-fifths of the beef produced is locally consumed.

X. FUTURE DEVELOPMENTS

Any major expansion of the beef industry in this country is likely to depend on the success with which chilled beef can be marketed overseas. At present the marketing of chilled New Zealand beef is in the early experimental phase and its ultimate outcome cannot be foreseen. The advantages that might fairly be anticipated from a development in this direction are not difficult to assess. The benefits to the farmers of second and third class country would be considerable. With more attractive returns for beef, the process of deterioration which is a notable present feature of our farming would be checked. An improvement in the sheep carrying qualities of the pastures would follow when the roughage was properly eaten out and a good pasture growth had developed. In such circumstances beef cattle would rank not only as mowing-machines but as direct income-earners as well and the farmer would, consequently, have a wider field over which to spread his risks.

Nationally the outcome would be to increase the number of our major products. Chilling would raise the possibility of effective competition on the overseas beef markets and so lessen our dependence on other products. Any development which helps to diversify our exports introduces a stabilizing influence on the whole economic structure and thus represents a direct national gain.[2]

2. For a special article on Chilled Beef, see Chapter XXIX.

CHAPTER XXIV

ARABLE FARMING

BY I. W. WESTON

I. Definition. II. Trends of Development. III. Types of Arable Farming. IV. Distribution of Arable Farming—A. Controlling Factors—B. Geographical Distribution: 1. North Island; 2. South Island. V. Organization of Arable Farming—A. Size of Farms—B. Tenure: 1. Freehold; 2. Leasehold; 3. Education Endowment; 4. Crown Leases—C. Total Areas Involved and Numbers Employed. VI. Methods of Cultivation—A. Objects of Cropping Systems—B. Rotation of Crops and Cultivation. VII. Areas Devoted to Arable Farming—A. Crops for Animal Feeding—B. Cash Crops. VIII. Capital Required. IX. Conclusion.

I. DEFINITION

UNDER this heading will be considered those main crops other than fruit and market garden crops produced by the ploughing of land, cultivation and seeding and harvesting. Arable crops may be either 'cash crops,' that is, crops which are harvested and sold, or 'fed-off crops,' which are fed off to stock.

It is normally convenient to distinguish between arable cropping and pasture farming, arable farming being taken to refer to such crops as grain or root crops, and pasture farming to grass, but there is no definite and clear-cut distinction between arable and grassland farming. Even permanent pasture may be considered as a crop in that it requires draining, cultivation and harrowing, manuring and top-dressing, original sowing, and occasionally re-sowing, is harvested for hay or ensilage, grass and clover seed, or fed off for sale through animal products. Both temporary (sown for one, two or three years) and more permanent pasture-production, occurs on land considered as typical arable or cropping land. Where short-rotation grass and supplementary turnip, rape, mangold and green-feed crops, or even ripened oat crops are grown, the only product sold may be livestock, all these crops being used for feeding to stock. On the other hand, such permanent pastures as those occurring in Akaroa, Hawke's Bay, Southland, etc., may be almost exclusively used for production of 'cash crops,' such as cocksfoot, ryegrass, dogstail and brown top seeds. Each farmer, according to his inclination, ability, capital available, type of land farmed, climate and markets available, tends to produce those 'cash' or 'fed-off' crops which it is considered will produce the largest nett income from the whole farm. Cash crops are frequently grown as an economical means of securing a ready cash income, or as a means of spelling the land in order to secure a new and better grass crop. Conversely, grass crops may frequently be sown to give the land a spell and get it into good heart for cash crops.

II. TRENDS OF DEVELOPMENT IN ARABLE FARMING

In the early days of settlement on the Wakefield plan, it was hoped to develop an economy based largely on arable farming, but the trend of development has been unmistakably away from the production of arable crops and in the direction of pasture farming, in which grass, the main crop, is fed off to stock. Nevertheless, even as late as the early 'eighties of last century, arable farming, in the form of wheat production for export, shared pride of place with sheep-farming. The main exportable farm products were wool, hides, tallow and wheat.

Early attempts to develop a farm economy based on arable farming were not successful, and up to about 1865 wool-growing on an almost purely pastoral basis was the dominant industry. The population increase, consequent largely on the gold rushes in the 'sixties, stimulated an internal demand for cash crops, and a substantial export trade also developed in oats and wheat. This was supported by the high prices in the 'seventies, and encouraged by the expansive policy of Vogel in opening up the country. Declining prices, and competition from Canada, Australia and the United States checked the relative growth of cereal production, while the advent of refrigerative methods in the early 'eighties encouraged the rapid growth of an export trade in meat and dairy produce.

Wheat-growing declined absolutely in the North Island, and eventually it disappeared almost completely. Its growth relative to livestock farming in the South Island was also checked, and eventually decline set in, more particularly after the close of the nineteenth century, until at last it could only be maintained at a level to meet the local demand with the help of guaranteed prices or sliding-scale tariffs. Canterbury remained the main wheat-growing and arable province in New Zealand.

Until about 1900 wheat production was conducted on a large scale by predatory methods of farming, which could be successfully conducted only because the virgin fertility of the soil was as yet unexhausted. During the next two decades the price of wool, mutton and dairy produce rose further than the price of wheat, and these industries expanded rapidly. With this expansion and closer settlement, the value of land rose considerably. Large-scale predatory farming could no longer be conducted profitably. Two other obstacles were in the way of large-scale methods. The supply of labour, especially casual labour, was difficult and expensive to obtain, while intensive methods involved a heavy expenditure on capital, which remained idle for a great part of the year.

Hence came the transition in areas suited to wheat-growing, to a type of mixed farming in which wheat is a rotation crop, cultivated in conjunction with sheep or other livestock farming. Even as a rotation crop, sufficient cannot be grown to meet New Zealand requirements without tariff assistance.

The growing mechanization of transport of recent years has dealt a further blow at arable farming in that it has reduced the demand for horse-feed.

Until the close of the War, arable crops, particularly root crops, still remained of importance in livestock farming, though such supplementary feedstuffs were subsidiary to grass. With the growing popularity of top-dressing, and of rotational grazing, however, supplementary fodder crops declined, especially after 1925. Wheat-growing for the local market received some assistance from the introduction of a sliding-scale tariff on wheat and flour in 1927, and continues to be stabilized at round about the level sufficient to meet the local demand, while the price collapse during the past two or three years has made it cheaper to grow supplementary crops in certain districts rather than top-dress. These conditions, together with some tendency to develop a trade in pure strains of certified grass and other seeds, and a somewhat smaller fall in the price of home-grown cash crops than of export staples, have checked the decline in arable farming for the time being.

III. TYPES OF ARABLE FARMING

Arable farming may be arranged according to importance of cash crops.

A.—Probably the type of arable farming from which the largest gross value of arable production and highest nett returns per acre are obtained, is the type devoted almost entirely to cropping, carrying no stock except, occasionally, cows usually for city milk supply, and having a few horses for hoeing, carting and inter-cultivation. This type of farming usually occurs close to one of the main centres, on land valued at £60 per acre upwards, and borders on market gardening.[1] The main crops grown are onions, potatoes, garden peas, cabbage and wheat. Certain specialized types of farming also occur, such as those growing mainly onions, near Christchurch, early potatoes near Auckland, at Pukekohe, maize in Gisborne, tobacco and hops in Nelson.

B.—The next important type, from the point of view of gross returns, is probably that where grass or lucerne enters into the cropping rotation, covering about one-third the total area of the farm each year, the grass being used for dairying, hay and seed production. The land may be valued at £40 to £60 per acre, and grows potatoes, wheat, mangolds, oats, hay, dairy produce and pig produce. Potatoes are usually the main crop. The land is not usually so close to the markets as in Type A above. This type of production mainly occurrs on the exceptionally fertile heavy and wetter or lower-lying cropping land of Canterbury.

C.—Where the land is less suited to dairying, crops such as wheat,

1. All land values quoted in this section are pre-crisis.

linseed, peas, barley, oats, potatoes, and grass-seed are the main lines, with rape, turnips, mangolds, fat lambs, and pigs and dairy produce as supplements. About one-third to one-half of the area will be in grass, and the land will be valued at from £20 to £40 per acre. This type occurs, with differences in the relative importance of different crops, throughout the best cropping land of New Zealand not exceptionally well adapted to dairy production. Wheat is the main crop, up to one-third of the area being in wheat and one-half the total area in crops, areas in grass remaining down for about three years.

D.—On land valued at £10 to £30 per acre the main crop is oats, wheat, grass-seed, green feed, rape, turnips also being grown. This type occurs on the medium cropping lands of Canterbury, North Otago, Southland, Rangitikei and Wairarapa, up to one-tenth of the area being in wheat each year, and one-third the total area in crops, grass being sown for about six years.

E.—On light-cropping lands of Canterbury, and on higher-altitude and foothill country, not heavy enough for wheat production, the production of short-rotation grass for feeding off is the main reason for cropping at all. The land is valued at £5 to £15 per acre. Chaff and oats, grass-seed, rape, turnips and fat lambs and wool are the main products grown.

F.—Marginal cropping land is usually valued at under £10 per acre. No cash crop is grown, but the land at present is raised above the store sheep wool-country margin by growing short rotation three to six-year pastures, and green feed, oats, turnip, rape or clover. In occasional good seasons, some hay or oats for crop, or grass-seed may be grown. Occasionally lupins for ploughing in may be grown also.

G.—In addition to the above types, *sideline arable production* also occurs. On typical dairying or sheep land some crops, such as mangolds, maize, green feed, Italian ryegrass and clover, potatoes, artichokes, swedes, wheat, oats, etc., may be grown either for supplementary feeds or for sale. Probably the commonest and most general crops grown in this way are potatoes and wheat in the South Island, and oats as an intermediary cash crop after rape, turnips or oats for green oaten hay in the North Island.

IV. DISTRIBUTION OF ARABLE FARMING

A. Controlling Factors

In general, it may be said that practically all level land, free from tree-roots and boulders, other than swampy land, can be used for arable farming of one form or another. In short, climate can scarcely be said to be a limiting factor. Nevertheless, the amount and distribution of rainfall, in particular, is of some importance in determining the comparative

advantage of different areas to different purposes. By and large, it may be said that, as the rainfall increases, grassland farming becomes more, and arable farming (exclusive of that connected with grassland farming) less characteristic. The bulk of arable cash crops are grown in regions with a rainfall of less than 40 inches annually, with a dry harvesting season. The Canterbury Plains may be cited as the most characteristic example of this type of area.

As the rainfall increases, pastures predominate, partly because arable crops become more subject to disease, and, in the case of cereals, are more difficult to harvest, but mainly because grassland farming is, in any case, more profitable in such areas. Except in the south of the South Island, it may be said that temperature, frosts, or other climatic conditions are not limiting factors to arable farming. In more elevated country, topographical conditions, as well as temperature and frosts, preclude arable farming on a competitive basis.

B. Geographical Distribution

The geographical distribution of arable farming is determined, in the main, by rainfall and topography, except in so far as market gardening is included, the location of which tends to be determined primarily by the accessibility of markets.

Arable farming, other than grassland farming, is conducted mainly on level or undulating country of low altitude, with a rainfall of less than 40 inches.

1. *North Island Areas*

In the main, arable farming in the North Island is confined to three areas. Marton is the centre of an arable region in Wellington Province, on the West Coast of the North Island. The growing of rape and turnips for fattening and dependence on short-rotation pasture necessitates a certain amount of rotational farming, and cereals are introduced. Wheat, oats, barley and ryegrass and clover-seed are sown. Oats is the main crop, wheat being grown to some extent when the land is suitable. Similar cropping areas occur on the East Coast in the Wairarapa and Hawke's Bay.

2. *South Island Areas*

In the South Island, arable farming occurs mainly in Canterbury, with lesser areas in Otago, Southland, and Marlborough.

(a) *Canterbury.*—The light-plains land between the foothills and the sea is mainly devoted to arable sheep farming. The main crops grown are rape, soft turnips, oats and grass. As the fertility of the land increases, a larger proportion of the area is used for cash cropping. On the very light land, tractors may be used, and no cash crops harvested.

On other areas only a sufficient acreage may be put in oats for crop to provide horse feed. On the better-class light-plains land, surplus oats, grass-seed, and (after crops of rape and turnips) a small area of wheat up to one-tenth the total area of the farm, may be grown. On the heavy plains land, mainly in the coastal regions or near the rivers, wheat is the most important crop. Up to one-third of the total area of the farm may be put in wheat. The remaining two-thirds of the farm may be devoted to fat lamb-raising, cattle-fattening, dairying, and the growing of various crops, such as barley, peas, potatoes, linseed, rape, turnips, and mangolds.

Intermediate between the light and the heavy-plains land there lies a large area of medium-cropping land, on which cash cropping is important.

Finally a fourth main type of cropping land occurs on the foothill country lying between the Canterbury Plains and the ranges. The pasture on this land tends to revert to brown top, but good crops of turnips, rape and oats can be grown. With the assistance of these crops, and periodic grass renewal, a fairly heavy sheep-carrying capacity of about two sheep per acre can be obtained.

(b) *Otago and Southland.*—Except for North and Central Otago, the majority of the arable land is situated in areas where the harvest season is rather late and wet for satisfactory wheat ripening. The growing of swedes is necessary to provide feed for the winter and early spring, when grass growth is backward. To complete the rotation, oats are the main cash crop grown. Ryegrass, brown top, and other grass-seeds are also harvested.

(c) *Marlborough.*—A relatively small area of good cropping land exists in this district, oats and chaff, barley, peas, wheat and other cash crops being grown. Lucerne is an important specialized crop in the Marlborough Province.

V. ORGANIZATION OF ARABLE FARMING

A. Size of Farms: Factors Affecting

The New Zealand Official Year Book for 1934 (p. 302) shows a total of nearly 84,000 holdings. About 5,000 are devoted to agriculture and grazing, with an average area of 380 acres, and about 4,000 devoted to general mixed farming, with an average area of 105 acres. The size of farms in any particular case chiefly depends on the amount of capital available to the settler, the distance from the market, the managerial ability of the occupier, and the particular type of farming for which the land is most suitable. Very few large, specialized cropping farms exist, although in the early days of settlement there were a few large cropping farms in Canterbury, and a few very large sheep-grazing and supplementary turnip-feeding farms in Otago. The difficulty and expense of securing casual seasonal labour, the competition for the purchase of the land to

establish small-scale mixed family farms on which full wage-rates, particularly in periods of low prices, are not received, and the State policy of encouraging closer settlement by means of capital assistance, and discouraging large holdings by means of graduated land taxes, all tended towards small farms. The recent substitution of the flat rate land tax for the graduated land tax, and the economies obtained from the use of large-scale machinery on farms of a suitable size may tend to reverse this process, but the drastic fall in prices and unemployment have greatly tended, on the other hand, to accentuate the process, and even in certain cases to cause a return to horses and a subsistence type of farming.

The fact that there were only six out of a total of 6,000 growers of wheat for 1930 with over 400 acres in wheat illustrates the very small scale of arable farming in New Zealand.

The following indicates the average size of holding for the various types of cropping farms: (1) The specialized cropping farms using a three to four-horse team range up to 100 acres; (2) the average heavy wheat-growing farms on the Canterbury Plain using a six-horse team and a tractor range round 200 acres, with a normal average of from 150 to 500 acres; (3) the light-cropping farms on the Canterbury Plain using two or more six-horse teams or tractors range round 1,000 acres, with a variation of from 600 to 2,000 acres; (4) for the agricultural or grazing farms, the sizes of holdings vary according to the type of farm. Dairy farms vary in the main between 50 and 200 acres, but high-country sheep runs are usually very large in area, sometimes as much as 100,000 acres.

B. Tenure

1. *Freehold*

The largest proportion of the area devoted to arable farming is freehold. The freehold system possesses some advantages in regard to arable farming. Improvements on arable farms are difficult of measurement, returns are only obtained over a long period, and improvements are not likely to be effected so readily if the tenure is leasehold. Much of the freehold area is held subject to mortgage, and on a rising-price level, change of ownership in the hands of those most desirous of farming a particular area is fairly readily effected. On a falling price-level the freehold is on the defensive.

2. *Leasehold*

A small proportion of the arable area is held subject to lease from private individuals. The period of lease is relatively short (one to five years), and conditions limiting continuous cereal cropping, and requiring the land to be re-sown to grass at the expiry of the lease, are usually imposed. The one-year rentals are usually associated with the growing of

such special crops as potatoes or wheat. These leases usually provide a stepping-stone to ultimate farm ownership, or a means whereby surplus man, horse or tractor labour available on a small area can be used more productively.

3. *Education Endowment Lands*

Those suitable for arable farming are invariably leased, and no ultimate right to the freehold exists in these cases.

4. *Crown Leases*

There are various types of Crown leases. Under the Lands for Settlement Act, many farms acquired and cut up by the State are leased for a 33-year period, with the right of renewal. Portions of pastoral and small grazing runs leased from the Crown are also occasionally used for agricultural purposes. On account of the fact that improvements may not revert to the original improver on the expiry of the term of the lease, and on account of the fact that such improvements, if effected near the period of lease renewal, may result in higher rents, permanent improvements requiring the use of the plough are not readily effected under these leases.

C. Total Areas Involved and Numbers Employed

The facts of the position are set out in the following table:—

TABLE CXXVII

	Arable Farming*	All Farm Holdings 1929-30	Approx. % of Arable to Total	Approx. Density per 100 Acres	
				Arable	All
Number of holdings ..	7,700	85,200	9	—	—
Total area occupied (acres)	2,400,000	43,400,000	6	—	—
Farm population ..	35,300	345,800	10	1·5	·8
Engaged in farm work†	15,700	138,100	11·5	·7	·3

*Taken as including the official categories (1), agriculture and grazing; (2) general mixed farming.
†Includes working proprietors and hired permanent labour, but not seasonal workers.

Thus, although in 1929-30 the total area occupied under arable farming comprised, on this classification, only about 6 per cent. of all farm holdings, the farm population supported is about 10 per cent. of all farm population, and the numbers engaged about 11½ per cent. of the total permanent workers on the land. Low as are the densities of population and of workers on arable land in New Zealand, they are approximately twice as high as the Dominion average in these respects.

A relatively large casual and indirect employment also results from arable production. For most efficient working, an arable farm requires to be at least able to support one teamster and one working manager to care

for the livestock, do extra team or tractor work, attend to fencing, carting and general. Since much depends on the efficiency of the teamster's labour, good working conditions, with provision of a cottage, and sufficient land for a garden, and cow for a hired married man, make for goodwill, contentment and permanency of the labour employed. There is sufficient labour available to the farmer, but skilled labour of the right type in normal periods is not plentiful. For the harvest, additional labour is required, and this may be provided by travelling contractors, or by the taking on of additional casual hands at this time of the year. The use of the latest labour-saving machinery, such as tractors, threshing-mills, or 'tin-mills' so-called, header-harvesters, etc., is tending to offset the necessity for some of the additional seasonal labour, and this is tending to reduce also the arduousness of the harvest to the farmer's wife, who formerly provided food for the harvesters where a cook was not engaged.

The seasonal nature of the labour demand raises a problem of management, the successful solution of which will have a material effect on the farm economy. Good management will seek so to plan in rotation that the surplus labour of the peak period is productively used in sidelines and subsidiary production. The different distribution of labour ideally required for different farms may be illustrated as follows:—

Days Team Labour on	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Farm A	24	23	25	20	13	13	22	18	22	18	22	17	237
Farm B	19	23	24	24	16	9	9	12	13	23	20	13	205

Farm A is a light-land farm. Farm B is a heavy-land farm.

VI. METHODS OF CULTIVATION

A. Objects of Cropping Systems

The object of management is to secure the largest nett return over the whole farm over a period of years. To secure the maximum returns possible implies:—

(1) For the specialized cropping land, the aim is to secure the greatest possible yield of the highest quality of the specialized crop grown and its sale in the best market. The whole of the rotation is planned to secure a maximum yield, by putting the ground in the best possible 'heart' for this main crop. Horse or tractor and man labour, when not required for this main crop, will be used as profitably as possible on subsidiary lines, e.g., on the heavy-cropping land, where wheat is the main crop, such crops as peas, rape, lupins, clover and grass are

grown, and sheep are grazed, in order to have the maximum area of land possible in good heart for securing the maximum yield of wheat.

(2) On light and marginal cropping lands, the main return is fat lambs. Cropping and short-rotation grass production is the most profitable method of securing a maximum sheep-carrying capacity and maximum return of first-quality fat lambs, the cropping entirely assisting fat-lamb production.

(3) On sideline arable production surplus labour may be devoted to increasing the return from some cash crop as a sideline so as to increase the total nett return from the whole farm.

B. Rotation of Crops and Cultivation

No definite rotation is followed, although a plan of operations extending over a period of years, leading to an ideal plan of operations, is usually aimed at. The actual operations and crops grown in any one year depend greatly on seasonal and price conditions. Management frequently requires adjusting to these, and to anticipated future conditions. A good rotation prevents exhaustion of soil fertility, eliminates weeds and plant diseases, conserves moisture, increases nitrogen content, puts the soil in good heart for the main crop, and then in the normal case renews the pasture.

Good tilth and early cultivation are all parts of a successful system of rotation. Crops have to be planned several years ahead; for example, a crop of wheat may be preceded by a crop of ryegrass and clover, followed by rape or potatoes. The crop of rape or potatoes itself may be prepared by ploughing early in December of the year prior to sowing, and allowing the land to lie in green feed, or fallow, in autumn and winter. This conserves moisture, kills weeds, and puts the land in good heart for the crop to be sown. A fallow or the sowing of a catch crop for green feed, or the ploughing in of such crops as oats, oats and vetches, peas, rape, lupins, etc., is, therefore, a common practice.

The rotation followed is necessarily affected by variations which occur in individual paddocks of any one farm. Moreover, any rotations planned may be upset by a poor strike of grass, effects of drought or grass-grub, etc. Much depends on individual conditions.

The wide variety of soil and climatic conditions, as well as differences in the size of farm area, and in accessible markets, results in a great variety in rotational practice. Peas, barley, potatoes, linseed, lucerne may all occupy a major place in different rotations. Some farmers concentrate on wheat and grass farming, others on pedigree seeds grown on contract, others on crops with or without sheep, others, again, on crops in conjunction with dairying, and so on.

Size has an important bearing on the rotation. On large properties, a sufficient living income can be obtained from sheep only, but smaller properties depend for gross cash income on higher per-acre crop returns. These require a form of management leading to a more effective utilization of labour. Hence, a planned crop rotation is more important on a small than on a large farm.

The distribution of labour being given, the rotation to be used depends (where cash cropping is profitable) on concentrating on that crop or series of crops which produce the highest nett money income. Where livestock is more profitable, the rotation depends on the grass growth, length of life of profitable grass, and seasonal scarcity of growth. In such a case, a rotation including 1 acre of turnips for every 10 up to 60 sheep wintered, depending on the size of crop, and 1 acre of rape for every 10 up to 60 lambs not fattened off the mothers will be required. If old grass becomes unprofitable after six years, then a rotation bringing each paddock under the plough after six years is usually necessary.

VII. AREAS DEVOTED TO ARABLE FARMING

At January 31, 1933, the occupied land was farmed as follows:—

	Thousands of Acres.	Per Cent. of Total Cultivated.
In grain and pulse crops	793·2	4·2
In green and root crops	700·2	3·7
In fallow	96·0	0·5
In sown grasses and clover (cut for hay, seed, or ensilage)	698·3	3·7
Total in crops	2,287·7	12·1
In sown grasses and clover (not cut for hay, seed or ensilage)	16,221·3	85·2
Other improved land	524·6	2·7
Total in cultivation	19,033·6	100·0
Unimproved land	23,639·8	—
Total area in occupation	42,763·4	—

A. Crops for Annual Feeding

The largest cropping area is that devoted to animal feeding, mainly for winter, early spring or autumn feeding, where, owing to coldness or dryness of climate, grass does not grow.

The crops used comprise (1) turnips, the largest areas being in Canterbury, Southland, Otago; (2) grasses and clover cut for hay and ensilage, grown mainly in the North Island. Where, as in Auckland and Taranaki, surplus grass growth in the summer period above the normal grazing capacity is obtained, hay and ensilage provide a cheaper winter feed than turnips; but, where, as often occurs in Canterbury, no surplus growth is obtained, and

rape and turnips require to be grown to supplement the grass even for summer feed, then turnips or some supplementary crop must provide the winter feed; (3) green fodder, the largest areas being in Canterbury, Otago, Southland, Wellington, and Hawke's Bay. This crop may be used for dry summer periods, but it also supplements the soft turnip crops, after turnips are eaten off, and before full grass growth begins in August and September. It may also be used along with other cash crops, such as oats and Italian ryegrass, for green feed in winter and spring. It is then shut up for crop about October-November; (4) lucerne for hay, etc., is grown fairly generally through the Dominion. This is in most cases merely a supplementary grass crop, particularly valuable for making hay or ensilage. Two or three cuts are made. The crop is excellent where irrigation can be practised, or where water at a depth of 6 to 20 feet is available; (5) mangolds, the largest areas being in Canterbury, Wellington, Otago, Taranaki, Auckland. This root crop is mainly used for supplementary feeding of dairy cows in September-October, after the other winter feed is exhausted, and before the flush of grass growth begins.

The total of animal feeding crops, mainly winter and early spring, and dry autumn feeding crops, comprised, in 1933-34:—

479,000	acres turnips.
470,000	acres grass and clover for hay and ensilage.
201,000	acres green fodder.
36,000	acres lucerne for hay, etc.
14,000	acres mangolds.
Total: 1,200,000	acres.

B. Cash Crops[2]

Oats.—Oats (78,000 acres threshed) are used as cash crops, and also for horse-feed on farms and for direct feeding to stock as a supplement to turnips. The only important areas are in Canterbury, Otago, and Southland.

Wheat.—Wheat (286,000 acres threshed) is the most important cash crop, and is used almost entirely for local consumption. The largest area is in Canterbury, where suitable harvest weather can be relied on, and the soil is sufficiently fertile.

Potatoes.—Potatoes (25,000 acres) are marketed in New Zealand. The crop is concentrated mainly in Canterbury, where again a fertile soil exists, with weather dry enough to allow potatoes to be kept through the winter. In Otago, Wellington, Auckland and Southland, lesser areas occur, mainly to cater for the early potato market.

Barley.—Barley (21,000 acres threshed) is mainly localized in Canterbury, Otago and Marlborough. It is in part used for malting, and in part for stock feeds.

2. Areas are for 1933-34 season.

Maize.—Maize (8,000 acres threshed) is grown in almost equal areas in Gisborne and Auckland Land Districts, part of the areas being grown as a dairy cow feed.

Linseed.—Linseed (1,400 acres threshed) is grown for local consumption for oil purposes. The total acreage is small, and is localized almost entirely in Canterbury, mainly on colder clay slopes of heavy land or in areas too late for sowing wheat.

Peas.—This crop (30,000 acres threshed) is mainly concentrated in Canterbury and Marlborough. Part is grown as garden peas for seed, and part as split peas for birds, stock and human food.

Grass and Clover Seeds.—93,000 acres are grown in Canterbury, Southland, Otago, Hawke's Bay, and Gisborne, in that order of importance.

Tobacco, onions and hops are minor crops, and not widely grown.

VIII. CAPITAL REQUIRED

The capital required naturally varies with size of farm, type of cropping, and so on, while the amount which the farmer requires to borrow will be influenced by a number of factors, in addition to the initial capital the individual farmer possesses. Thus, if the land is rented or worked on shares, the credit requirements of the farmer are reduced, while if crops are grown on contract the responsibility of finance is frequently shifted from the farmer.

Over-investment in machinery and inadequacy of working capital are common sources of difficulty, the former frequently being responsible for the latter.

The following statements are illustrative of the capital requirements on two different types of arable farm in Canterbury. A light Canterbury Plain farm of 1,000 acres, growing about 100 acres each of turnips, oats, green feed, rape, and new grass each year, and carrying 1,000 ewes and a six-horse and a four-horse team, would require the following:—

Buildings: House, £700; stable, £100; implement shed, £100; cowshed, pigstye, and barn, £100; total	£1,000
Land and other improvements	5,000
Total: 1,000 acres land and improvements at £6 per acre	£6,000
Implements: 2- and 3-furrow ploughs, harrows, discs, grubber, roller, drill, binder, stripper, spring-cart, two drays, tree, harness, sundries, etc.; total	£300
Stock: 10 horses	200
1,000 ewes, 20 rams, 26 killers, 5 cows, 2 calves, 2 yearlings, 1 sow	600
Produce: 50 tons chaff, sacks, twine, seed, manure, etc., in hand	300
Estimated working cash required for year	500
	£7,900

On a heavy Canterbury cropping farm the capital required for land, implements and working would be much greater. A farm of 400 acres, growing about 100 acres of wheat, 50 acres of oats, 50 acres of barley or peas, 50 acres rape or turnips, and 50 acres of green feed and grass, carrying 500 ewes and a six-horse team and tractor, would require the following:—

Buildings: House, £1,000; stable, £100; implement shed, £200; cowshed, pigstye and barn, £100; total	£1,400
Land and other improvements	8,600
Total: 400 acres at £25 per acre	£10,000
Implements: 2- and 3-furrow ploughs, harrows, discs, grubber, roller, mowers, drill, binder, spring-cart, 2 drays, tractor, tin mill, trees, harness, sundries	£1,000
Stock: Horses 7	140
500 ewes, 10 rams, 5 cows, 2 calves, 2 yearlings, 2 sows	400
Produce and stock in trade, 40 tons chaff, sacks, twine, seed and manure, etc.	300
Estimated working cash for year	660
	£12,500

Where rape or turnip fattening was extensively used, or where crops were not placed on the market immediately after harvesting, or where such expensive crops as potatoes were extensively grown, then much more working capital would be needed.

The above figures relate to the period immediately prior to the crisis.

IX. CONCLUSION

At the present time there is a tendency for improvements to take place in the types of machinery used, and for per acre production of arable crops to increase.

The prospects of an increased production of cash crops are definitely limited, unless they can be produced under modern large-scale methods. There seems very little tendency in this direction, and the competition of pasture farming, associated with comparatively small-scale production in the case of dairying, and of large-scale sheep-farming on lands unsuitable to arable production are likely to hamper large-scale arable farming on a competitive basis, and to cause the present tendency towards an expansion of pasture farming to continue.

Increased per acre production is associated with improved machinery, improvements in the quality of seeds, and in manuring and cultivation. It is unlikely that this will lead to any expansion of the area devoted to arable crops, especially to cash crops, though it may retard the competition of grasses, with root crops as supplementary feed for livestock. In certain directions expansion may take place. Thus, the development of true

breeding strains of certified grass and clover seeds may open up prospects of a local market, or even of an export trade, but arable cash crops, as well as arable supplementary feeds, are likely to do little more than maintain their present position in the farm economy. Even this may be difficult, especially if the protection given to wheat and to other cash crops is removed or reduced, and if improvements in pasture management continue at the present rate.[3]

3. The whole position will be complicated, of course, if quotas are imposed on export products, such as meat and dairy produce.

CHAPTER XXV

FRUIT, MARKET GARDENING, TOBACCO, AND TUNG OIL

BY J. A. CAMPBELL

I. Fruit—A. Introductory: 1. Early History; 2. Introduction of Diseases and Pests; 3. Legislative Action; 4. State Control and Assistance; 5. Growers' Organizations—B. Geographical Distribution: 1. Topography; 2. Soil Qualities; 3. Rainfall; 4. Temperature; 5. Transport and Markets—C. Economic Organization: 1. General; 2. Size of Orchards; 3. Technical Organization; 4. Fruit Crops and Labour Utilization; 5. Fruit-growing in Relation to Other Undertakings; 6. Labour—D. Finance—E. Present Position of the Industry. II. Market Gardening. III. Tobacco Culture. IV. Tung Oil.

I. FRUIT

A. INTRODUCTORY

1. *Early History*

IN the early history of the country, before organized settlement took place, and for many years subsequently, groves of stone fruit trees, particularly peaches produced from stones planted by the Maoris, were found bordering practically every watercourse in the North Island. These trees bore heavy crops of beautiful fruit, and continued to do so until age and the ravages of introduced diseases eventually wiped them out.

The early missionaries were the first Europeans to interest themselves in fruit-tree planting, and took advantage of what opportunities were offering to introduce fruit trees of different kinds from abroad. The first attempt at orcharding took place in the localities where the first mission stations were established, notably Auckland, Rotorua and Waikato, in the north, and Nelson and Motueka in the south. While practically all the trees planted by the missionaries have long since disappeared, there are one or two pear trees still existing at Motueka, which are said to have been planted by them, while there is a very large cherry tree on the northern shore of Lake Rotorua, which is said to be one of the first trees planted by a European in this country.

Possibly the earliest grouping of fruit trees in the form of an orchard took place in the Birkenhead district of Auckland some 90 odd years ago. During the period between 1840 and 1850 several small orchards were established at Birkenhead, Northshore, Onehunga and Otahuhu, in the vicinity of Auckland.

The earliest nursery recorded in the Dominion is that of B. T. Hawkins, of Birkenhead, established in the same period, while the oldest nursery catalogue is one issued by the same firm in 1852.

Subsequently fruit-culture developed more or less in accordance with the growing settlement of the country, but at times lagged behind, mainly

due to the period a tree takes to reach productivity. At other times supplies outstripped requirements as plantings developed and the trees increased in productivity. Over-planting, which was consequently followed some few years later by over-production, took place in several parts of the Auckland Province in 1870 and 1880, particularly in the Waikato district, in the vicinity of Hamilton and Cambridge. During the height of production from these plantings, at a time when the local fruit markets had entirely collapsed, an attempt was made to develop an export trade in fruit, resulting in the first export shipment of apples being despatched from this country to London in 1892. Two consignments, comprising some 15,000 cases, were despatched, and although it is recorded that the fruit arrived in reasonably good order, and sold at fair prices, the effort was attended by so many difficulties that no attempt was made to repeat it in a substantial way for many years.

2. Introduction of Diseases and Pests

In the meantime orchard diseases imported from abroad were beginning to make their presence felt. Notable among these were the codlin moth, apple and pear scab, woolly aphis, and several types of scale pests. The development and spread of destructive orchard diseases, the control of which had not been highly developed during the last century, together with over-production and the disorganized state of the markets, where no restrictions were placed on the sale of diseased fruit, led in a comparatively few years to the decline and almost complete decay of what was a substantial orchard development along the valley of the Waikato River. Other northern orchard districts met with much the same fate.

The more southern fruit-growing areas, however, which, with the exception of Nelson, were younger and less extensive, did not suffer from over-production to anything like the same extent, nor was the problem of disease so acute, for it was some twenty years before codlin moth, which at that time was an almost uncontrollable pest, became general throughout the country.

3. Legislative Action

The Waikato Fruitgrowers' Association was one of the earliest associations of the kind recorded in this country, and the earliest attempt toward legislation in the direction of the control of orchard diseases and the regulation of fruit markets was drafted by that association. The movement, however, proved to be several years in advance of its time, for although an Orchard Pest Act was introduced in 1897, it was not until 1903 that the present Orchard and Garden Diseases Act was introduced. Incidentally, a somewhat ironical position was created. The enforcement of the 1903 Act,

which was largely based on proposals made by the Waikato Fruitgrowers' Association many years previously, led to the almost complete destruction of what were left of the Waikato orchard properties, which by this time had been allowed to deteriorate very considerably.

The enforcement of the Orchard and Garden Diseases Act, 1903, led to a general cleaning up, largely by destruction of all old and neglected orchards, particularly in the vicinity of the principal fruit-growing areas. The enforcement of disease control, and the entire prohibition of the sale of fruit affected by disease, led to a very decided improvement in fruit-marketing prospects. It can safely be said that this legislation laid the foundation or made possible the establishment on sound lines of a fruit industry suitable to the particular requirements and possibilities of the country. This, apart from providing soft fruits in season to meet local requirements, has facilitated the establishment of an export trade in apples and pears.

The planting of fruit trees was accelerated almost immediately, the Nelson Province experiencing a boom in 1910. This condition of affairs continued until 1915, when the World War brought an end to what might otherwise have been an embarrassing developmental situation. As it was, many hundreds of acres of land unsuitably situated were planted, and many individuals who, through lack of knowledge or capital, were quite unsuitable, became involved in this development as a result of the advertising propaganda of the various development companies. In consequence of this, and the very changed outlook brought about by the War, a mild reaction set in a few years later, resulting in the destruction of many new but neglected and otherwise impossible orchard properties. This development was mainly confined to apple trees, with a small percentage of pears, the object being to lay the foundation of an oversea trade in these fruits. In this the movement, although retarded as a result of war conditions, was eventually successful.

A small export fruit trade was commenced in 1910 when a shipment of 8,000 cases of apples was despatched to London. This was followed by small shipments to the Argentine, commencing with 20,000 cases in 1911, and increasing to 60,000 in 1915. Owing to the lack of shipping as a result of the War, the trade was discontinued, and the year 1920 really marks the commencement of the business on sound co-ordinated lines, based on a clearly recognized system of standard grading, packing and inspection.

4. *State Control and Assistance*

From the point of view of the State, the industry comes within the province of the Department of Agriculture, and is controlled by the Horticultural Division of that Department. The Division is controlled by

a Director, with whom is associated an Assistant Director and Senior Instructors in horticulture, vine-culture, wine-making, tobacco-culture, and bee-keeping, a headquarters staff, and a staff of Field Instructors. For the purposes of control, the Dominion is divided into fruit areas. Each area is in charge of a field officer, designated Orchard Instructor, who has associated with him one or more Assistant Instructors. The duties of field officers include the enforcement of the provisions of the Orchard and Garden Diseases Act by inspection of orchards and nurseries to ensure disease control; control of fruit markets; supervision of grading, packing, and standardization of fruit intended for export. As their designation implies, their principal work is that of instructing the fruit-grower in all phases of his industry.

5. *Growers' Organizations*

The co-ordination and government of the industry from within may be explained as follows:—

In practically all fruit-growing areas there are one or more fruit-growers' associations. All these associations have combined and set up a general controlling body known as the N.Z. Fruit-growers' Federation Ltd. Each society, including the Federation, is registered under the Industrial and Provident Societies' Act. The district associations watch the interests of fruit-growers in their respective localities, act as a medium for the exchange of ideas, rallying centres for lectures and the dissemination of forms of appropriate information, including all phases of orchard management and the conduct of the trading side of their undertakings.

The Federation, which is controlled by a general manager and a board of directors elected by the affiliated associations, attends to the wider aspect of the industry, including the educational, political, and trading aspects. This society was brought into existence in 1910. During the early stage of its career it was financed by means of an orchard tax. In 1912 the Government introduced an Orchard Tax Act. This legislation imposed a tax of 1/- per acre, with a minimum of 2/6, on all commercial orchards. The tax was collected by the Government, and the proceeds, less the cost of collection (approximately £2,000), were handed over to and utilized for the purposes of establishing the Federation. Although the basis has been slightly altered, and the proceeeds diminished, this tax is still being collected, but the organization, through the growth of its trading business, has long since outgrown the need of such assistance for general purposes. The proceeds are paid to the Federation, which body devotes them to such purposes as the payment of the expenses of delegates to the N.Z. Fruit-growers' Conference, which is arranged to take place annually under the societies' constitution.

Another important organization in connection with the industry is the N.Z. Fruit Export Control Board. This body, which will be dealt with more fully later, was brought into existence on the passing of the N.Z. Fruit Control Act, 1924.

B. Geographical Distribution of Fruit-growing

Temperate climate fruits can be successfully grown practically throughout the whole of the Dominion, but, nevertheless, for one reason or another, concentration has taken place in special localities. While each of the factors mentioned below has had some bearing on this, the principal are those of transportation and markets.

1. *Topography*

While a considerable portion of New Zealand is steep and mountainous, there is a large area composed of low hills, easy slopes, river valleys and plains. Naturally fruit-culture is carried out on the latter types of country, and as there is ample of this available no restriction of the development of the fruit industry has occurred, or is likely to occur, due to lack of suitable land.

2. *Soil Qualities*

Soil qualities vary considerably, ranging from the rich alluvial flat lands, such as are represented by the Taieri Plains of Otago and the Canterbury and Hawke's Bay Plains, to the marly clay lands of North Auckland formerly occupied by kauri forests. The latter lands are known as gumlands, on account of the quantity of kauri gum recovered from them from time to time. Not only do the soil types vary generally throughout the country, but they are liable to vary considerably within any given locality. Fruit of one type or another can be grown on almost all soil types. Even the gumlands, although somewhat difficult to work in the early stages, not only produce good-quality apples, but are noted for their strawberry production. Generally speaking, soil types have not seriously affected the geographical distribution of fruit-culture beyond calling for an intelligent selection of the class of fruit to suit the different soil types in a locality. Soil types have, however, exercised considerable control in the Nelson district and the Huapai district of Auckland, where a concentration of apple production on low-priced land has taken place, this being due to the fact that the land was held to be too poor in quality for ordinary agricultural purposes.

3. *Rainfall*

The rainfall is generous and well distributed, and, while ample for fruit culture, it is not excessive in any part where commercial fruit-growing

is practised. The only area deficient in rainfall is a comparatively small area known as Central Otago. Owing to the topography of the country, which is generally steep and rugged, the rainfall is low, and although stone fruit culture is very successfully practised along the valley of the Molyneaux River, which runs through the area, irrigation is in general necessary.

4. *Temperature*

Although commercial fruit-growing extends from Keri-Keri (or Bay of Islands), in the north, to Roxburgh (or Central Otago), in the south, a distance of 600 miles, the average summer temperature only varies by about four degrees. The winters in the south, however, although not excessive, are longer and colder, and the frosts are heavier and later. These factors do not militate to any extent against the production of apples and pears, but do affect the culture of stone fruits, grapes and citrus fruits. Consequently, with the exception of the dry area of Central Otago and the Nelson district, the climate of which is much milder than elsewhere in the south, stone fruit, grape and citrus-culture is mainly confined to the northern areas. On the other hand, the South Island is much more successful than the north in the production of certain types of berries and bush fruits.

5. *Transportation and Markets*

Apart from the necessity of confining the production of sub-tropical fruits to the milder areas of the Dominion, which are situated mainly in the northern portion of the North Island, transportation and markets have played a greater part in the geographical distribution of fruit-culture than any other factor. Fruit is a comparatively low-priced, bulky, and perishable commodity. Consequently, the tendency has been to develop fruit-culture in the vicinity of settlement whenever the topography and soil have been at all suitable, the concentration being greatest in the vicinity of the larger towns and cities. The principal exceptions to this rule are the Nelson district and the Hastings district, in Hawke's Bay. The former is one of the oldest fruit-growing districts of New Zealand, and has remained popular owing to its mild and sunny climate, and almost entire absence of serious winds, and a considerable area of poor-quality, low-priced land has been available. The popularity of the Hastings district is due to the excellent climate and the high fertility of the soil of the Hastings plains.

The fact that New Zealand has a very limited population, and is situated many thousands of miles away from the large centres of population, has had a considerable influence on the economic organization of the fruit industry. A successful fruit industry—or, for that matter, any other industry—cannot be built up and maintained on production alone. Production must go hand in hand with the ability to dispose of the product at a

profit. Fruit, especially stone fruit, is a highly perishable commodity; therefore, to dispose of it in a fresh state, without undue wastage, a market sufficiently large must be readily available.

The local demand falls far short of the quantity of stone fruit that could be produced, and it is not practicable with the existing means of transportation to convey soft fruits the distances necessary to secure a satisfactory market. Canning, drying and jam-making represent means whereby such fruits can be preserved and safely shipped long distances. At first glance one would be inclined to assume that there were great possibilities in this direction, but in reality whatever possibilities there might be concern the future rather than the present, for, although the processing of fruit in the manner indicated is carried on to some extent, the whole of the local requirements would not be sufficient to absorb the output of one modern factory, while any attempt to build up an export trade in canned fruit would be extremely difficult owing to the high state of perfection this industry has already reached in other parts of the world.

C. Economic Organization of Fruit-growing

1. *General*

The area of registered commercial orchards is approximately 27,000 acres, made up as follows:—

Apples	17,855	Apricots	1,085
Pears	2,244	Cherries	347
Peaches	2,214	Quinces	198
Nectarines	359	Lemons	956
Plums	1,350	Oranges	402

Six hundred bushels per acre of commercial apples is looked upon as a good crop from full-bearing trees. The yield per acre varies from 250 cases from inferior orchards on poor land up to 1,000 cases from the older and better-class orchards, and on the richer soils such as obtain in Hawke's Bay. About 35,000 cases of apples and pears were exported in the year 1920. The quantity has increased substantially year by year, reaching a total of 1,500,000 cases of apples and 70,000 cases of pears for the year 1932.

The marketing difficulty, which applies to practically all soft fruits, has forced the industry to develop along the lines of apple and pear production, for, although perishable, these fruits are, under modern conditions of handling and transportation, capable of being satisfactorily shipped to practically any part of the world. While apples are grown generally throughout New Zealand, the leading apple export districts in order of production are: Nelson, Hawke's Bay, Auckland, Otago, Blenheim, and Wairarapa.

Central Otago is noted for its stone fruits. It would be difficult to find a

district anywhere that would excel this area in production of this type of fruit, particularly apricots. Apricots also succeed well, and are produced in reasonable quantities at Thames, on the Coromandel Coast, Nelson, and Hawke's Bay. Peaches are produced in quantity in all these districts, as well as in Auckland and the adjacent localities. Cherries are grown in quantity in Greytown, Wairarapa; Governor's Bay, Canterbury; and Central Otago. The cherry-grower in New Zealand is, however, under a disadvantage owing to the small-bird nuisance, which has necessitated the netting of practically all cherry orchards, the expense of which adds materially to the cost of production and to the retail price.

Oranges and lemons have been grown to some extent ever since the days of early European settlement, but it has only been of recent years that any decided movement has been made towards building up a citrus fruit industry. However, comparatively large areas of citrus trees, particularly lemons, have been planted, and the annual yield of this class of fruit is increasing year by year. A greater amount of attention is being given to picking, curing, packing and marketing, with the result that the demand for the local product is increasing. The principal citrus-producing localities are Auckland, North Auckland, Thames, Tauranga and Gisborne districts.

Grape-growing is also on the increase, and there is room for further development. Although the grape is a very perishable fruit, and therefore has its limitations as a fresh fruit, it can be readily preserved by conversion into wine. Several kinds of wine of excellent quality are being manufactured in considerable quantities in different parts of the country, mainly in Hawke's Bay and Auckland.

2. *Size of Orchards*

Orchards range in size from 1 acre up to 100 acres. Small orchards from 1 to 5 acres are insufficient to maintain a family satisfactorily, unless the soil is extremely good and concentrated attention is devoted to the undertaking. An area of five acres may then be large enough to support a family. Orchards of this range are invariably worked either as a side line or in combination with some other form of industry, or as a hobby by those engaged in some other calling.

In comparison with most types of agricultural effort, fruit-growing is highly intensive, consequently a livelihood may be procured from a comparatively small area. Operating costs per unit decrease with increased yield per acre, and as relatively high production per acre depends largely on the skill of the orchardist, and personal supervision of every detail, the comparatively small area, capable of being worked without much assistance, is regarded as the most satisfactory from a business aspect.

However, plant and equipment necessary for producing and preparing for market, say, a 4,000-case crop would suffice for a crop of double the size. Consequently, an orchard below a certain area, if fully equipped, might easily become so much over-capitalized as to increase operating costs to such an extent as to largely eliminate profits. The size of orchard regarded as most economical to work is one where most of the year's operations except harvesting may be performed, with the assistance of modern equipment, by the orchardist himself and one, or at the most two, assistants, and capable of producing an average crop of 5,000 to 8,000 bushels of fruit per season.

The size of orchard required to produce a crop of these dimensions varies considerably according to richness of soil, other factors being equal. On the heavier type of land as utilized for fruit-growing in such a district as Hawke's Bay, an area of 6-10 acres has proved to be sufficiently large. The majority of commercial orchards in Hawke's Bay actually range in size from 5-10 acres, comparatively few exceeding 20 acres. In other parts, where the land is of poorer quality, the popular size is from 10-15 acres up to 25 acres.

The following table, being a sample of 2,954 orchards, indicates the distribution according to size in New Zealand:—

TABLE CXXVIII

Size of Commercial Orchards

Size (Acres)	No of Orchards	Size (Acres)	No. of Orchards	Size (Acres)	No. of Orchards
1 to 5	1,653	31 to 35	15	61 to 65	2
6 to 10	775	36 to 40	9	66 to 70	1
11 to 15	268	41 to 45	7	71 to 75	1
16 to 20	134	46 to 50	3	96 to 100	2
21 to 25	41	51 to 55	6	110	1
26 to 30	32	56 to 60	2	116	1
				185	1

With a definite maximum yield of fruit aimed at, richness of soil is the chief factor in determining the size of orchard, although variety and kind of fruit are important. Price of land is not such an important factor, as the original value represents a comparatively small proportion of the total cost in bringing to maturity an orchard with buildings and full equipment.

Kinds of fruit, coupled with ability to recruit labour for harvesting, is an important factor in determining the size of an orchard of any particular type. Apples and pears of any variety have a period of several weeks for harvesting, and larger areas may be planted without great danger of loss through interference with picking when the fruits mature. The harvesting of peaches, nectarines and plums is a more hazardous undertaking, and such fruits are best worked in a limited way, 5-acre blocks of mixed varieties

and kinds on the heavier land being the maximum area regarded as safe, while cherries, the most difficult of all to harvest, do best in areas of not more than two acres, fully enclosed by wire-netting as a protection against birds.

3. *Technical Organization*

(a) *Layout.*—What is aimed at in selecting an orchard site is to secure land of good quality, falling slightly toward the north-east. If not naturally sheltered, protection against the prevailing winds is provided by planting a hedge of some suitable shelter-tree, such as Lombardy poplars, Lawsoniana, etc. Attention to drainage is an essential matter. If this is not naturally provided, a system of field-pipe drainage has to be resorted to.

Pears being the strongest-growing trees, are the first planted on the windy side, followed by apples, and, if stone and bush fruits are to be included, peaches, apricots, cherries, and bush fruits follow in that order. As the several kinds of fruits develop and mature at different periods, the different varieties are grouped in the interests of economic spraying and other orchard practices. The layout may have to be varied to suit existing circumstances, such as arise from the contour of the land, variation in soil types, etc.

Planting is conducted on the square system, that is to say, the trees in the row are the same distance apart as they are between the rows. Any departure from this results in broken rows, adding materially to the difficulties of subsequent cultivation.

(b) *System of Cultivation, Planting and Pruning.*—The practice in preparing an area for the planting of an orchard is to plough and subsoil the land, and let it lie fallow for a period, discing and working into a fine tilth prior to planting in the autumn or spring. The power used for this purpose in the past has been the horse team, but of recent years the mechanical tractor has grown in popularity for this purpose, as well as for general orchard work, more particularly where the land is flat or approximately so.

Subsequent cultivation consists of ploughing in the autumn and spring, working the land down with an appropriate cultivating implement, such as a disc, cultivator or harrow, several of which have been specially designed for orchard work. What is termed clean cultivation until well through the summer is the general practice, after which, unless a cover crop is sown, weeds and other growths are permitted, these being ploughed in at the autumn ploughing. Usually when a cover crop is sown in the late summer it is allowed to persist throughout the winter, and turned under in the spring.

The whole technique in fruit-tree training is aimed at the elimination of the ladder to the greatest extent possible, and otherwise simplifying the

labour of fruit-picking. As far as the kind and variety of fruit will permit, the tree is not allowed to reach any great height. This applies particularly to the apple, which is the dominating fruit tree of this country. Apple trees are almost entirely raised on what is known as the Northern Spy stock; this stock has a semi-dwarfing habit, and promotes early bearing. Any loss in weight in crop that may attend this method of training is offset by closer planting than is ordinarily practised, and by starting the head low and training the tree with an open centre, thereby encouraging the production of fruit from low down in the crown upward throughout the framework of the tree by the admission of the maximum amount of air and sunlight. The average distance apart at which deciduous fruit trees are planted is 18 feet. This distance is decreased to 16 or even 15 feet in the case of low-quality land, or increased to 20 or 22 feet in case of rich land.

Citrus trees are planted 22 to 25 feet apart, the latter distance being the more popular.

Pruning operations are carried out each winter, and are directed in the early stage of the tree's existence toward building up a low-set, sturdy tree, with well-placed main arms and framework. Usually, trees one year old from the bud are selected for planting; in the case of the apple, the unbranched tree commonly termed the 'whip' is preferred. This is cut back to about 18 or 20 inches from the ground. During the following season the main branches are formed. These are again cut back at the following winter pruning to within 10 inches or a foot from the base. Fairly hard pruning is carried on for a season or two, the main branches, secondary branched, being increased in number each growing season until from 10 to 12 main leaders have been established.

Subsequently, until the tree has reached a reasonable size, moderately hard pruning of the main branches is continued. In the meantime the numerous laterals that arise throughout the framework of the tree require judicious treatment. In the case of a tree lacking vigour as a result of heat, drought, or lack of soil fertility, the principal laterals are pruned back heavily to promote vegetation and shield the branches from the evil effects of the direct rays of the sun. Trees of this kind take on the fruit-bearing habit readily—almost too readily for their future welfare; therefore, no special efforts need to be made in this direction beyond that of leaving some of the weaker laterals uncut. The stronger the growth of the tree the greater are the number of laterals left intact. In cases of extra strong growth, not only are the laterals left uncut, but the heading back of the main branches is discontinued for a season or two. In these circumstances winter pruning frequently ceases almost entirely, and summer pruning, to the extent of opening up the centre of the tree and the removal of excessive and crowded laterals, for the purpose of admitting air and sunlight, begins.

As the tree steadies down and commences to bear fruit, the laterals are judiciously shortened from season to season until a proper balance has been established.

While the different kinds of fruits, and to some extent the different varieties, call for variations in the system of pruning—which variations are also to some extent affected by the vigour and health of the tree itself—the general principles are much the same; trees are freely pruned when young to promote vigour and to correct errors in shape, subsequently to renew fruiting wood and to keep a satisfactory balance between growth and fruit production.

Although bush fruits—currants and gooseberries—thrive fairly well on many types of soil, the best results are obtained when they are planted on rich, loose loam, and in a warm situation. Good treatment is necessary to secure the best results, consequently care should be taken in thoroughly preparing the land for planting. The system of planting is similar to that applying to an apple orchard, except that the distance apart each way in this instance is 5 to 6 feet.

Probably no fruit responds better to good cultivation than the raspberry, and, although the plant will accommodate itself to many types of soil, provided these are deeply and thoroughly worked, the best results are obtained when planted in a rich, open soil, of a somewhat sandy nature, particularly if the situation is warm and sunny, and there is an adequate supply of moisture available to the roots of the plant during the summer months.

Planting is usually on the square system, 5 feet between the crowns, or in rows 6 feet apart, with 3 feet apart in the rows. Strong, sturdy canes are selected for planting, and whether planted singly or in stools they are cut back to a height of from 9 to 12 inches. Subsequent pruning is not quite so heavy, but the leaving of long canes at any time is not advisable. Frequent but light cultivation is practised throughout the growing season.

Of all the small fruits, the strawberry is probably the most popular. Not only is it in demand for dessert purposes, but also for jam-making and preserving. Many varieties of strawberries have been introduced in recent years, resulting in the plant being successfully raised over a much wider variation of soils. Generally speaking, the strawberry does best on soils ranging from deep, moist loam to a fairly stiff clay well supplied with humus. Prior to planting, the soil is well and deeply worked. Good drainage is essential to successful strawberry-culture.

The plants are set out usually in the autumn in rows 12 to 15 inches apart, with 2 feet to 2 feet 6 inches between the rows. Weeds are kept down by means of the hoe and cultivator. Runners not required for planting are cut off in the interest of berry production on the part of the main plant.

The plants are mulched, i.e., clean straw is spread around them just prior to blossoming to keep the berries clean and free from soil contamination following heavy rain. Weakling plants are replaced at the end of each season, and the whole ploughed under at the end of the third or fourth year, sometimes sooner.

(c) *Implements and Machines.*—The small farm tractor, both of the wheel and caterpillar type, is rapidly growing in popularity for orcharding purposes, particularly where the contour of the land is suitable. There are ploughs of many types in use, but the most popular are the double furrow type especially designed for orchard work, such as the Harvey, and the short mould-board single furrow type such as the Olliver. The same can be said of the disc harrow and cultivator.

Portable power spraying machines are used in the main, but are being rapidly superseded by what is commonly termed the stationary spraying system. This system consists of the establishment of a pumping system at a fixed point, and the leading of high pressure pipes therefrom throughout the orchard. Stand pipes with high pressure taps arise from the piping system at fixed intervals throughout the orchard. The spray liquid is forced through the pipes from the pumping station at a pressure of 300 to 350 lbs. A hose ranging from 90 to 150 feet in length with a spray nozzle or gun attached is coupled up to the tap of one of the stand pipes, from which a block of some forty trees and upwards may be sprayed before moving on to the next stand. The size of pipes usually used for the purpose in this country are $\frac{3}{4}$ inch mains with $\frac{1}{2}$ inch laterals. This method of spraying is proving to be highly efficient, economical and convenient. Spraying can be done more quickly, thoroughly, and without having to wait unduly for the ground to dry after rain.

Other machines important to the industry are fruit grading or sizing machines, the most popular makes being imported. There are several quite satisfactory locally-made graders in use. These in the main are small, having a capacity from 300 to 600 cases per day.

(d) *Pests and Their Control.*—Parasitic control of orchard pests has been attempted, but with partial success only, the outstanding exception being the Aphelinus Mali and its control of woolly aphis. With this exception, the universal method of disease control is by spraying the trees and fruit with an appropriate specific. A considerable number of insect pests and fungus diseases of more or less importance exist in this country, almost the whole of which have been imported from abroad. The principal of these are:—

Apple: Black Spot (*Venturia inaequalis*); Powdery Mildew (*Podosphaera leucotricha*); Codlin Moth (*Cydia pomonella*); Red Mite (*Bryobia pratensis*).

Pear: Pear Scab (*Venturia pirina*); Codlin Moth (*Cydia pomonella*).

Peach and Nectarine: Leaf Curl (*Taphrina deformans*); Brown Rot (*Sclerotinia cinerea*); Silver Blight (*Stereum purpureum*); Red Mite (*Bryobia pratensis*).

Plum: Brown Rot (*Sclerotinia cinera*): Bladder Plum (*Taphrina pruni*).

Orchardists' spraying programmes vary to some extent to meet the different temperature and humidity conditions obtaining in different parts of the country.

(e) *Manuring and Fertilizing.*—Cover cropping is looked upon as a highly desirable practice, and is one that is generally followed, particularly in respect of clay soils or soils of a light or sandy nature. Plants used for this purpose include blue lupin, which at the present time is the most popular, yellow and white lupins, field peas and beans, mustard, vetches and oats. Stable and farmyard manure, fish and seaweed are highly popular, but not always readily obtainable. For this reason their use is largely confined to the culture of vegetables, tomatoes, and similar market gardening crops.

Artificial fertilizers are in universal use. Phosphate in one form or another—the most popular is superphosphate—invariably forms part of any mixture applied to the land, while basic slag, bonedust, blood and bone, muriate of potash, and nitrate of soda are all used to some extent for their respective purposes. The most popular method of supplying a complete manure is by means of superphosphate, sulphate of potash, and sulphate of ammonia. The deleterious effect on the soil that might otherwise arise from the use of such acid fertilizers is met by the liberal use of carbonate of lime.

While the effect of fertilizers on annual crops can be fairly readily and accurately determined, the fruit tree, for obvious reasons, presents a much greater problem; and, although experiments have been and are being carried out for the purpose of more accurately determining the effect of different manurial systems, up to the present the fruitgrower has had to depend mainly for his guidance in this regard on the general health of his tree and the quality and weight of its crop. The general practice, varied to some extent to meet different conditions, is to lime the land thoroughly and periodically and to dress with 2 cwt. of superphosphate, 1 cwt. potash, and 1 cwt. sulphate of ammonia per acre, applying the super and potash in the late winter and the ammonia in the middle or toward the end of spring. Much the same system of manuring obtains with respect to bush fruits and berries and vegetables, but the amount applied is usually greater, some market gardeners using up to 25 to 30 cwt. per acre.

4. *Inter-relation of Different Kinds of Fruit Crops in Reference to the Utilization of Labour*

This is affected to some extent by the following factors: whether the orchard is planted for the production of fruit for export or for local market; the class and extent of the labour required; and the suitability of the land and site for general fruit production.

In the case of an orchard intended primarily for export crops, the fruitgrower may plant a limited area of early fruits to keep him and his staff occupied until his export crop commences; but the preparation of his export crops is usually sufficient to keep his staff and himself fully occupied, since he arranges his export varieties in such a way as to spread his export harvest over as large a portion of the year as possible. If, however, the orchardist is primarily depending on the local market, he aims at making the season as long as possible by planting a range of fruit, commencing with strawberries and following with gooseberries, cherries, apricots, peaches, plums, pears and apples, arranging such kinds and varieties of fruit as will give him a satisfactory rotation.

The extent to which hired labour is employed also affects the economy of the orchard. Where the orchardist depends mainly on labour of his own family, his aim is to make the season as long as possible, using outside labour only at peak periods. But where the bulk of the labour used is hired, the aim is to make the season short and heavy, cleaning up the bulk of the work as soon as possible, thus reducing the wages bill to a minimum.

5. *Inter-relation of Other Undertakings with Fruit-growing*

The settler in a small or comparatively small way, as far as fruitgrowing is concerned, can well undertake in combination therewith, such other lines as market gardening, tomato culture, beekeeping, poultry-raising and even dairying and, where the conditions are suitable, tobacco culture. But as fruit culture, owing to the dangers of insect pests and diseases and the attention necessary to harvesting, particularly in the case of stone fruits, is an exacting industry, it is likely to suffer through combination with other small undertakings which likewise have their exacting periods unless the settler is intelligent, appreciative and energetic.

Many fruitgrowers run a few pigs, fowls, etc., but fruitgrowing, when undertaken on commercial lines, is generally considered to be sufficient in itself.

6. *Labour Supply—Nature of Recruitment, Wages, and Condition of Work*

Apart from the heavier off-season work, such as ploughing, pruning, spraying, draining, etc., orchard work is comparatively light and interest-

ing, and has a considerable attraction for young people seeking open-air employment, particularly those living in cities and towns. Orchards are generally established on a plan that enables the orchardist and his family, with the assistance of one or two permanent hands, to attend to all requirements during the major portion of the year, extra assistance being necessary only during the harvesting period. This extra assistance, which varies in volume according to the class of fruit produced, is readily recruited from the adjacent cities, towns and urban areas.

While female labour obtains to a very limited extent in connection with New Zealand farming generally, the fruit industry represents a considerable departure in this regard, many features of the industry providing extremely suitable and congenial employment for young people of both sexes.

The skilled labour necessary to perform the expert work of the orchard, such as pruning, grading, packing, etc., is provided by the orchardist himself, members of his family and his permanent staff, and these also provide the necessary guidance and instruction of any temporary hands employed. There are also to be found in all commercial fruit districts, gangs of expert pruners, graders and packers who undertake this kind of work, either on piece-work basis or by the hour, moving from one orchard or packing shed to another while such work is available.

When on wages the daily rate for this class of labour is from 14/- to 16/- per day.[1] Permanent hands, when engaged on pruning, grading and packing, receive 12/- to 14/- per day, while the average daily rate for ordinary orchard hands is from 10/- to 12/- per day, or from 30/- to 50/- per week when found in board and lodgings. Inexperienced hands, such as youths and girls, engaged in picking small fruits and similar occupations, are either given piece-work or receive 6/- to 8/- per day.

All work in the orchard is based on an eight-hour day and a forty-four hour week. In the rush season work frequently extends much beyond eight hours, but overtime is paid for all time worked in excess of the recognized hours.

Orchard labour, where the hands do not reside locally, is provided with accommodation by the orchardist, either in his own house, in buildings provided for the purpose, or in comfortably-equipped camps composed of tents with board floors, chimneys, and similar conveniences.

D. Finance of Fruit-growing

Finance of fruit-growing, as distinct from finance of marketing referred to elsewhere, is usually a very important matter to the prospective fruit-grower—how important, of course, depends upon the amount of money he has at his command when undertaking the venture. Not only does the

1. I.e., in 1931.

purchase of the land, breaking in, planting and subsequent cultivation and general attention represent considerable expenditure in money and labour, but the individual concerned requires to envisage several years of somewhat dreary waiting for the trees to come into bearing, and to make allowances accordingly. Failure to fully appreciate this, when combined with over-optimism in other ways, has often led to years of hard work and frugal living, not infrequently ending in failure.

Orchard land varies in quality and value, ranging from £10 and £100 and more per acre. The cheaper land is usually the class of land that tempts the man with a limited amount of money, whereas the dearer, so long as the situation is right and the quality of the soil corresponds with the price, is not only the better proposition, but is usually more easily financed.

Apart from the purchase price, the cost of establishing and maintaining an orchard on poor land is much the same as on rich land, excepting that the trees make more rapid growth on the latter, and call for a greater amount of labour in pruning; but this fact so enhances the prospects of the venture as to render a second mortgage, if required, more readily practicable. In addition, it is possible, with thrift and intelligence on the part of the owner, to meet his current expenses, including interest, by raising between his trees various kinds of vegetables, tomatoes, small fruits, etc.—a matter only practicable on good land.

The financing of the purchasing of land for the establishment of an orchard, or for the purchase of an existing orchard, is frequently arranged under mortgage with the original owner of the property; but the common practice is through the State Advances Office, which Department, under its advances to settlers scheme, will advance up to 75 per cent. of the value of land, buildings, and other improvements. Under this scheme, however, fruit trees, owing to the rapidity at which they are liable to deteriorate under neglect or bad management, are not treated as improvements for loaning purposes. Outside of this the finance of orcharding is very closely associated with the personality of the individual. While private financial institutions, for the same reason as the State Advances Office, do not look upon orchards as sound security, unlike the latter they are able to discriminate—and frequently do—by way of extending short-term credits to approved individuals, based on the general prospects of the respective projects, but more particularly on the skill and stability of the person concerned. The right type of man undertaking a reasonably sound orcharding scheme energetically and intelligently, even though he has only a limited amount of capital, can usually secure such financial assistance as will enable him to carry on.

E. Present Position of Industry—Its Problems and Prospects

A fruit industry that returns a satisfactory net profit to the producer is a valuable industry to a community in consequence of the proportionately heavy utilization of labour and material in the production, preparation and marketing of the crop. Viewed from this angle, the fruit industry of New Zealand is much more valuable to the country than its size would otherwise indicate; for not only are the net returns comparable with those of other primary producers, but as far as export fruit is concerned they represent a comparatively low percentage of the gross sale values. Net returns of over £100 per acre, while by no means general, were not uncommon in our better fruit-growing areas before the crisis.

The problems of the industry have to do with disease control, manuring, stocks, varieties, storage, transportation and marketing. While local practice in all these matters compares favourably with those obtaining elsewhere, it is realized that these problems are still far from solution, and that by prosecuting a specific system of research some improvement in the practices now obtaining will be effected.

With this object in view a fruit research scheme under the auspices of the Department of Scientific and Industrial Research has been inaugurated. Great assistance has been rendered by the Empire Marketing Board of Great Britain, the Cawthron Institute of Nelson, the Department of Agriculture, the Plant Research Station, and other bodies including the fruitgrowers' own organizations: the Fruit Export Control Board and the Fruitgrowers' Federation.

The Fruit Research organization so established is carrying on its investigations in a specially acquired Fruit Research Orchard in the Nelson district, and co-operatively with orchardists throughout the Dominion.

While the limited population of the country precludes the early development of extensive fruit canning and drying industries, the growers of soft fruits for consumption in an unpreserved state are prospering extremely well. At the same time the export trade established in connection with apples and pears is in a good position. Owing to the sound grading and packing standards established and maintained, these fruits are well received on all overseas markets. This industry is capable of considerable extension.

The production of oranges and lemons has by no means reached the limit of local requirements, and reasonable extension in this direction should be quite sound.

The prospects of passion fruit culture have recently been receiving considerable attention. Market investigations suggest that there are very extensive demands in different parts of the world for passion fruit pulp. This fruit succeeds well in the northern portion of the North Island of New Zealand, where it has been grown for many years; and present indica-

tions suggest that extensive developments in passion fruit production are likely to take place in that area in the near future.

II. MARKET GARDENING

The basis of the statistics of market garden crops has been altered from time to time, and they do not therefore provide a good indication of the progress of this industry. For instance, the record for the year 1900 is given as 'In Garden' 16,890 acres. For the year 1921-22, under the heading of 'Market Gardens,' the acreage was 4,262. For the year 1932-33 'Market Gardens' covers the sub-titles of Small Fruits, Tomatoes and Other Market Gardens, the acreage for the Dominion being 6,852 acres. This figure excludes potato crops of ¼ acre and over; also onions and peas, which are listed separately. But it includes crops of asparagus, cabbage, cauliflower, etc., which often are 4 or 5 acres in extent. More especially it should be noted that these statistics exclude boroughs, although in Otaki, Lower Hutt, Nelson and elsewhere, very large acreages of these crops are inside borough boundaries. Another important feature is the extent to which these crops are grown under glass and are also excluded from statistics. A recent survey in and about Christchurch estimated there were about 25 acres there under glass, the value of these houses being estimated at about £135,633, excluding the land. Glasshouse-culture is also extensive in the vicinity of other large towns.

The distribution of areas under this class of crop is chiefly in the vicinity of large towns where there is the advantage of quick access to markets. Some areas have been developed because the mildness of the climate permits early maturity, as at Bay View in Hawke's Bay, and Pukekohe, where early tomatoes and potatoes respectively are grown extensively. Other regions, as in Canterbury, where a big acreage of potatoes and onions is grown, have no doubt been developed because the dry climate permits these crops to be grown with little trouble from the fungous diseases which are troublesome in localities with a larger rainfall. With but a few exceptions, these crops are grown in rich alluvial soils on foothills or in the valleys.

Large quantities of fertilizers are used, sometimes to the extent of 1 ton per acre, and usually with very great skill. Poultry-keeping, dairy farming and pig-keeping are sometimes combined with this class of farming, on account of the valuable manures thus obtained, and the added facility in arranging rotational cropping. This practice could no doubt be extended with advantage.

Growers of the above products usually have an association in each centre for the purpose of looking after their interests. They meet together annually in conference, where matters of interest to the industry are con-

sidered. The main result of these conferences so far has been the establishment of collective purchasing, especially of boxes for packing, and of fertilizers. In this way costs have been reduced and the quality of the supplies has in many cases been much improved.

Grading and packing are carried out by individual growers very much according to their own ideas. But in each locality there are some traces of uniformity. A very commendable effort is being made to standardize the packing and so facilitate sales, but growers are naturally slow to give up their usual practice and make any compromise. Marketing is generally done by auctioning in the town nearby, but goods are sometimes forwarded on consignment by train over long distances. These consignments are made individually with no knowledge of what each is doing, with the result that serious gluts sometimes occur; and, what is equally serious, markets are sometimes short of supplies.

At times there has been great dissatisfaction with the handling of supplies of auctioneers, and in the Wellington district the growers took the extreme measures of establishing their own market. However, marketing will perhaps never be satisfactory until the growers agree on the standard packing and marking of their goods, and bulk their shipments to distant markets. By keeping in close touch daily with the demand, consignments could then be made which would assure more even distribution and increased consumption, and give more satisfaction to the grower, consumer and the trade generally.

III. TOBACCO CULTURE

Early in the history of New Zealand, before the days of European settlement, the Maori occupants of the country acquired the smoking habit in consequence of tobacco secured from the visiting whalers. From the same source they also secured tobacco seed for the purpose of raising their own supplies, and, as may be expected, a fairly crude tobacco was the result. This practice has been continued to some extent ever since, but the quality of the native product never reached a standard acceptable to the average European taste.

In the meantime certain Europeans from time to time turned their attention to tobacco culture with varying success, but it was not until some 20 years ago that any genuine attempt was made to establish a commercial industry.

In the year 1912 Mr. G. Husheer, present General Manager of the National Tobacco Co., commenced operations in the Hawke's Bay district, and established a small factory in the town of Napier. The present National Tobacco Co. is the outcome of Mr. Husheer's efforts, the requirements of the Company by way of tobacco leaf being mainly supplied by small growers

in different parts of New Zealand, but principally in Waimea County, Nelson. While no very rapid development took place, the operations of this Company increased year by year until a very sound and profitable business has been built up.

In the year 1927 the New Zealand branch of Messrs. W. D. and H. O. Wills Ltd. became interested in locally-produced leaf, and has since that time absorbed into their business the product of some 400 or 500 acres of tobacco lands.

The progress in tobacco culture has been steady and reasonably sound, the total area devoted to this plant in 1932-33 being in the vicinity of 2,000 acres. All the popular methods of production and treatment generally obtaining in other parts of the world have been incorporated in the industry, and the major portion of the leaf produced is cured in flue-curing barns. Although leaf of excellent appearance and texture is being produced in our tobacco-growing areas, experts are not yet prepared to admit that it is of first quality from all points of view.

No attempt has yet been made to establish an export trade in tobacco leaf, although samples of our product have been sent to London from time to time with a view to securing the trade's opinion as to its quality and suitability for that market. On the whole, very favourable reports have been received on the samples submitted, but as expected in the absence of any guarantee as to continuity of supply, no definite commitments have been received from merchants in London. There are a number of difficulties attending the satisfactory introduction into the world's markets of leaf from a new tobacco-producing country such as New Zealand. Buyers will have established connections with other countries on the basis of adequate supplies of standard qualities. The new competitor is unable to obtain a satisfactory footing until it can offer similar conditions. Further, much preparatory work must be done in trying out suitable areas, and educating producers to grow a satisfactory product. There is also the added difficulty that in New Zealand, other types of farming can normally be more profitably undertaken on land suited to tobacco growing. So far the attention of producers in New Zealand has been directed towards the capturing, as far as possible, of the local tobacco industry, in connection with which they have the advantage of a limited protection against the imported article.

In 1929 the Government set up a tobacco commission to enquire fully into the prospects of the tobacco industry, and to suggest to the Government how such an industry could be assisted. The report of the commission was highly favourable to the industry, and certain recommendations were made as to how its development could be assisted. Although the prospects of the industry have been improved as a result of the commission's report, progress is not likely to be extremely rapid, in view of the notorious pre-

judices of the average smoker in favour of the brands of tobacco and cigarettes he has been in the habit of consuming. Nevertheless, the industry, though small, has been firmly established and can be relied upon to develop. Although there is ample scope as far as suitable land is concerned, the rapidity of development will depend on the quality of the product on the one hand and its reception by the smoker on the other.

IV. TUNG OIL

We are indebted to the late E. H. Wilson, of Arnold Arboretum, Harvard University, U.S.A., for the identification of the species from which this important oil is obtained. Aleurites Fordii (tung-yu) is a comparatively hardy species from the Yangtze Valley, and furnishes fully nine-tenths of the tung oil used and exported from China.

Owing to the increasing demand for this oil in the paint, varnish and other trades, it is considered desirable that its experimental culture should be undertaken in suitable parts of the British Empire.

The oil is expressed from the nuts, four or five of which are contained in a hard husk. The tree is said to be quick-growing and short-lived, attaining a height of 20 to 30 feet. On the watershed of the Yangtze it grows on the hills up to altitudes of two to three thousand feet, where there is a minimum rainfall of about 30 inches. The summer temperature ranges from 90° to 110° F., but the winter is cold, the snow often lying for days, but the temperature seldom falls below 28° F. At the higher altitudes, however, the summer is cooler. It is planted there on rocky hillsides and waste places where farming is impossible. It is a deciduous tree with large dark-green leaves more or less heart-shaped. The pink flowers appear in spring before the leaves, and the clusters contain separate pistillate and staminate flowers.

A few trees were raised by Mr. Hayward Wright at the Avondale Nurseries, Auckland, and planted out about the year 1923. One of these on the property of the Misses Best at Avondale is growing in a rather closely-planted shrubbery. It is about 20 feet high and rather poorly furnished with branches, as is to be expected in its crowded position, but it has flowered and borne nuts for some years.

In the year 1926 the Department of Agriculture took steps to import seed and raise plants at the Horticultural Station at Te Kauwhata. Some delay occurred owing to the difficulty of obtaining seed in any quantity, but when it arrived plants were raised successfully and distributed among selected planters in the Nelson, Hawke's Bay, Gisborne and Auckland districts.

Apart from losses from sundry causes, experience has abundantly proved that where severe early and late frosts occur the plants suffer to a

serious extent. Furthermore, ample shelter is required, even under the best conditions, to protect the foliage from destruction by prevailing winds, and also to modify the effects of low temperatures, which is specially important in the early stages of growth. From the amount of 'die-back' which occurs in young trees it appears desirable to prune them, as it has been found necessary to do in Florida, cutting away the unripened tops of the young wood in winter so that new growth starts from strong buds on ripe wood. This is probably necessary only while the tree is young and is making vigorous growth over a long season.

From the above statements it will be understood that this crop is quite in the early stages of its introduction into New Zealand and much remains to be done to work out an economic system of culture and select and propagate the best type of tree for maximum production of oil of good quality.

Farmers and commercial men generally in the more suitable districts are taking great interest in this crop. Farmers (with a view to the utilization of rough waste country) and commercial men, have formed companies with considerable capital for production on a large scale. These hopes may be realized eventually when experiment has cleared the way, but meanwhile, caution is necessary to avoid serious disappointment. The chief fact learned so far is that this crop cannot be planted here profitably in the casual manner that is practised in its native country.

Although the tung oil industry is in an experimental stage at present the mild climate of the northern portion of the North Island, where there are thousands of acres of cheap land available, may ultimately prove congenial to the tung tree, but no definite determination of the point can be made until the developments now under way in that area have been carried on for some years longer.

CHAPTER XXVI

FLAX (PHORMIUM TENAX) OR NEW ZEALAND HEMP

BY J. S. YEATES

A. Purposes for which Used—B. The Phormium tenax Plant—C. Markets and Marketing: 1. Exports and Prices; 2. Markets; 3. Nature of the Market; 4. New Zealand Hemp in the World Market—D. Supplies of Raw Material: 1. Areas in Flax; 2. Quality of Fibre from Natural Areas; 3. Biological and Other Enemies; 4. Competition of Dairying for Flax Land; 5. Phormium Plantations—E. Organization of the Industry: 1. Methods; 2. Costs; 3. Organization of Mills; 4. Labour Conditions—F. The Future of the Industry.

A. PURPOSES FOR WHICH USED

NEW ZEALAND hemp, or 'flax' as it is termed locally, is one of the so-called 'hard' or leaf fibres, as contrasted with the 'soft' fibres from the bast of stems. There are three main hard fibres in common use, namely, manila, sisal (used in a general sense to include all agave fibres), and New Zealand hemp. The total world trade in hard fibres is about 450,000 tons annually, of which New Zealand can supply at the most 25,000 tons, the remainder being fairly evenly divided between sisal and manila.

Hard fibres are used mainly in the manufacture of heavy cordage, including rope for marine purposes, and for the twine used in harvesting grain crops. Nearly one-half of the total production of hard fibres was used for this latter purpose six or seven years ago, but the introduction of a new type of harvesting machine threatens the total elimination of binder-twine in the main wheat-growing countries. The production of heavy marine cordage is almost restricted to manila on account of its superior strength, buoyancy, and resistance to the prolonged action of sea water. Recent tests made in England have shown, however, that manila is not greatly superior to the other hard fibres in these respects.

B. THE PHORMIUM TENAX PLANT

Phormium tenax is found from end to end of the main islands of New Zealand, and in Stewart Island, Norfolk Island and the Chatham Islands. *Phormium Colensoi* (a smaller, less fibrous plant) is restricted in range to the main islands and Stewart Island.

A mature plant of *P. tenax* consists of a short, much-branched, more or less horizontal rootstock about two inches in diameter, from the up-turned ends of which arise leaves, while numerous roots pass from it into the soil. The leaves which arise from any one tip of the rootstock are in two opposite rows, and each leaf is folded along its midrib. The result is a number of sheathing leaves arranged fanwise, the growing point of the stem being

inside the youngest leaves near the narrow and lower end of the 'fan,' as this group of leaves is generally called. The 'fan' is in a sense the unit of a Phormium plant. Young leaves continually arise in the centre from the hidden growing plant, while older leaves at the outside eventually die away. The age of a leaf before it finally dies is about twenty months. A new young leaf appears on the average about once every two months. Both of these statements can be accepted only in the most general sense, for varieties differ in these respects, and there is also a seasonal variation in leaf-production. The number of leaves in each 'fan' varies from about eight to twenty or more. Under natural conditions, a 'fan' continues to produce new leaves indefinitely. The growing point may, however, grow upwards to produce an inflorescence, in which case the development of new leaves ceases and the 'fan' dies within a year or so.

Pollination in the past has probably been due largely to a bird, the Tui (*Prosthemadera novae-zeelandiae*), but the part played by the wind, by other birds and by certain insects, is by no means certain. At present the Tui is comparatively rare on account of the destruction of the native forest, and pollination seems to be due to bees and to certain birds such as the starling (*Sturnus vulgaris*) and the sparrow (*Passer domesticus*). These birds are attracted to the flowers by the large quantities of very sweet nectar to be had at certain times.

The seed capsule is from two to four inches long, about one-half inch in diameter, and triangular in cross section. The seeds, which number from 50 to 100 in each capsule, are flat, black and shining. One pound contains about forty thousand seeds. The mature leaf of *Phormium tenax*, from which the fibre is obtained, varies in length from about 4 to 16 feet, and in width from 2 inches to 8 inches, according to variety and conditions of growth. In general structure the leaf resembles a giant grass leaf. The 'blade,' which makes up about two-thirds of the total length, is smooth and shiny on the upper side, but on the lower side is dull and often covered with greyish-green bloom. The blade has a distinct midrib about which it is often folded with the smooth side inwards, to form a distinct letter 'V.' The lower part of the blade is especially folded in this way, and where the blade merges into the 'butt' or base of the leaf, the two halves become joined together along the inside of this V. Throughout the length of the 'butt,' the two halves remain in close contact except at the very base, where younger leaves force the two halves apart to form a narrow letter 'U.' Roughly speaking then, the leaf consists of a flat blade which is closely folded along its middle in the lower half.

The expanded part, or blade, is about one-twentieth of an inch in thickness, while in the region of the butt the thickness of each half-leaf is as much as one-half inch. The midrib or keel of the leaf projects at the outer angle

of the V as a much thickened, coloured rib of horny cuticle. The edges of the blade also generally bear a much thickened marginal rib of coloured cuticle. The colour found in this thick edge may spread laterally as far as half an inch into the blade of the leaf. Many varieties of *Phormium tenax*, cultivated for ornamental purposes, have a bronze or reddish colour on the upper surface of the leaf. This colour is due to pigment in the sap of the leaf.

Where the two halves of the leaf are folded closely together at the butt of the leaf, the colours seen on splitting the leaf apart vary from white, buff, to dark orange, or even purple. The main visible features distinguishing leaves of different varieties are thus:—

Length and breadth of leaf.
Thickness of leaf.
Degree of acuteness of leaf tip.
The depth of green colour on the upper side.
The presence of bronze or red colour in the leaf.
The degree of thickening and colour of the 'keel.'
The degree of thickening and colour of the edges.
The extent to which the colour of the edges 'runs into' the blade.
The colour of the inner surfaces of the butt of a split leaf.

The fibres of commerce run from end to end of the leaf. Each fibre strand is best described as a ribbon set with one edge against the upper surface of the leaf, and the other edge against the lower surface. There are about two or three hundred of these 'ribbons' set side by side in a single blade. In the thick leaf-base the 'ribbons' are split, some parts lying close against the outer surface of the leaf, other parts being embedded in the fleshy leaf-base.

C. Markets and Marketing

1. *Exports and Prices*

The price of flax fibre is subjected to very considerable fluctuations. These induce sympathetic movements in the production of fibre for export so that the volume of exports varies enormously. This is shown by Table CXXIX. The ready fluctuation of production according to prices is due to two factors which do not affect other fibres to the same degree. First of all is the fact that nearly the whole production cost is incurred in processes subsequent to the growing of the raw material, and the second important feature is that this raw material can conveniently be left unharvested for several years.

The fall in the price of fibre after the war years 1914-1918 caused the volume of fibre to contract rapidly, so that exports were lower in volume in 1921 and 1922 than for any year since 1898. Thereafter the volume of

exports rose substantially, to fall enormously again during the present crisis.

TABLE CXXIX

Price Fluctuations and the Volume of Exports—Phormium Fibre

Year	Price per Ton, £	Volume Exported, Thousands of Tons	Year	Price per Ton, £	Volume Exported, Thousands of Tons
1917	51·0	23·5	1925	31·5	16·4
1918	55·1	25·2	1926	30·6	17·2
1919	38·9	22·3	1927	29·3	16·2
1920	34·3	18·9	1928	27·2	12·9
1921	30·6	9·6	1929	27·7	12·3
1922	27·3	9·7	1930	24·8	8·0
1923	26·9	10·6	1931	17·4	1·8
1924	29·9	13·0	1932	12·6	3·4

2. *Markets*

Of the total production, between one thousand and two thousand tons are used in New Zealand for binder-twine, small ropes, fibrous plaster, and upholstery. Until recent years the United Kingdom and Australia have together absorbed about half the exported output. The United States took, on the average, about as much as the United Kingdom. These three countries together accounted for close on 90 per cent. of the total exports.

TABLE CXXX

Destination of Phormium Fibre. Thousands of Tons

Country	1926	1927	1928	1929	1930	1931	1932
United Kingdom ..	3·7	6·7	5·6	3·7	1·8	·4	·9
Australia	3·3	2·7	2·9	3·0	2·4	1·0	2·1
United States	6·2	4·9	3·5	4·9	3·2	·2	·2
Others	4·0	1·9	·9	·7	·6	·2	·2
	17·2	16·2	12·9	12·3	8·0	1·8	3·4

3. *Nature of the Market*

(a) *Demand.*—As mentioned in the first two paragraphs of this chapter, Phormium is one of the leaf fibres or so-called 'hard fibres,' the use of which is mainly restricted to the manufacture of heavy cordage and binder-twine for grain harvesters. A certain amount of hard fibre is also used for coarse string in various trades such as the newspaper and horticultural trades where bulky packages must be handled. Phormium fibre is also used in preference to others as a central core in wire ropes.

Until the onset of the present world depression, manila fibre was used almost exclusively for marine and other cordage of high quality. As a result of the greatly lessened demand for sisal and Phormium in the binder-twine trade, consequent upon a rapid extension in the use of header-

harvesters, these two fibres are beginning to compete with manila in the marine cordage trade. During the period when binder-twine manufacture absorbed a large proportion of the total output of hard fibres, prices for these fibres were subject to sudden fluctuations, dependent on reports from the grain-growing areas as to the prospects of large or small crops. Now that binder-twine is used in smaller quantities, this uncertainty of grain crops has not the same disturbing influence on fibre prices.

Apart from wars, general trade prosperity is the most important factor external to the fibre industry in determining price tendencies. The direct cause of such price variation is mainly the demand for fibre set up by the transportation industries, particularly by shipping.

(b) *Supply.*—Naturally, world production of hard fibres plays a large part in determining prices. Occasional hurricanes in the Philippine Islands are apt to cause unexpected sudden decreases in manila production; but otherwise no sudden disturbing influences causing restriction of output are to be expected. Hard-fibre plants, especially those involved in sisal production, are not liable to sudden epidemics of disease or to great annual variations in yield such as affect annually-sown crops.

The most disturbing influence in the supply of hard fibres during the last decade has been the rapid development of sisal growing in British East Africa. In 1925 the exports were 33,500 tons, rising steadily to 72,100 tons in 1931.

In view of the fact that in Africa the sisal crop has to be replanted every seven years, and that no fibre is taken from replanted areas in the first two or three years, the amount of this fibre produced lags behind changes in demand to the extent of three or more years. This is bound to have a disturbing influence on markets.

4. *New Zealand Hemp in World Market*

(a) *Influence of volume on demand.*—Since New Zealand's maximum annual output of fibre is not more than 25,000 tons in a total world production of some 450,000 tons, it is obvious that fluctuations of production in New Zealand have little effect on world prices. In fact the average annual production in this country is too small for the best prices to be realized. Overseas manufacturers who are unable to obtain continuous supplies of suitable grades of Phormium naturally prefer to use other fibres of which ample supplies are always available. Readjustments of machinery or of manufacturing routine are often necessary in changing from one class of fibre to another and, other things being equal, the manufacturer is naturally reluctant to incur expense in such changes.

(b) *Influence of quality on demand.*—There is no doubt that well-prepared Phormium is an excellent material for the manufacture of binder-

twine. It is a more pliable fibre than sisal, and the pieces which may be left in straw or chaff are considered by some farmers to be less harmful to cattle than are other fibres. In recent years much of the better fibre has been used in New Zealand and Australia for binder-twine, to the detriment of its reputation in markets to which the balance of exported fibre is supplied.

(c) *Factors affecting quality.*—On the score of quality Phormium does not attain to such high standards as are desirable. The shortcomings may be set out under three headings, according to the main causes of poor quality.

Poor grade raw materials.—It must be recognized that all Phormium so far grown in commercial quantities is derived from the mixed leaves of the numerous good, bad, and indifferent varieties found in natural flax areas. Unless the land is replanted with good varieties it is impossible to eliminate plants which produce weak, poor quality fibre. Even when good quality plants are grown it will be necessary to sort the leaves and reject those which are badly damaged or diseased.

Damage to fibre in manufacture.—The process of manufacture, described on a later page, is such that most of the fibre strands are severely damaged—usually in two or three places for each inch of their length. This not only reduces their strength, but also renders them much more liable to be broken in the later operation of 'scutching.' These broken pieces of fibre are often dragged down to the tip of the leaf in scutching, and give rise to compact knots of fibre which are a cause of trouble in subsequent manufacture. Another fault which is related to the method of manufacture is that of uncleaned fibre at the tips of leaves. Where fibre from a short leaf is lying amongst other fibre from longer leaves, these uncleaned 'tails' are liable to escape the clipping or scutching processes which are designed to remove them.

Lack of thoroughness in manufacture.—There are several stages in manufacture where quality and uniformity can readily be improved. The main reason for not applying these improvements is simply that the extra cost in wages is not recompensed by a corresponding selling price for the fibre. It is possible that if such methods were universally applied there would be a commensurate price increase when the trade came to appreciate the improvement. Nevertheless it seems that no considerable improvement along these lines is feasible without some mechanical improvements which would avoid higher labour costs. The main points at which improvement could be made while still using the present stripper are: sorting of leaves so that only leaves of similar length are treated together, so eliminating much trouble from uncleaned 'tails' in the middle of hanks; more thorough scutching of the tails to complete the cleaning and to remove more of the

fine 'towy' tails which are apt to become matted or tangled; more careful grading of hanks after scutching so that the quality shall be more even throughout each bale.

(d) *Influence of grading system on supply and demand.*—The object of the compulsory Government grading system introduced in 1902 was of course to give some guarantee of the quality of fibre in each bale of a certain line. There is no doubt that such a system was needed, largely on account of the irresponsibility of small temporary mills which had no reputations to lose and no cause to take any interest in the distant future of the industry. Nevertheless it must be admitted that the grading system is far from perfect; for the grading marks awarded are not directly related to the value of the fibre for its main purposes. Equal numbers of points are allotted to the following: the stripping, the scutching, the colour, and the strength. It will be noticed that nominally one-half of the points in grading are allotted not strictly for qualities of the fibre, but rather with reference to the processes of preparation. Such a grading system is no doubt useful if we assume that the object is largely to teach flaxmillers by showing them at which stage their process is faulty. To the consumer of fibre the method by which the fibre is obtained means nothing. He needs fibre first of all for its strength, with cleanliness and colour as secondary requirements. The more nearly a grading system allots points in accordance with such requirements, the better guide will it be to purchasers. The mixture of many varieties in the present milling areas would seem, on account of lack of uniformity in the product, to render satisfactory grading by tests of strength a very difficult matter. While, therefore, a modified grading system should be capable of yielding more satisfactory results than the present one, any system must be far from perfect until uniform quality can be secured by the use of uniform raw materials.

Thus, there can be little doubt that the grading system has been effective by discouraging the poorer type of miller and by enabling the purchaser to operate with more confidence than formerly, yet the time has plainly arrived when it is necessary to consider using a system of grading which shall be more directly related to the requirements of the purchaser.

(e) *Influence of marketing methods on demand.*—In most cases the fibre has been sold by millers to merchants in New Zealand, who in turn deal with overseas merchants or manufacturers. The New Zealand merchants handling the fibre have their main interests in other produce and with rare exceptions have no interest in the development of the industry apart from providing a part of the capital for the mills which supply them with fibre. This lack of interest in the industry results in a tendency on the merchants' part to secure the greatest immediate profits rather than to develop goodwill towards the product. On account of the small output

and small financial resources of most mills, direct contact between mill and consumer has been almost non-existent. In recent years, however, there has been a tendency for more direct contact to be established between producer and consumer. Where this is possible it is to the advantage of both parties, but the effect is for the fibre which comes to the open market not to include those brands which are the best within any one grade.

The general effect of the lack of a satisfactory marketing policy cannot have been otherwise than to adversely affect demand for the fibre. The uncertainty of supply from year to year, and the withholding of supplies by merchants in times of low prices, are instances of short-sighted policy. In view of the great lack of uniformity in the fibre, it would be particularly desirable that the manufacturer should have close contact with the miller, so that a continuous supply of fibre from that mill might be used. The manufacturer would secure the advantage of greater uniformity, and by long contact with the miller should be the better able to have his particular requirements in milling carried into effect.

D. Supplies of Raw Material

1. *Areas in Flax*

Table CXXXI shows the area returned as occupied land under Phormium for the years 1921 to 1933. The wide variation from year to year (compare the years 1922-1923 and 1930-1931) indicates how unreliable these figures, taken from the New Zealand Official Year Book, really are.

A better guide is to be found in the incomplete records, in the same publication, showing the numbers of mills working in various years. For instance in the year 1927-1928 when the industry was in a flourishing state over 16,000 tons of fibre and tow was produced. Seventy mills were working, and the total area of flax available to these mills was 29,546 acres. In view of the fact that much productive flax-land has been converted to other forms of farming in the last five years the total productive flax-land at the present time probably does not exceed 28,000 acres.

Table CXXXI

Occupied Land in Phormium

	Acres
1921-22	43,896
1922-23	39,456
1923-24	43,180
1924-25	54,814
1925-26	57,780
1926-27	69,420
1927-28	66,492
1928-29	62,704
1929-30	68,260
1930-31	91,219
1931-32	77,437
1932-33	64,206

2. *Quality of Fibre from Natural Areas*

The quality of fibre produced by present methods from wild flax is much below what could be obtained from selected and planted varieties. The main trouble is that hundreds of varieties, differing widely in quality, grow together in the wild state. The fibre of many of these is difficult to clean without seriously damaging its strength. Some varieties have inherently weak fibre; others have fibre of poor colour. The very fact that there is no uniformity is a bad feature. The presence of weeds, such as blackberry, often leads to local discolouration of fibre, on account of scratching or chafing of the leaves. Other disadvantages of the wild areas will be mentioned in dealing with Phormium plantations.

In general, the high-yielding leaf is from slower-growing and less tall areas of Phormium, as in the cold districts of Otago. The low-yielding leaf is found especially in swamps where the climate is warm and growth rank. It is not yet known to what extent conditions of growth are directly responsible for the variations in yield. There is no doubt, however, that in many cases, short-leaved varieties from dry conditions, and tall varieties from swamps, to a large extent retain their growth characteristics when grown side by side. While the yield of fibre per ton of leaf has a great influence on costs of milling, the yield of fibre per acre is, of course, the true measure of growing costs.

3. *Biological and Other Enemies*

Biological enemies of the flax plant itself are by no means unimportant, and have been responsible for the destruction of very large areas of good flax. Of these enemies, the most notorious is the 'yellow leaf' disease which appears to be the result of attack by some micro-organism which has not yet been identified. The disease has much in common with the 'Panama disease' of bananas. Yellow leaf disease certainly was responsible for the destruction of thousands of acres of excellent flax in the Manawatu district in the decade just after the war of 1914-1918. There are large areas which are contiguous with those destroyed, but still unaffected by the disease. In no other districts has the disease caused any noticeable loss. 'Yellow leaf' is, rightly or wrongly, the most dreaded of all the flaxgrowers' troubles.

Next in order of importance are insects, the grubs of which damage the leaf by eating small holes in it, so cutting fibres and causing their loss in the manufacturing processes. Certain weeds are troublesome, especially blackberry (*Rubus fruticosus*) and convolvulus (*Calystegia sepium*). The former not only damages the leaves by scratching them, but also, in severe cases, renders it impossible for workmen to cut the flax, without being severely scratched by the blackberry. One large swamp containing nearly

two thousand acres of excellent flax has recently had the flax destroyed for this reason alone.

The other weeds are troublesome mainly for three reasons. They compete with weak flax for possession of the soil, they impede the work of cutting, and in the dry months of autumn they often serve to carry a fire. Fires are often the cause of severe losses, and in fact cause about as much loss as yellow leaf disease. In general the spread of these fires is aided by the dry rubbish which has grown amongst the flax, and by old dead flax leaves. Certain peaty areas are particularly susceptible to fires which secure a hold in the peat soil itself. Once established these fires are very difficult to control.

4. *Competition for Land Between Phormium and Dairy Farming*

The tendency during the past twenty years or so has been for dairy farming to displace flax-growing in many areas. There are many reasons for this. The main one is that in many large drained swamps the flax, though well suited to the amount of soil moisture and texture in the transitional stage, was not suited to the drier conditions and competition under these conditions with weeds such as blackberry and tall fescue (*Festuca arundinacea*), which, together with disease, lowered the yield unduly. In other cases hundreds of acres of standing flax have been destroyed by fire. In the case of small areas associated with farms, from which leaf might be sold on royalty, the total dependence on one miller and the comparative irregularity of fibre prices together with one or more of the above reasons has led to the conversion of these small areas to the type of farming being already carried on by the occupier.

For several reasons, there has been little likelihood of these areas, when used for dairy farming, being replanted in flax. Apart from the considerable expense of planting there is a period of at least three years before returns will be secured, and the farmer is entirely at the mercy of a miller who may decide not to purchase the leaf at all. Another trouble is that transport costs from isolated plantations to a mill are likely to be so great as to reduce the royalty value of the leaf almost to nothing. The transport factor alone is so important that it seems doubtful whether the planting of flax in scattered areas will ever be profitable. It is essentially an undertaking for large-scale operation, and a minimum area of about three hundred acres of heavy-yielding flax land is necessary for economic operation of a mill.

The dairy farm is comparatively small in average size and enjoys numerous advantages. Being a highly organized industry in this country it has numerous channels provided through which credit and loans are available. The greatest asset of all that dairy farms usually enjoy is the

advantage of family labour, assisted if necessary by hired labour which is paid a very low wage in proportion to the hours worked. In flaxmilling, on the other hand, unless the undertaking be on a very small scale, all labour must be hired and paid for at rates fixed by the Arbitration Court. There is here not the incentive of ownership, and the worker of the family alone must earn the family income during the seasonal operation of the mill.

As a result of these differences in labour organization the dairy industry offers a higher net return per acre, except when fibre prices are high, although in gross returns and in labour payments per acre the flax industry compares more favourably. The following figures show the gross returns per acre on adjacent land of similar type under the same management:—

Butterfat per acre	150 lbs.
Gross returns per acre at 8½d. per lb.	£5 6 3½
Fibre per acre	1⅕ tons
Gross returns per acre at £13 per ton	£15 12 0

The fibre at present carries also a subsidy of £4 per ton from the Unemployment Board.

At the flax mill quoted above, the cost of producing one ton of fibre is £14/15/6, plus interest charges on land, buildings and plant. Further analysis of these costs[1] shows that £9/8/3 of the costs per ton is paid at the mill in wages and salaries.

The production at this mill per acre being 1⅕ tons, the total wages per annum amount to £11/5/11 per acre (£9/8/3 x 1⅕). In view of the different labour conditions on dairy farms it is impracticable to obtain a comparable figure for wage payments per acre. It should, however, be noted that *the labour payment of £11/5/11 per acre on flax land* is more than double the gross returns per acre (£5/6/3½) for butterfat on the dairy farm.

5. *Phormium Plantations*

(a) *Early Plantations.*—It seems probable that amongst the Maoris, Phormium, as a cultivated crop, must be at least a century old. In many ways these early plantations might serve as a model to the modern European industry. The Maoris usually had near their cultivations or in their villages small areas, each of which was planted with one variety. The plants were always multiplied by vegetative means, ensuring a trueness to type which is unobtainable if seedlings be used. Even at the present time, in spite of the damage done by cattle, many of these plantations still exist. Each variety might occupy an area twenty yards long by five yards across.

1. See section E.2 of this chapter.

The plants were set out in definite rows and from a distance the rectangular areas show very plainly. Amongst the Maoris certain named varieties were used for the various purposes such as clothing, basket-making, net-making, and so on.

Early colonists were quick to realize the possibilities of the industry in the days before refrigeration had shown the possibilities in dairy produce and meat. A Royal Commission was appointed in 1869 to report on the subject and its report is a most valuable one even at this date.

Considerable interest was taken in the establishment of plantations at that time, but none of the attempts appears to have been a commercial success. There have been spasmodic bursts of activity in planting ever since, and, beginning with post-war years, mill-owners came to look on planting as necessary in order to maintain supplies of raw material.

(b) *Modern Plantations.*—A boom in flax planting has taken place in the last decade but appears now to have come to its end. The reason for the great increase in planting was the same as for the extensive planting by afforestation and later by tung oil companies, namely the exploitation of the savings of thousands of people mostly in this country and in Australia. The usual method followed in promoting these undertakings was as follows:—

An option would be secured over an area of land by the parent company, the capital of which might be in the neighbourhood of ten thousand pounds. The public would then be invited to purchase bonds priced at from £20 to £25 each, and the parent company undertook to plant and maintain for three or four years, one acre of flax for every two or three bonds sold. The price paid by the bond-holders in this way varied from about £45 to £65 per acre. In some cases the parent company undertook to erect and operate a mill on a commission basis, while in other cases the scattered bond-holders would find it necessary to go to the expense of forming a company of bond-holders to manage their property.

The capital invested was obtained almost solely from small investors whose knowledge of the flax industry was very superficial. Many reasons were supplied why the new organizations should be much more profitable than the old companies operating in natural flax areas. Fibre from planted flax was claimed to be more abundant and of better quality than from wild flax, a promise likely to be fulfilled only if the planted flax were of superior varieties. The use of a special system by which only mature leaves were to be cut was to increase yields per acre three-fold—this in spite of the fact that the method had long since been tried and abandoned by most flax-millers. Further great benefits were claimed from the large-scale production and co-ordination possible when one company owned both plantation and mill.

The cost of the planted land to the bond-holder was usually quite excessive in these companies. The land in its unimproved state could usually be bought for less than £5 per acre, and the total cost to the parent company of planting and maintaining the crop for four years should not exceed £30 per acre even on a liberal estimate. The selling price to the bond-holder had, of course, to include all money invested up to the time when the first crop is ready for cutting. The varying amounts per acre spent in taxes such as those due for drainage and roading also render it difficult to generalize with respect to these costs. Some Phormium areas are subject to an annual drainage rate of eighteen shillings per acre. A hypothetical set of costs such as follows is one which allows for good quality land and the growing of good plants:—

Land	£20 per acre
Clearing and cultivation	4 „ „
Plants	3 „ „
Fencing, draining, etc.	1 „ „
Planting	3 „ „
Contingencies	2 „ „
Total	£33 per acre

The total annual charges on such a plantation would be approximately £2/10/- per acre, made up as follows:—

Interest on capital invested	£1 13 0 per acre
Rates	0 6 0 „ „
Maintenance and management	0 11 0 „ „
Total	£2 10 0 per acre

The first crop should be ready for cutting at the end of four years, and should be about 30 tons of leaf per acre. Subsequent crops should be 40 tons of leaf per acre each four years.

It is important to note that a large expenditure per acre is incurred quite independently of the cost of the land. This fact should emphasize the folly of making such outlay on poor land when a much greater return can be obtained from rich land without a proportionate outlay in total costs up to maturity.

The total area planted in Phormium during the past eight years is in the neighbourhood of ten thousand acres. It is doubtful whether even one quarter of this planted area will be equal in yield to a natural swamp of average quality. The contribution of existing plantations towards increasing the quantity of raw materials is negligible and in only one or two small plantations is the fibre quality likely to be better than in natural swamps.

E. Organization of the Industry

1. *Methods*

(a) *Harvesting.*—The existing industry depends on the use of natural, or induced areas of wild Phormium, in the sense that there are a mixture of good, bad and indifferent varieties which occur naturally and are commonly brought to full productive capacity by draining the land. The Phormium is generally not the only plant growing in the swamp. Usually there are numbers of other plants including 'niggerheads' (species of *Carex*), cabbage trees (*Cordyline australis*), raupo (*Typha angustifolia*), willows (species of *Salix*), blackberry (*Rubus fruticosus*), convolvulus (*Calystegia sepium*) and tall fescue (*Festuca arundinacea*).

Narrow roads (called 'Flylines') are cleared at intervals of 3 chains in the swamp, for access and removal of the leaves. The usual means of transport is a light railway, the rails of which are moved from one flyline to another when required. Horses are generally used to draw the trucks. Drays, waggons, or motor trucks may also be used; where a river or canal is available, barges towed by launches are used, frequently in conjunction with one of the above means of land transport.

Cutting is done simply by using a semi-circular reaping hook and severing the whole Phormium plant about six inches above the ground. The leaves are tied into bundles containing about 90 lbs. each, and the bundles are carried by the cutter to the flyline and stacked there for removal.

The yield of leaf in a really good swamp may be as much as 40 tons per acre. Cutting is carried out at three- or four-yearly intervals. The bundles after carriage to the mill, are weighed in order to fix payment to the cutter, and to keep records of the percentage of fibre. The bundles are then stood in the yard of the mill, usually for several days, before sorting and stripping. Sorting consists of removing dead or badly-diseased leaves by hand, and of grading the remaining leaves into two or three lengths, by standing them in a hole in the ground and lifting out first the longest leaves which naturally stand highest.

(b) *Processing.*—The stripping machine has a cast-iron drum which bears on its circumference raised diagonal beaters, set at alternate angles so that they form a complete zig-zag around the circumference. The drum is about 18 inches in diameter, weighs 1½ cwt. and is kept at about 2,000 revolutions per minute. The leaf is beaten between the beaters of the drum and a chilled steel bar, known as the beater-bar, which is placed almost touching the circumference of the drum.

The leaves are fed, butt first, and two or three at once, between two 'feed-rollers'—deeply-fluted intermeshing rollers which grip the leaf tightly and feed it to the drum. The feed-rollers are about four inches in diameter and revolve at about 450 revolutions per minute. The leaf is therefore fed

at a speed which is much less than that of the circumference of the drum. The greater part of the non-fibrous part of the leaf is beaten off by this machine, and the fibre is caught on a chain which carries it past automatic shakers, to remove loosened matter, then into a washing machine whence the fibre is delivered by the chain at the outside of the stripping shed. Here a man twists it into hanks and throws it over large rails, where it is left for about a day for excess water to drain off. The amount of Phormium treated by each unit in a given time depends on the speed of the man who feeds the leaves into the stripper. An average rate is about one and a quarter tons of leaf per hour, although much depends on the weight of an individual leaf. In an eight-hour day each machine should treat enough leaves to produce one ton of finished fibre, exclusive of tow.

From the draining poles the fibre is loaded on to carts and removed to the bleaching fields where it is spread out on the grass for times varying from a week to a fortnight, depending on the suitability of the weather for bleaching. In very wet weather the fibre is taken from the grass and hung over wires, otherwise the colour of the fibre would be harmed. After bleaching the hanks are tied into bundles of about six hanks each and carted back to the mill for the next process, known as scutching.

The scutcher is essentially a drum about six feet in diameter and of the same length, fitted with four to six plain beaters. The drum is almost completely enclosed by a stout boxing but an opening is provided, into which the ends of the fibre are thrown, while a workman holds the other end of the hank. The beaters drag the fibre downwards and remove any broken fibres or dry non-fibrous matter. An automatic scutching machine, in which the fibre is gripped on a moving chain, is in very common use.

After being scutched, the fibre is pressed and tied in bales ready for Government grading and export. It must be emphasized that the term 'bleaching' does not cover the whole of the work done in the bleaching field. A great deal of green tissue near the leaf tips is merely bruised by the stripper and is in effect 'retted' whilst in the bleaching field. This material is afterwards knocked off by the scutching machine. If bleaching alone were necessary, it could be more easily done chemically than in the field.

The total yield is about 1 ton of fibre and 3 or 4 cwt. of tow from 8 tons of green leaves. There is a great deal of variation in the quantity of leaf required to make a ton of fibre. In some localities, as little as 6½ tons of leaf is needed; in others as much as 11 tons.

2. Costs in the Industry[2]

It is almost impossible to give in a brief review any comprehensive idea of costs of fibre production which shall cover all methods and condi-

2. I.e., in 1932.

tions of working. Moreover, the analysis of costs can be only approximate without a thorough examination of a company's costs by a competent accountant. The fairest basis for analysis of costs is a business in which the growing and milling of Phormium are combined. With the gradual elimination of small scattered areas of flax on land used for other purposes, combined growing and milling is now the usual method. The costs in such an enterprise may be most conveniently arranged as follow:—

(a) Cost of raw material delivered at mill, to produce one ton of finished fibre.

(b) Manufacturing costs per ton of fibre, including railage to port, grading, insurance, etc.

The costs under (a) may be further subdivided as below. Approximate figures are given for each heading. It is assumed that 9 tons of leaf is needed to produce each ton of fibre. The labour costs are those at present in force and show a reduction of about one-third as compared with wage rates in force until 1930.

(a) *Raw Materials*:					
Growing of leaf (rent, rates, weed-control, fences, drains, etc.)				£2	5 0
Cutting—5/- per ton				2	5 0
Transport to mill				1	7 0
Total cost (delivered) of raw materials per ton of fibre				£5	17 0
(b) *Manufacture*:					
(1) *Sorting, stripping, washing*:					
Electric power	£1	4	0		
Mill maintenance, interest on cost	0	7	0		
Labour	2	19	0		
				£4	10 0
(2) *Bleaching*:					
Including cartage, rent, and rates of land, maintenance of posts, wires, etc.				2	10 0
(3) *Scutching and baling*:					
Including labour, power, interest, and maintenance				1	10 0
(4) *Cartage, Railage, Grading and All Charges at Port*				1	17 6
(5) *Management and Office*				1	10 0
Total Manufacturing Costs				£11	17 6

3. *Organization of Mills*

(a) *Type of Ownership.*—In the flax milling industry the majority of mills have always been operated by individuals or partnerships. Since 1910 there have never been more than two public companies operating mills out of a total varying from 20 to 81 mills:—

TABLE CXXXII

Ownership of Flax Mills

Form of Ownership	1910	1915	1920	1922	1923	1924	1925	1926	1927	1928	1933
Individual ..	38	45	20	16	22	21	34	42	37	40	14
Partnership ..	31	23	12	9	10	19	22	17	20	17	3
Private Company	10	8	13	7	8	6	6	10	14	12	3
Public Company	2	2	2	2	2	2	2	2	2	1	—
Totals ..	81	76	47	34	42	48	64	71	73	70	20

The size of mills is best expressed in terms of the number of strippers in use since, assuming adequate supplies, the output of fibre depends on the amount which can be stripped. Each stripper should produce over one ton of fibre in eight hours of work. About 300 acres of good flax swamp is required to keep each stripper in operation for the usual season of eight or nine months of the year. For this reason the majority of the mills have only one or two strippers, and the largest has seven. From two to four is the usual number of strippers in the better type of permanent mill.

The small size of mills is indicated by Table CXXXIII, which classifies mills according to the number of employees.

TABLE CXXXIII

Size of Mills—Number of Employees

Establishments Employing	Under 6	6–10	11–20	21–50	51–100	Over 100	Total No. of Mills
1922–23	2	11	21	6	1	1	42
1923–24	6	8	24	7	1	2	48
1924–25	6	23	28	8	1	1	67
1925–26	5	22	34	8	—	2	71
1926–27	12	22	24	12	2	1	73
1927–28	12	24	25	7	1	1	70
1928–29	9	17	28	4	1	1	60
1929–30	8	13	22	12	2	—	57
1930–31	10	3	8	1	—	—	22
1931–32	10	3	2	2	—	—	17

The ownership of the small mills is usually in the hands of one person or a small partnership and the larger mills are mostly operated by limited liability companies. The reasons for this difference are fairly simple. In the case of the small, more or less temporary mills, little capital need be invested by the owner or partners, who to a large extent supply the labour themselves and usually secure financial assistance from exporters of fibre. The raw material used is generally bought on a royalty basis, so that no capital need be invested in land for growing flax. These mills resemble dairy farms in their methods of finance and in the fact that one of the main objectives is the provision of employment for the owners. The larger mills are generally run on a basis of limited liability for reasons which are the converse of the above. A large undertaking is scarcely safe unless a permanent supply of raw material is secured by lease or purchase of flax-growing land, and the comparatively large capital necessary is best suited to the organization of limited liability companies.

(b) *Number of Mills.*—Table CXXXIV shows how the number of mills in operation fluctuates from year to year:—

TABLE CXXXIV
Flax Mills in Operation

Year	No. of Mills	Year	No. of Mills	Year	No. of Mills
1880	40	1910	81	1928	70
1885	30	1915	76	1929	60
1890	177	1920	47	1930	57
1895	52	1925	64	1931	22
1900	101	1926	71	1932	17
1905	240	1927	73	1933	20

This marked fluctuation in the number of mills in operation from year to year is the basis on which mills are commonly divided into 'permanent' and 'non-permanent' mills. This distinction must be quite an arbitrary one for actually there are less than six permanent mills in the country, these being mills which supply fibre for local manufacturers. Nevertheless it is convenient to consider mills as falling into the two classes of permanent and non-permanent. The former operate more or less continuously from year to year, despite considerable fluctuations in price. The latter include mills which have limited supplies of leaf available which are soon worked out, or which come into operation from time to time when prices improve, and have little prospect of permanence. They cease operations when prices fall, or when supplies of leaf are worked out.

(c) *Permanent Mills.*—The main factors determining the degree of permanence of a mill are (i) the supply of raw material; (ii) cost of production of fibre; (iii) the amount of capital invested in the enterprise.

(i) *Supply of Raw Material.*—The supply of raw material may be restricted by the area in flax or by the cost of transport, or because supplies of flax, though plentiful and accessible, are held by non-millowners and sold to the highest bidder. This introduces an element of uncertainty discouraging heavy capital investment. For the above reasons, permanent mills are usually those which have an adequate supply of flax available on land owned by the miller or leased for a satisfactory period.

(ii) *Costs of Production.*—Since the output of New Zealand fibre is only a small proportion of the world output, its effect on price is small. The permanence of a mill is dependent very largely on its costs in relation to a price which fluctuates owing to world conditions outside the control of the New Zealand industry. Only those mills can continue permanently in operation where costs, including costs of procuring flax as well as of milling, are low enough to enable them to withstand periods of low prices.

(iii) *Amount of Capital Invested.*—Adequacy of supply and low costs are dependent mainly on the integration of the primary and secondary processes, i.e., the control of supplies of fibre by the miller, and an efficient plant. Both of these normally necessitate the investment of large sums of capital. Hence the more permanent units are usually the larger mills, and the bulk of the total fibre output is from these mills.

(d) *Non-permanent Mills.*—These may be divided into two groups. In the first group are mills which operate in areas where there is a limited supply of flax, which the mill is able to use up in a season or two. When the area is worked out the mill closes down. In the second group are 'boom mills' which suffer from high prime costs and come into operation only when prices are high. Such mills are usually small, and even if a cheap supply of leaf is obtainable, costs of milling are high. The grade of fibre is frequently low and this further reduces profits. In many cases the high cost is due to scattered and remote areas of supply.

On the whole it is probable that non-permanent mills have operated at a loss. In addition they have damaged the industry as a whole by putting on the market a low quality fibre which has prejudiced the reputation for quality on the world markets. The association of merchants with such 'boom mills,' the operation of which they very frequently finance, has been prejudicial to the industry, since this section of the industry is liable to be affected by the marketing policy of merchants. This is not always conducive to the best interests of the industry as a whole. By financing his operations the merchant is largely responsible for the phenomenon of the boom miller.

Of recent years, 'boom mills' have been less characteristic of the industry, probably because of the advent of grading, which has tended to place the output of non-permanent mills in a low grade. There has

also been a tendency for merchants to interest themselves to a greater extent in more permanent mills and in flax plantations.

4. *Labour Conditions*

(a) *Labour Costs.*—An examination of official figures for costs in flax mills for the years 1919-20 to 1927-28 inclusive shows that, on the average, wages were 48·2 per cent. of the total, materials 26·4 per cent., and other expenses 25·4 per cent. Since materials consist mainly of leaf in which labour costs are the main item, it is probable that labour costs comprise about two-thirds of the total expense at the primary and secondary stages taken together. This estimate is justified by the analysis of a flax mill's costs for the year 1929-1930, which shows the following percentages for all the costs in fibre production:—

Wages and salaries	75 per cent.
Interest	11 ,, ,,
Goods and services	5 ,, ,,
Power, insurance, depreciation, rates and taxes	8 ,, ,,
Swamp maintenance	1 ,, ,,
Total	100 per cent.

Since that time wages have declined by roughly one-third. Other costs have also been lowered, although not to the same extent. The total wage percentage apart from wages included in railage, grading and port charges under the new scale certainly amount to more than 50 per cent.

With labour as the main element in cost, conditions affecting labour are naturally of great importance. On the other hand the instability of the industry has created conditions very unsatisfactory from the point of view of the worker. The high proportion of wages to total costs increases the incentive to the millowner to cease operations for a period if markets are unsatisfactory. The loss is less than if supplementary costs were a high percentage of the total.

(b) *Type of Labour.*—Except for millowners and stripper-keepers, flax workers are classed as unskilled labour. Much of the work is heavy and demands a good physique. In the early days, the casual nature of the work, the isolation of mills and temporary, unsatisfactory living accommodation discouraged the better type of worker from entering the flax industry. Of recent years, improvements in conditions of work, and in accommodation, and improved facilities for transport which have removed the isolation of mills, have made a change for the better.

(c) *Organization of Workers.*—Until 1907 flax workers were not organized. Labour was casual and mobile because of the intermittent work-

ing of the mills. The labour turnover was high, and many mills were small and isolated. Hence, flax workers were difficult to form into unions. Organization was needed to improve accommodation and conditions of work, but in good times there was little need to organize to obtain comparatively good wages, since these were ensured by the competition of millowners for men. In bad times organization would have been ineffective in maintaining wages, except in the 'permanent' mills.

The first union was formed in 1907 when workers in the largest flax-milling area, the Manawatu, registered under the Industrial Conciliation and Arbitration Act. In the districts where mills are scattered and the enforcement of awards would be difficult, workers have not usually registered under the Act. Workers in such districts prefer to organize under the New Zealand Workers' Union, an organization of unskilled workers. In practice the awards of the Manawatu Union are accepted as the basis for agreement in other parts of New Zealand.

(d) *Wages.*—Some of the operations have been carried out by the piece-work or contract system. This applies almost invariably to cutting the leaves, usually to handling fibre in the bleaching fields, and sometimes to transport of leaf. The wages earned in this way are usually higher than those paid by the hour. The minimum hourly wage at present is 1/3, giving a return of £3 per week to the worker. Mills usually work about 200 days per annum, so that the minimum annual wage is about £100. The average annual wage of those paid on hourly wage is probably about £130. The mills usually close in the months April, May and June on account of slow recovery of plants which are cut in these months.

As pointed out elsewhere, the wages paid in the hemp industry are decidedly higher than those paid in most other forms of agriculture in New Zealand.

(e) *Working and Living Conditions.*—Not only is much of the work heavy, but also it is uncomfortable owing to the fact that much of the flax must be obtained from swamps. For many years the unattractiveness of the work was accentuated by unsatisfactory living conditions, accommodation being frequently in the form of temporary structures near to the mills. Provision was made for improved accommodation under the Agricultural Labourers' Accommodation Act of 1907, but conditions remained unsatisfactory. In 1913, new regulations were gazetted which led to considerable improvement, largely as the result of more effective inspection.

Further improvement in labour conditions depends largely on a return to prosperity in the industry, but in the long run the elimination of the non-permanent mill and its replacement by a more stable type of organization is essential. Not only would this help to stabilize employment, but also it would make possible better living conditions.

(f) *The Future of the Industry.*—The effect of the past few years of low prices for hemp has undoubtedly been to drive out of existence many of the small mills. The fact that other produce prices did not fall to an unprofitable level so early as did those of hemp, has led to much land being converted from flax to pasture. Also the effect of several years of idleness on small mills has been to cause serious deterioration or dispersal of buildings and machinery, and frequently the owner-manager has found another occupation. Taken together these factors have eliminated many or most of the small mills and consolidated the industry mostly into the control of large concerns which control both raw materials and milling. Several of the largest of these mills are in turn controlled under one organization. It is to be anticipated that this tendency of growing and milling to become grouped into large units will continue and that the greater ability of these units to adopt new methods in growing and manufacturing will in time eliminate all but the larger mills or the more stable small ones.

The expansion or contraction of the industry depends primarily on the price of fibre relative to the prices of other products which could be produced on the same land. It has already been indicated that dairy farming, the chief competitor for land, is at an advantage on account of the utilization of family labour. It should not be overlooked that there is a possibility of combining the advantages of both the high wages paid in the flax industry and of the use of family labour on a farm. This could be accomplished by establishing a number of small farms near each flax mill. The man of the family would be able to earn about £130 per annum in the mill and with the aid of his family on the farm would make a reasonably good living. Such an arrangement would lead to much more stabilized labour conditions in the industry.

In many quarters hopes have been raised that large plantations may provide the basis for a revived, more stable, and more efficient industry. It has already been indicated that most of the ventures in planting Phormium are unlikely to return the expected profits to investors. Even when fibre sells at good prices most of these undertakings would be too highly capitalized to return a normal rate of interest to the original investors. The loss of money in these companies is likely to make the general public very cautious about supporting new undertakings. The established plantations will, in some cases, be utilized after financial reorganization involving heavy writing down of capital. The immediate future development of an industry based on sound planting methods is certain to be slow and confined to a few enthusiastic individuals or small companies. It is better that this should be so; for this part of the industry is in a transitional, experimental state, and only those who keep in close contact with the latest developments should be encouraged to plant.

In the reorganization of the industry scientific research is a basic need. Such investigations with a view to placing the industry on a sound footing were undertaken by the Department of Scientific and Industrial Research in 1927. After the necessary legislation had been passed in 1928, a Phormium Research Committee of that Department was set up to direct the investigations. On this Committee are representatives of the interested Government Departments, of the industry, and of the Massey Agricultural College. The fund is derived from a levy of twopence per bale on fibre, together with an equal amount as subsidy from the Government. The main work which has been carried out under this Committee is an investigation into the varieties of Phormium. This section of the work is being carried out at the Massey Agricultural College, where more than 250 varieties of Phormium have been collected for a study of their cropping power, fibre quality, and resistance to disease. The inheritance of important characters is also being studied, the best plants are being propagated, and hybrids between certain varieties are being grown. In addition, manurial trials have been undertaken in different parts of the North Island.

Phormium is a slow-breeding plant, requiring five years to a generation, so that genetical work on the plant cannot be expected to be very rapid. Enough has been done, however, to indicate that vegetative propagation is at present the only sound method of multiplying plants for commercial use. Tests of fibre from different varieties indicate that by confining planting to some of these, tensile strength in the finished product can be very greatly increased. Commercial fibre, as at present exported, falls just short of the strength demanded by those who use large quantities for rope manufacture. There is no doubt that fibre from the better strains would have this large market opened to it.

The Phormium Research Committee has devoted some of its funds to research on the manufacturing side of the industry, particularly to chemical bleaching of fibre and to improvements in the stripping machine. A consideration of the figures already given, relating to costs of production, will show that manufacturing costs, including cutting of the leaf, are responsible for almost the whole cost of production. Any noticeable saving must presumably be by improved manufacturing methods. At first sight it therefore seems odd that attention was not mainly directed at research on the manufacturing side. To a certain extent the use of planted flax was expected to lower manufacturing costs on account of the possibility of mechanical cutting between the planted rows. The main problem on the manufacturing side is, however, the improvement or abolition of the present stripping machine. Since the introduction of the stripper over sixty years ago, tens of thousands of pounds have been spent by millers, often aided

by skilled engineers, in attempts to improve and cheapen the process. These efforts have not produced any marked benefits and it seems futile to spend further money, unless some totally new idea in manufacture is brought forward for development.

The investigation of new uses for the fibre, particularly in the local markets, is closely bound up with the research programme and it is possible that new uses for the fibre may be the main factors revitalizing the industry.

The prospects of the industry during the next twenty years depend on so many factors that any forecast must be expressed only in the most general terms. Mainly, of course, the tendency of world fibre-prices will determine contraction or expansion. It must always be considered probable that coloured labour, the secret of low costs in competing fibres, will demand higher wages in the future. Changes in the relative prices for tropical products may also cause expansion or shrinkage of fibre-production in those countries.

The invention of a new and cheaper process for extraction of fibre from Phormium is by no means improbable, and would go far to revolutionize the industry. Sufficiently lowered costs would lead to planting of superior strains and a great improvement in quality, while there are at least hopes that new uses for the fibre may stabilize the existing industry while new methods of growing and manufacture are being evolved.

A case in point is the factory, which has now commenced operation, for the manufacture of wool-packs from Phormium fibre. At the present moment it appears that a satisfactory article can be manufactured to compete with the imported jute goods, and that a sufficient price can be paid for fibre to allow of improved milling and growing methods. The maximum annual tonnage of fibre that is likely to be used in supplying the domestic market with wool-packs is 4,000 tons. An assured and profitable market for such an output should give the flax-growing and milling industry a good opportunity to improve its methods until it is able to compete more keenly with the sisal industry in supplying outside markets.

The relative values of dairy produce and fibre will be most important in determining the future of the fibre industry, since these two industries compete for the use of land. The possibility of a quantitative restriction on the exports of dairy produce to Great Britain has to be taken into account here. Should such a restriction be imposed, it is probable that special attention will be given to fibre production on account of the fact that this industry uses more labour per acre and pays greater wages per acre than any other of our major export industries.

In the absence of any restrictions on the export of dairy produce it is likely that many of the present areas of natural flax will be converted to dairying, but that the planting of selected varieties of Phormium will be

gradually extended by those already engaged in flax growing and flax milling.

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Chapter XXVII

FORESTRY IN NEW ZEALAND

By E. Phillips Turner and A. Beasley

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I. INDIGENOUS FOREST AREA

A. Area of Forest When Settlement Commenced

Of a total area of 65,864,000 acres in the Dominion, it is estimated that there were at the time when organized European settlement was first started (about 1840) about 40,000,000 acres under forest. These figures relate to the North, South and Stewart Islands, with their adjacent islets, but omit the Pacific dependencies, which, however, do not appreciably affect the total. The proportion of forest to total area was by the above figures 60·7 per cent. or approximately the same proportion as at the present time in Finland, which is the most densely forested state of Europe.

B. Present Area of Indigenous Forest

The rapid advance of settlement—which was too often indiscriminate—the operations of sawmills, and the ravages caused by kauri-gum diggers, mining prospectors, and other pioneers, have resulted in the forty million


ESTIMATED FORESTS
of NEW ZEALAND
1840
Scale of Miles :
80 60 40 20 0 80 160
Shading = Forest-covered areas.

Map 25

acres of forest being rapidly reduced, so that at the present time, 1934, the remaining total area of all forest in New Zealand is only about 12,600,000 acres. A considerable proportion of this area, however, being Native land, ordinary Crown land, and privately-owned land, will probably be deforested and used for settlement. Furthermore a large proportion—as yet not accurately determined—of this area is subalpine scrub-land or protection forest. Of the forest land it has been estimated that about 3,617,400 acres carry timber stands of over 5,000 board feet to the acre, and may thus be classed as 'merchantable' forest land.[1]

C. Forest Area in Proportion to Total Area

The extensive deforestation which has taken place has so reduced the area of forest that at the present time it is only about 19·1 per cent. of the total area. In addition there are about 600,000 acres of planted forests of exotic trees, which brings the area under forests to 20 per cent. of the total area of New Zealand, whilst the area under merchantable forest is only 6 per cent. of the total area. In the opinion of forest economists this is a low proportion, and New Zealand foresters consequently urge that the greatest care be exercised in protecting the forest, and that none of it be opened for settlement until it has been thoroughly examined by competent experts as to its suitability for successful farming.

D. Accessibility of Remaining Timber

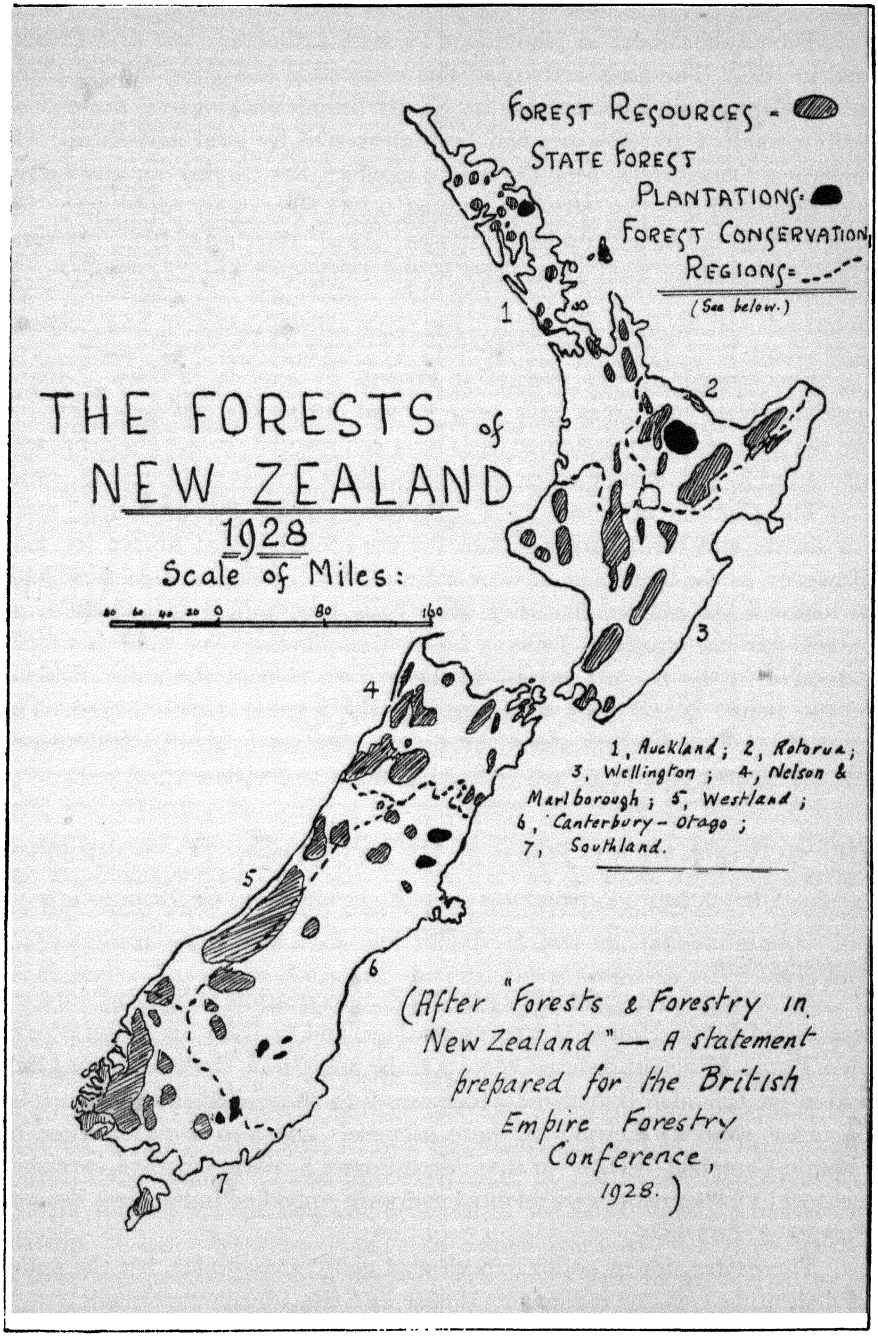
Except on the west coast of the South Island, the coastal forests and those along the banks of navigable rivers have largely disappeared, and for the most part heavy transport costs have to be incurred. Increasing transport costs as the more accessible forests have been depleted, have been a factor in making competition with timber from the Pacific coast of Canada and the United States more difficult for New Zealand; but the main factors are the large-scale operations of the North American mills, superior stands of timber which is more easily sawn, and lower wages.

II. AREA OF PLANTED FORESTS

A. State Forest Plantations

Since organized State afforestation was first started in 1896 there had been planted a total area of 364,000 acres up to the end of 1933, of which about 70 per cent. are in the North Island, mainly on the central volcanic plateau. During the years 1928-29, 1929-30 and 1930-31 an average of 56,257 acres was afforested per annum. The foregoing figures make New Zealand the leading State in the British Empire as far as State afforestation is concerned both as regards the aggregate area planted and the area planted yearly.

1. See State Forest Service Circular No. 22/30.


FOREST RESOURCES -
STATE FOREST
PLANTATIONS:
FOREST CONSERVATION
REGIONS=
(See below.)
THE FORESTS of
NEW ZEALAND
1928
Scale of Miles:
80 60 40 20 0 80 160
1, Auckland; 2, Rotorua;
3, Wellington; 4, Nelson &
Marlborough; 5, Westland;
6, Canterbury - Otago;
7, Southland.
(After "Forests & Forestry in New Zealand" — A statement prepared for the British Empire Forestry Conference, 1928.)

Map 26

B. Local Authority Plantations

The establishment of plantations by local authorities was first authorized in 1879. The main activity in this connection has from the first been in the Canterbury Province of the South Island where up to the end of 1930 a total of 16,582 acres had been afforested by local authorities. Of the cities, Dunedin has been the only one which has carried out any extensive afforestation; that city has planted 6,100 acres with forest trees for water-conservation and timber purposes. As at March 31, 1931, the total area afforested by local authorities in the Dominion was 22,682 acres.

C. Public Company and Private Plantations

Encouraged by the successful growth of exotics in New Zealand several private companies have been formed during the last few years for the purpose of growing timber trees on a commercial scale. The total area afforested by public companies was about 234,000 acres at March 31, 1932.

The planting of forest trees by private persons has been done more for shelter and farm purposes than for the production of timber for sale. However, as the trees planted were mainly *Pinus radiata,* and as these have in many cases reached maturity, they have been milled to a quite large extent for case timber. Private forest tree-planting has been far more extensive in the treeless parts—on the eastern side of the main divide—of the South Island than it has been in the warmer North Island. The total area of plantations owned by private persons is about 68,000 acres, but the figures obtainable are rather indefinite and appear confused.

III. GOVERNMENT POLICY IN RELATION TO FORESTRY

A. Dedication, Protection and Exploitation of Indigenous Forests

1. *Dedication*

As early as the years 1860 and 1868, the question of applied forestry was raised in the House of Representatives, and in 1873 Sir Julius Vogel, then Prime Minister, ordered reports to be made to a Parliamentary Committee on Colonial Industries, recommending some elementary principles of forest control. Certain of these proposals and also some of those of Captain Campbell-Walker, of the Indian Forest Service, who had furnished a report to Parliament, were adopted and were embodied in the New Zealand Forests Act of 1874.

Thereafter, forest policy experienced many vicissitudes, but the policy of dedicating areas of indigenous timber as State forests continued.

The position with respect to forests controlled by the State Forest Service at March 31, 1932, was as follows:—

Status	Area in Acres	Percentage of Total Area of N.Z.
Permanent State Forest ..	2,196,037	3·4
Provisional State Forest ..	5,632,090	8·4
Total of both	7,828,123	11·8

2. Protection

Although a Forests Act was passed in 1874, it was not until 1886 that any comprehensive regulations for the control and protection of forests were gazetted. The regulations were not based on any scientific forestry practice, and in some districts were not strictly enforced. After the report of the Forestry Royal Commission of 1913, the importance of forest conservation and protection was more fully and generally realized, and the revised regulations of 1908 and 1912 were far more strictly enforced. After the establishment of an independent forestry department (The State Forest Service) and the passing of the Forests Act of 1921-22, conservation and protection has been carried out on modern lines.

3. *Exploitation*

Up till the establishment of the State Forest Service and the passing of the Forests Act 1921-22, the system generally adopted in disposing of timber from State forests or Crown lands was the granting of licences to cut over certain areas at fixed royalties on the sawn output of the various timbers milled. This was, of course, a very unbusinesslike and unscientific system, as it encouraged waste both in the forest and in conversion at the mill, and difficulty in checking the quantities and kinds of timber cut and in some cases encouraged the miller to make incorrect returns. Before the establishment of the State Forest Service in 1920, royalties charged by the State were generally extremely low, while conditions of operating and payment were frequently but loosely drawn up, indefinite and often ambiguous. Except in Auckland district, there seems to have been little attempt to place timber sales on a businesslike basis. Little appears to have been done to ensure that the State received payment for the whole of the timber used, or that there should be the fullest utilization of the content of the trees felled. In most districts, after a timber right had been granted, time and conditions of working would appear to have been altered more in the interest of the purchaser than of the State. Moreover, the system allowed for 'picking the eyes out of' areas of standing timber and leaving the less advantageous parts to future operators. Obviously such a system was uneconomic to a degree. The miller paid in proportion to his output not in proportion to the timber used. The natural outcome was the adoption of wasteful logging methods. Had the charges been on the timber content of the trees it is obvious that a fuller utilization of resources could have been secured.

The ease with which timber rights could be secured and retained at very low cost to the holder was conducive to aggregation of timber stands in the hands of speculators. The unearned increment accruing to such at the expense of the State was a serious weakness in the system. Regulations requiring a time limit on holdings appear to have been non-existent so that, not only were considerable areas non-productive of revenue, but settlement thereon was retarded or prevented.

In addition, the timber-bearing land in question, except sometimes that over which sawmilling licences had been granted, being State-owned, was a definite burden on the local governing body concerned, since it was exempt from rates. Thus additional taxation had necessarily to be borne by the settlers in such districts. Nor was this all. In many districts the use of the roads by timber interests involved heavy maintenance costs to already over-burdened local bodies.

In the Auckland Province, owing to the existence there of the highly valuable kauri pine, the system of appraising the standing timber and disposing of it by public tender or by auction had been in practice since about 1905.

Under the administration of the State Forest Service all timber disposed of by that Service is carefully measured up and appraised by experienced forest officers as it stands in the forest. An upset price which allows a reasonable profit to an operator is fixed and the timber is then disposed of by public tender or auction. Under this system the State gets the full market value for its forest produce, and the miller, in his own interest, wastes as little timber as is reasonably possible. After a tender or bid has been accepted by the District Forest Officer a licence to the purchaser is issued by the Minister in Charge of the Service. This licence contains a statement showing the quantities and kinds of timbers sold, the price, and the various conditions—repayments, lighting of fires, protection of young trees, efficient logging, etc.—which the licensee is subject to.

The quantity of timber sold in one lot is generally enough to supply a miller for five years, but adjacent timber is held in reserve for future disposal to him. At present cut-over areas, when not suitable for withdrawal from forest reservation for settlement, are, except in the case of some few areas on which experiments are being made, merely protected from fire and trespass.

In the 1920 report of the Director of Forestry, definite recommendations to meet the above conditions are made. Included among these are the following:—

(i) The State Forest Service to be the sole controlling authority of State-owned forests.

(ii) Reconsideration of royalty rates, with a view to basing them on a more equitable basis, by readjustment, say, every five years.

(iii) Imposition of a ground rent of one shilling per acre per annum, the same to be paid annually as a condition of renewal of licence for the ensuing year.

(iv) Payment to be on cubic content of the log, not upon superficial measurement of output of sawn timber.[2]

(v) Right of access to books of operators with a view to assessing charges for ensuing five-yearly period.

(vi) A minimum yearly or periodic cut to be required with each contract.[3]

(vii) No timber sale contracts to be transferable or assignable. They should be regarded as a contract only between the Government, as owner of the timber, and the user.

The objects of the above are obviously to secure a more equitable distribution of potential forestry revenue by:—

(i) Securing a uniform policy throughout the Dominion.

(ii) Ensuring that the State receive payment for the timber used, not only for that actually produced as sawn timber.

(iii) Ensuring full use of timber by requiring full payment to be made for it, the assumption being that if the operator is compelled to pay for all the timber cut, the methods adopted will tend to eliminate waste.

(iv) Preventing the holding of blocks of standing timber at the expense of the State pending a rise in price.

(v) Ensuring that estimates for future renewals of licence will be on an equitable basis.

(vi) Preventing undue delay in the use of land for other purposes.

(vii) Preventing aggregation of timber supplies for speculative purposes either by the licensee or his successors or assigns.

The above policy has been adopted, except in some inessential details, and has been helpful in bringing nearer the reforms aimed at.

B. Afforestation

1. *Government*

Though between 1884 and 1891 the Railway Department had established plantations of exotics on some of its reserves, it was not until 1896 that State afforestation on an organized basis was started. An Afforestation Branch of the Lands Department was formed, and forest-tree nurseries

2. Payment is still made on the basis of board feet, however, since it has not yet been possible to persuade the trade to accept measurement in cubic feet.

3. This is not, as yet, enforced.

were established at Tapanui and Eweburn in the South Island, and at Rotorua in the North Island. Shortly afterwards afforestation was started at these and other localities. By 1904, operations had reached 1,000 acres a year, and between 1908 and 1919 the acreage annually planted was about 2,600 acres, the planting being done mainly by prison labour. In 1924 the area planted for that year rose to 7,275 acres, in 1928 it had risen to 36,792 acres, and during the three years ending March 31, 1931, the annual average had risen to 56,257 acres. The prevailing severe financial stringency, however, is preventing a continuance of planting on this very extensive scale.

There has not been, nor is there at present, a definite Government policy with respect to afforestation. The State Forest Service is financed by the varying annual receipts from the State indigenous forests and the plantations; but as the revenue received has been insufficient to carry out the *annually-decided* operations, the State Forests Account had from time to time to be supplemented by loans from the Consolidated Fund. This position of affairs has had the bad effect of preventing the Service from laying down a definite forestry programme covering a reasonable number of years. The large areas afforested during the last few years have resulted rather from the fact that tree-planting afforded material relief of unemployment than from an appreciation of the country's future requirements with respect to forests and timber. However, it is estimated that at the year 1965 the total area now afforested, together with the indigenous forests and the areas proposed to be afforested in the near future by local authorities and private concerns, plus about fifty million board feet of importations, should amply satisfy the Dominion's home requirements. In the Dominion there is a very considerable area of land unsuitable for profitable agriculture; and as such land, in this country of abundant and well-distributed rainfall, can profitably grow forest trees, it is highly probable that it will be used for afforestation by the State, local bodies, and private concerns.

2. *Local Authorities*

The first afforestation undertaken by a local authority was that done in Canterbury by the Selwyn Plantation Board in whom the Government had vested several areas totalling 16,000 acres. Since then other local authorities have engaged in afforestation, Government assistance being given in some cases by way of grant.

3. *Companies*

Influenced mainly by the proved exceptionally rapid growth and large yield of exotic trees in New Zealand, and also realizing the impending

world-shortage of softwood supplies, several public companies were formed in 1923 and thereafter for the purpose of commercial afforestation. The total area returned as acquired by the companies as at March 31, 1931, was 277,000 acres, most of which is in the central pumice plateau of the North Island, which locality is exceptionally favourable for tree-growing. The total area already (March 31, 1931) afforested by these companies is about 212,000 acres. There is every reason for assuming that they will supply a material proportion of the future timber requirements of New Zealand, and not improbably, will also be exporters of softwoods.

4. *Plantations of Individuals*

From the earliest days of settlement in New Zealand a small amount of tree-planting was done by settlers for the purpose of shelter or beautification of their farms; but from 1871 planting was much increased owing to the encouragement offered to individuals by the Provincial Governments by the issue of a land-order for £4 to everyone who successfully planted one acre with any kind of trees. This was taken advantage of during the following twenty years, especially in Canterbury and Otago where the frequency of strong north-west winds made shelter belts of trees of particular value to farmers. Some of the plantations in Canterbury are of considerable area, sometimes as much as two or three hundred acres. Most of the plantations were composed very largely of *Pinus radiata, Cupressus macrocarpa,* and blue gums, and such plantations have of late years given large returns of timber which has been used mainly as case material. The plantations of Mr. James Deans, of 'Homebush,' have been managed on a 'sustained yield' plan; but most other plantation owners have clear felled their plantations, and have not always replanted.

In some cases in the South Island where the Lands Department has leased open lands as grazing runs, the lessee has been under an obligation to plant annually a small area with shelter trees. The State also encourages tree planting by reducing the rents of Crown tenants who plant trees on their leaseholds. A considerable stimulus was given to private planting when in 1915 the Government decided to supply settlers with young trees at cost price for planting on their farms. Subsequent to 1921 and up to the end of 1930 the provision of trees by Government was carried on with great activity. In the year 1927 alone, 4,760,490 trees were issued from the State Forest Service's nurseries, and the greater part of this number were issued to individual planters. The Government, however, agreed with the Nurserymen's Association to cease selling trees after 1930. During the late war and for some years after, discharged soldier settlers received small grants of forest trees from the Government for planting for shelter and farm purposes.

Free advice is given to intending tree planters by the State Forest Service; and from 1921 to 1930 an officer for the North Island and another for the South Island were detailed to travel round the country for the purpose of giving addresses and advice on tree planting.

Encouragement is given by the State to private tree planting by certain exemptions with respect to taxation, viz.: (a) The value of land for taxing purposes does not include the value of trees in plantations, or the value of the labour or capital expended in planting them;[4] (b) profits made from the sale or disposition of plantation lands are, for the purposes of income tax, on the same footing as those relating to other lands; profits made from the extraction, removal, or sale of timber from land are subject to income tax, but royalty paid for timber in plantations, or the cost of growing the trees is deducible as cost of production, which includes all cost of planting and maintenance up to the income year, but does not include interest on capital expended in meeting these costs; (c) local rates on land supporting plantations are levied on the value of the land, which does not include the value of any trees, or the value of the labour or capital expended in planting them. The area of tree plantations owned by private individuals in New Zealand is about 68,000 acres, but the records are by no means clear.

C. Education and Research

1. *Education*

As early as 1886 Kirk, in one of his reports, advised that the Government should establish a school for the training of its forest officers. By 1908 the appreciation of the necessity of having trained men as forestry officers had advanced to the stage that the State Forests Act of that year actually contained authority to establish schools of forestry and agriculture, and also specified a block of land near Whangarei, in the North Island, to be reserved for a school of forestry and agriculture.

No definite action towards establishing a School of Forestry was taken till 1925, when Canterbury College established a School. In 1926 another School was established by Auckland University College. Both schools of forestry received monetary grants from the Government, but both have now been abolished.

With a view to inculcating into the rising generation an appreciation of the value of trees and forests, tree nurseries have been formed in many of the primary schools, and tree seeds and small quantities of young forest trees are supplied to these by the State Forest Service. The formation of many school plantations in country districts is now in progress. As a means of educating farmers with respect to the value of trees and plantations, the State Forest Service for many years staged as exhibits at the main agricul-

4. All State land taxation is, however, on unimproved value.

tural shows samples of forest tree seeds, nursery stock, timbers and other forest produce. Numerous leaflets are also distributed giving information with respect to the most suitable trees for farmers' plantations, the preparation of the land, raising the young trees, planting them out, and the subsequent necessary management.

2. Research

Since the establishment of the State Forest Service, research in connection with forestry has been carried out to a quite important extent. The research may be conveniently divided into four divisions, viz.: (a) the management of the indigenous forests; (b) the establishment and management of the exotic plantations; (c) forest products research; and (d) research in connection with forest and timber pests.

(a) *The Management of the Indigenous Forests.*—In this connection selected officers of the field staff of the State Forest Service have been engaged in marking out sample plots in various types of forest. In some of these plots, Nature is allowed full action, whilst in others various plans of treatment are applied. In cut-over areas of forest, experiments have been carried out to test both regeneration of the indigenous species and replacement by exotics. In the South Island a forest experiment station has been established to test the practicability of establishing exotics on cut-over areas of indigenous forest. In the North Island an experiment station has been established at the Waipoua Kauri forest to carry out experiments in the practicability of a 'sustained yield' plan of management, the re-establishment of kauri on cut-over areas, the extension of kauri forest over, and the planting of and sowing of kauri on adjacent fern and scrub lands, etc.

The underplanting of the indigenous forests with shade-bearing exotics has been experimentally carried out. Dr. Cockayne, F.R.S. (Honorary Botanist), has made an exhaustive study of the ecology of the *Nothofagus* (Southern beech) forests. A comprehensive mill-conversion study has been made.

The School of Forestry at Canterbury College carried out investigations with respect to the regeneration and restoration of the indigenous forests of the west coast of the South Island.

(b) *Establishment and Management of Exotic Plantations.*—The field staff of the State Forest Service has carried out experiments in the nurseries such as the following:—The best time for seed-sowing; the density of sowing for various kinds of tree seeds; the maintenance of soil fertility; the amount of shade required by the different crops of seedlings; the effect of different fertilizers, etc. In the plantations sample plots have been laid off and growth and volume increments have been observed.

Experiments have been made in direct establishment by different plans of seeding, e.g., spot sowing, broadcasting, and drill sowing. Experiments have also been made in underplanting, etc.

(c) *Forest Products Research.*—There is a Forest Products Research Branch of the State Forest Service, and this Branch has carried out research and tests with respect to the following: The classification and grading of New Zealand timbers; the use of certain indigenous timbers as substitutes for foreign timbers now imported; the successful dry-kiln treatment and the air-seasoning values of the main building species for districts with different climates; the determination of the physical and mechanical properties of indigenous and exotic timbers; structural tests; antiseptic treatment of plantation and indigenous timbers; tapping indigenous and exotic conifers for resin; the structure of New Zealand-grown timbers; and, in collaboration with the Forest Products Laboratory at Madison, Wisconsin, U.S.A., the very important test of New Zealand-grown timbers, indigenous and exotic, for the making of paper-pulp.

(d) *Forest and Timber Pests Research.*—With the co-operation and financial aid of the State Forest Service, the Department of Scientific and Industrial Research, the Timber-growers' Association, and the Sawmillers' Federation, the Cawthron Institute carried out until 1931 important investigations with respect to entomological and mycological pests of forest trees and timbers. The Plant Research Station of the Department of Agriculture also gives valuable assistance in mycology.[5]

IV. UTILIZATION AND PRODUCTION OF INDIGENOUS FOREST SUPPLIES

A. Stand of Timber

On the estimated total area of 3,613,400 acres of merchantable indigenous forests, according to State Forest Circular No. 22/30, it is estimated that there is a total stand of about 2,290 million cubic feet of economically exploitable softwoods.

B. Utilization

The forests in National Parks, Scenic and Climatic Reserves are controlled by the Department of Lands, Scenic Boards, or National Park Boards. Such forests are excluded when dealing with utilization. Forests subject to exploitation are held mainly (1) by the State Forest Service, (2) by the Department of Lands, (3) by corporate bodies, (4) by Maoris, and (5) by private Europeans.

5. The State Forest Service has published a valuable monograph by Dr. Miller, of the Cawthron Institute, on forest and timber insect pests in New Zealand.

1. *The State Forest Service*

Nearly two-thirds of the total forests of the Dominion are under the administration of the State Forest Service. The general practice is for the miller to secure an area of forest by tender. The working of the forests is very destructive, for though trees under 12 inches diameter of the valuable species are excluded from sale, they are often so mutilated that they are of little value afterwards.

2. *Forests Controlled by the Lands Department*

In most cases where the Lands Department decides to sell forest of timber value, that Department requests the State Forest Service to measure up the timber and fix an upset price for it. The timber is then disposed of by the Lands Department by tender or auction. As in these cases the land will be subsequently used for settlement, the only operational restriction is with respect to the regular felling of all marketable timber. In a few cases the Lands Department does its own appraisals.

3. *Corporate Bodies*

In cases where corporate bodies own reserves carrying marketable timber, the State Forest Service is sometimes requested to dispose of the timber under its own system, and to pay the net proceeds of sales to the particular body owning the timber.

4. *Forests Owned by Maoris*

There is in the Forests Act 1921-22 provision for the administration of Maori-owned forests by the State Forest Service, but this wise provision has not been taken advantage of by the Maoris. The present practice is for millers to arrange with Maori owners to buy the timber at an agreed-upon rate of royalty on the sawn output of the forest. This agreement has to be approved by the Maori Land Board for the particular district, and finally the Minister of Forests has to give his consent to the dealing. In cases where the Minister is advised that the royalties are not just to the Maori owners, he may withhold his consent. Also if the Minister considers the timber should be bought by the State he may withhold consent in order that it may be bought by the State under existing legislative provision which empowers such action. Sales of timber from Maori-owned forests are not subject to any operational restrictions beyond regular felling and prevention of fire.

5. *Forests Owned by Private Persons*

Sales of timber growing on privately-owned lands are usually on the basis of payment of royalty on the sawn output of the operator's mill, although many small exotic stands are now bought for lump sums. Regu-

larity of felling and prevention of fires are generally enforced, but as the private owner wants the forest cleared off in order that the land may be used for farming, operational restrictions are seldom imposed.

C. Production[6]

For the five years up to 1932, the average production was about 240,000,000 board feet, of which rimu contributed about 55 per cent. and Kahikatea about 22 per cent. Beech (*Nothofagus* species) is the only hardwood produced to any material extent. The production of kauri, the most valuable timber, is progressively decreasing. A notable development has occurred in the production of the exotic insignis pine (*Pinus radiata*), which increased from about 7½ to 13½ million feet between 1928 and 1932.

Of the total timber production, about 20 per cent. is obtained from forests belonging to the State. The figures given above are the *net* product of the sawmills. There are no figures giving the gross quantity cut. There is a large amount of timber used for poles, sleepers, mine-props, posts, battens, and fuel, but there are no reliable returns giving the quantities.

D. Exhaustion of Supplies

In the Annual Report of the New Zealand State Forest Service for 1925, the total quantity of economically available softwoods was estimated by the then Director of Forestry, Captain L. MacIntosh Ellis, to be 25,000,000,000 feet, board measure, The population of the Dominion was at that time 1,350,000, and the annual *per capita* consumption was estimated as being 240 feet, board measure. Taking into consideration the normal trend of population, and the development and expansion of intensive agriculture, and of secondary industries over a period of years, it was estimated that the gross national consumption of sawn-forest produce would by the year 1965 be 675,000,000 board feet per annum (other products in proportion). Hardwoods will only function as a subsidiary source of supply, because of their general distribution in the mountainous regions, and because owing to their normal refractory qualities, they do not lend themselves readily to industrial, constructional, and building uses. In the Report it was predicted that New Zealand's virgin softwood resources would be economically exhausted by the period 1965-1970. With the information at present available, the present writers see no reason for varying this forecast. Provision against this exhaustion is, of course, being made by the very extensive exotic plantations of the State Forest Service, private companies, the Dunedin City Council, the Selwyn Plantation Board, and the lesser plantation proposals of some corporate bodies and a few private persons.

6. Returns are given annually in the N.Z.O.Y.B.

V. SUITABILITY OF NEW ZEALAND FOR AFFORESTATION

A. Climate

No country in the world has a climate more favourable to tree-growth than has New Zealand. Not only is there an abundant rainfall—with the exception of a few comparatively small areas—but the rainfall is remarkably well distributed throughout the year. With respect to temperature, the extremes experienced in the Northern Hemisphere are unknown. Except at an altitude of about 2,000 feet in the North Island, and about 1,500 feet in the South Island, snow is not sufficient to be in the least detrimental to tree-growth. The climate is also advantageous to tree-growth as regards sunshine. Being isolated in a huge ocean, and having a great length in proportion to its width, it is only natural that New Zealand should be subject to wind, but it is only in a few localities on the coast and in mountain valleys that wind is a seriously detrimental factor in tree-growth.

B. Topography and Soils

As far as timber production is concerned, topography is less important as a limiting factor than in general farming. Beyond stating that altitude does not prove a limiting factor below 2,000 feet in the North Island, and 1,500 feet in the South Island, and that the broken nature of the country in certain districts hampers economical utilization through its effects on transport, there is little further that need be said. Except in North Auckland, the rivers are not utilized to any great extent for logging, since, in the main, there are too many shallows.

The soils unfavourable to tree-growth are small in area. On the other hand, much land, unsuited to farming, such as sand dunes, the pumice area in the central plateau of the North Island, and some of the gum lands in the North Auckland peninsula are well suited to afforestation. Hence, afforestation may bring into profitable use large areas which would otherwise be waste.

C. Transport

Owing to the great length of the Dominion, and its comparative narrowness, no part is far from the sea, though in places the broken nature of the country may make transport difficult. There are numerous harbours, which allow easy transport of timber from one part of the Dominion to another or to overseas ports. There are numerous railways which tap or go to within a short distance of most large forest areas. The Dominion is also well roaded, and motor carriage is on the increase as a means of timber transport. When kauri timber was plentiful, logs used to be floated down the streams of the Auckland Province to deep-water harbours, where the mills were generally situated; but many logs were also rafted in the coastal waters to mills in Auckland. The kauri trade, through depletion of supplies,

has dwindled to very small dimensions, and as the other indigenous softwoods, when in a green condition, will not float, rafting is now practised to a very limited extent. The main future supply of indigenous timber is on the West Coast of the South Island. The export of this timber to the North Island and to Australia is sometimes hampered by the unsatisfactory nature of the West Coast ports, all of which have bar harbours.

All planted forests of exotics are close to railways or projected railways, and in most cases also close to ports, so when these forests produce sawn timber, transport to different parts of the Dominion or to overseas ports will be easy.

VI. ECONOMICS AND TECHNIQUE OF FORESTRY

A. Main Indigenous and Exotic Trees

All but a very small area of the State forests which are now being exploited are taxad forests, that is, the commercially-valuable stand is composed of from two to four species of taxads scattered among a generally larger number of at present not valuable broad-leaved species. White pine or Kahikatea (*Podocarpus dacrydioides*), at one time found in pure stands of considerable extent, is now found pure only in very small stands, except in South Westland. Rimu, or red pine (*Dacrydium cupressinum*) is often a dominant tree in a more or less mixed stand of other taxads with broad-leaved trees. Formerly kauri was often found in large pure groups, but the few remaining groups do not exceed a few hundred acres each, and where this most valuable tree still exists it is found in most cases scattered amongst other trees. The chief indigenous trees of commercial value are: Kauri (*Agathis Australis*), Kahikatea or white pine (*Podocarpus dacrydioides*), rimu or red pine (*Dacrydinon cupressinum*), totara (*Podocarpus totara* and *Podocarpus Hallii*), miro (*Podocarpus ferrugineus*), Kaikawaka or mountain cedar (*Libocedrus Bidwilli*), yellow pine or silver pine (*Dacrydium Colensoi* and *D. intermedium*), red and hard beech (*Nothofagus fasca* and *Nothofagus truncata*), silver beech (*Nothofagus Menziesii*), black beech (*Nothofagus Solandri*), black maire (*Olea Cunninghamii*), northern and southern rata (*Metrosiderous robusta* and *Metrosideros lucida*).[7]

The most important exotic timbers being grown on a commercial scale are: *Pinus radiata* (Insignis pine), *Pinus ponderosa* (western yellow pine or pondosa pine), *Pinus laricio* (Corsican pine), *Pseudotsuga taxifolia* (Douglas fir or Oregon pine), *Larix decidua* (European larch), *Sequoia sempervirens* (Californian redwood), *Thuya plicata* (western red cedar), *Cupressus Lawsoniana* (Lawson's cypress or Port Oxford cedar).

7. An account of the chief New Zealand forest trees will be found in the N.Z.O.Y.B., 1934, pp. 351-356.

B. Nursery Operations

1. *Seed*

Of the seed used in afforestation in New Zealand, by far the greatest quantity is that of *P. radiata,* and this is collected in the Dominion. The State Forest Service collects a fair amount of Californian redwood seed, and also some *P. ponderosa, P. Laricio,* Lawson's cypress, and Douglas fir seed, but, omitting *P. radiata,* most of the tree seed used is imported from Europe, Canada, and the United States. Before being sown it is treated with carbon bisulphide as a precaution against the introduction of noxious insects; it is also subjected to tests of viability.

2. *Sowing*[8]

In sowing the seed, both the band method and the line-sowing method are used. In the case of the latter, no protection is given to the seedlings, and sturdier stock is obtained; further, the seedlings, except in the case of *Pinus ponderosa* and *P. Laricio,* are large enough to plant out in one year, instead of two, and their cost is less. In line-sowing, a small hand Planet Junior single-wheel seeder is used. With *Pinus radiata,* about 75 lbs. of seed per acre are used, the lines being spaced at 12 inches. With other species, the amount of seed varies according to the size of the seed and the germination test.

3. *Lining Out*[8]

In State nursery practice lining-out has been eliminated for *Pinus radiata, P. laricio, P. ponderosa,* and *P. muricata,* but is still carried out with other species, such as Douglas fir, Californian redwood, the cypresses, etc., and such stock as is being raised for disposal to outside planters. Now the usual practice is to leave the young trees in the seed-beds for two years, and then to transfer them direct to the plantations.

4. *Wrenching*[8]

For this operation, except in those nurseries which have stiff soils, the use of spades has been abandoned for a Planet Junior, to the wheel-hole of which an L-shaped blade is attached. This is operated by two men, one pulling in front, and the other pushing and guiding. By this method the work is done in about a quarter of the time and at far less cost than by the old method of spades, also the roots are cut at an even depth, which is not the case with the spade method.

5. *Manuring the Soil*[8]

Areas which are being spelled, or are not in use, are restored to condition by sowing blue lupins on them in the spring, and ploughing in the lupins when in flower. This not only adds nitrogen to the soil, but also

8. *Vide* paper by W. T. Morrison in *Transactions of Empire Forestry Conference of 1928.*

smothers weeds. In addition to the lupins, such fertilizers as superphosphate, basic super, bone dust, sulphate of ammonia, etc., are also used to maintain the fertility of the nursery soil.

6. *Cost of Trees*

The cost of raising the trees for planting varies with the species and their age, and is affected by the cost of the seed, the success or otherwise of the sowing, the weather, disease, etc. At Rotorua the cost ranges from 4/4 per 1,000 for line-sown stock to 22/2 per 1,000 for two-year-old transplanted stock. At the other nurseries the soils are less favourable, and the costs are somewhat higher.

C. Planting Operations

1. *Surveys, Roading, and Layout*

The first operation in preparing the land for planting is a topographical survey, after which roads and firebreaks and compartments are laid off. The roads or tracks are then formed on the ground.

2. *Destroying Rodents*

In most localities where afforestation has been carried out, rabbits or hares have been very plentiful. Before planting, these pests have to be destroyed, and this is done mainly by rabbiters, who use strychnine for the purpose.

3. *Cutting Lines and planting the Trees*

The next procedure is the cutting of the lines for planting (the land is generally covered with *Leptospermum* or other scrub, which has previously been fired, but generally only partially consumed by the fire). The espacement adopted for planting is 8 feet by 8 feet, and the notch method is used. The wide spacing has been adopted for economic reasons, as up to the present there has been no market for thinnings, and this condition may obtain for several years yet.

4. *Cost of Establishing the Trees*

Including the foregoing operations, plus the making of camps for the labourers, the supplying of firewood, and the cost (5/6 to 6/11) of the trees (680) received from the nursery, the total cost of planting in the Rotorua region—the soil there is a light pumiceous loam, generally covered only with light scrub—is from 23/- to 27/- per acre. At the other planting centres the soil is generally of a stiff, clayey nature, with higher and denser scrub, and the establishment costs are somewhat higher; but more than half the total afforestation is carried out in the Rotorua region.

D. Conservation of Indigenous Forests

The conservation of the remaining indigenous forests is a fixed policy of the State Forest Service, but to secure the operation of this policy is often difficult, as there is always a considerable proportion of the population who, ignorant of the importance of maintaining supplies of timber for future requirements, and also ignorant of the value of forests for the regularization of stream-flow, prevention of erosion, etc., make strong demands that the reserved forests be made available for farming, even though the farming of similar lands has previously proved disastrous for the farmer, and has been followed by serious landslides and erosion, and the spreading of noxious weeds on the land from which the forest has been cleared.

A few of the most valuable forests, such as the Waipoua Kauri Forest, have had forest guards or caretakers stationed in them, and the more valuable millings forests are in some cases patrolled by temporary guards during the driest months; but the great majority of the forest reserves have only the occasional visits of the regional forest rangers. Forests in which the timber is now marketable have closer supervision.

Apart from man himself, the chief dangers to forest conservation are deer, goats, and fire. Deer, imported for sport, have multiplied, and have become extremely numerous in many parts of the Dominion, and in some forests are doing very serious damage. A considerable amount of money has been spent during the past few years in efforts to reduce the number of deer, but, as there is no sale for the meat, and a very restricted sale for the hides, the cost of operations has been so high that restricted finance will not allow their continuance on a scale large enough to have a definitely beneficial effect. In some localities, too, goats are already a serious pest to the indigenous forest, and they are spreading to forests in other localities. In some forests, wild pigs and cattle are abundant, but a long experience of the forest has shown that these animals do little harm, mainly because, in respect of cattle they do not become numerous.

Fires, originating generally from settlers' clearing-off operations, or the operations of kauri gum diggers and mineral prospectors, have in the past done considerable destruction, especially to the valuable kauri forest, and at the present time such fires often destroy large areas of Southern-beech (Nothofagus) forest. To lessen the danger from fires, there is power under the Forests Act to proclaim a fire district any State forest and the land surrounding such. In any fire district it is illegal for anyone to light a fire except under a permit from an authorized forest officer. This provision may also be extended to local authority and private forests upon request by the owner thereof.

Insect and fungus pests are common in the forests, and doubtless do a large amount of damage, but no systematic observations have yet been made

as to the extent of this damage, and it is probable that this damage is readily repaired by natural young growth.

E. Forest Control

1. *Pests*

With regard to indigenous forests, pests have already been dealt with under (C) above. With regard to plantations, the action so far taken has been inspections made by entomological and mycological officers of the Agriculture Department and the Cawthron Institute and the liberation of parasites of some of the insects which have been found to be attacking the live trees and dead timber of the plantations.

With respect to the pines, *Sirex juvencus* (horntail) has, in some localities, done damage, but it is generally considered that this insect rarely attacks healthy trees, though diseased or wind-blown trees and felled timber are readily attacked by it. The spruce aphis is now so prevalent, and its attacks so bad in New Zealand, that it is not wise to plant either Norway or Sitka spruce. (Spruce was abandoned for afforestation many years ago on account of its slow initial growth.) *Hylastes ater* has, of recent years, become established in New Zealand, and in some cases has done damage to young pines. Some of the species of *eucalyptus,* especially *E. globulus,* in plantations, have been attacked by *Rhicnopeltella eucalypti,* the snout beetle, *Gonipterus scutellatus,* and the scale *Eriococcus coriaceus,* but the last has been much checked by releasing the ladybird *Rhizobius ventralis.* The trees of the planted forests have, so far, been remarkably free from attacks by fungi, but *Pinus radiata* is occasionally fatally attacked by *Botryodiplodia pinea.* The black wattle (*Acacia decurrens*), in the private plantations, is of recent years very subject to the gall-fungus (*Uromycladium notabile*), which has done great damage in these plantations and in wind-breaks of this tree.

Wild animals do considerable harm in some of the plantations. Rabbits and hares in many localities are extremely numerous, and though these animals are greatly reduced in number by poisoning, etc., before planting, those that escape destruction often do considerable damage to the young trees. As in the case of indigenous forests, imported deer are often a serious pest.

2. *Fires*

Fires have already been dealt with as regards the indigenous forests. In the exotic plantations, numerous fire-lines are left, and the sides of these fire-lines are kept bare of vegetation by burning off the scrub and bracken when the weather conditions are favourable. Where the surface is sufficiently even, wide bands are ploughed along the sides of the fire breaks. Well-equipped fire lookout stations are built on the highest eminences. They

are connected with headquarters by telephone, and during the summer months a man is continually stationed in them. At various points on the plantation roads, fire depots are kept, and are well furnished with fire-fighting implements. Also, during the summer, mounted fire-guards are detailed for patrolling the plantations.

As with indigenous forests, plantations can also be brought under the provisions of the Forests Act as regards fire-districts.

3. *Stock*

The exterior boundaries of all smaller plantations are fenced, consequently settlers' stock do no damage to these. The indigenous forest reserves, as a rule, are not fenced, and the stock of adjoining settlers frequently get into the reserves and do a certain amount of damage to marginal young growth. This damage does not occur to such an extent to warrant the expense of preventive measures.

4. *Trespass*

The plantations are so well staffed and guarded that trespass does not often occur. In the indigenous forests, which, of necessity, are less well guarded, trespass does occur, and fires have occasionally occurred as a result. Before the State indigenous forests were placed under the control of the State Forest Service, supervision was seldom adequate, and was often lax. As a result, persons who had been granted timber-cutting rights not infrequently disregarded their legal boundaries. Even under the more effective control of the State Forest Service, timber licencees have occasionally cut over the boundaries of their licence-areas, but when these encroachments have been discovered by the Service rangers the offenders have been punished by the infliction of heavy fines, and the practice of deliberate timber trespass is decidedly on the wane.

F. Organization of State Forestry

The Forest Authority, as defined by the Forests Act, 1921-22, is composed of the Minister of Forestry (the Commissioner of State Forests), the Director of Forestry, the Secretary of Forestry, and such conservators, rangers, and other officers as may from time to time be appointed as officers of the State Forest Service. Since March, 1928, the Director of Forestry has also held the office of Secretary of Forestry.

The central management and administrative control of the State Forest Service consists of the Director of Forestry (assisted by the Chief Inspector), with the head office at Wellington. Other personnel consists of the Milling Expert, the Forest Products Engineer and assistants, Surveyor, Check Appraisal Officer, two forest assistants, Chief Clerk, Chief

Accountant, and clerical and draughting staff. There is also a silvicultural research officer, whose headquarters are at the Waipoua Kauri Forest Reserve.

New Zealand is divided into seven forest regions, each of which is under the control and management (both with respect to indigenous forests and forest plantations) of a Conservator of Forests assisted by a staff of rangers, forest guards, and clerical staff. The Conservators are directly responsible to the Director of Forestry. The Minister determines the general forest policy, signs all privileges, such as grants of timber cutting rights and grants of leases, and approves all expenditure over an amount of £10. The Forest Act provides that the Governor-General appoint the Director of Forestry and the Chief Inspector of Forestry. All other officers of the State Forest Service are appointed by the Public Service Commissioner. The lands administered and controlled by the State Forest Service are of two classes, viz., permanent State forests—only 22 per cent. of the total area controlled by the State Forest Service—and provisional State forests. The reservation over the former class can be removed only by a resolution to that effect by both Houses of Parliament. The reservation over the latter class can be removed by proclamation by the Governor-General on the recommendation of the Minister of Lands that such lands are required for settlement (farming) purposes.

G. Organization of Labour Supply

1. *Prison Labour*

Up till the year 1921 a large proportion of the labour used in State afforestation was supplied by the Prisons Department. When this co-operation of the two departments was first arranged for no charge was made by the Prisons Department for the prison labourers it supplied, but for about six years before the termination of the arrangement, the Prisons Department charged the actual cost of the prisoners to that Department: this cost ranged from 5/- to 7/6 per prisoner per diem. Since 1921 prisoners have not been used for State afforestation.

2. *Maori Labour*

Since the start of State afforestation Maori labour has been largely used in the North Island. The Maori is very apt at forestry work, especially in the tree nurseries of the North Island where women are largely used. The Maori men labourers are paid the same rate of wages as that paid to ordinary European labourers.

3. *European Labour*

During the tree-planting season of late years most of the labourers employed have been from the ranks of the unemployed. A register of these

men is kept by the Labour Department, and upon request by the regional Conservator of Forests, that Department sends him the number of men he requires for the operations he has planned to execute. In addition to these casual labourers, there are always a good many men who are kept on throughout the year, and these men receive the same wages paid by the Public Works Department for comparable work.

4. *Seasonal Demand*

As tree-planting is confined to the months between May and September, most of the labour is required then. It is during this period that unemployment is worst, and for this reason forestry is most valuable as a means of materially relieving unemployment.

5. *Accommodation for Labourers*

The State Forest Service erects tents (with boarded floors and sides) and cook-houses for its labourers, and firewood is supplied to all camps. The labourers supply their own food, but the cost of this generally does not exceed 22/- a week.

VII. ECONOMIC AND TECHNICAL ORGANIZATION OF MILLING

A. Organization of Timber Companies

Commencing as they did in the years when power-driven plants were in their infancy, the timber-producing concerns were, in the early stages, mostly on a small scale. The more or less isolated situation of many of the mills was such that small-scale production was inevitable, partly from the extreme limits of the market and partly from lack of capital. In such circumstances it might be expected that individual and partnership concerns would predominate over company organizations. Such was the position as late as 1910, as shown by Table CXXXV.

Private concerns are usually small in size though in the aggregate they provide a considerable proportion of the total output. In some cases the timber is owned by the individual or partnership and the mills are often closed when the stands are worked. Hence such concerns are usually transitory and the operations are frequently incidental to the clearing of the land.

Partnerships are usually larger and more permanent, the partners frequently being working proprietors. As has been indicated, private companies are frequently formed from the reorganization of private concerns or partnerships, though they are also established in many instances by builders operating on a large scale to enable them to produce their own requirements. The scale of operations is usually larger than in the private concern or partnership.

TABLE CXXXV

Timber Mills and Sash and Door Factories

Year	No. of Establishments	Individual Concerns	Character of Organization			
			Partnerships	Public Companies	Private Companies	Miscellaneous
1910	534	199	211	50	73	1
1915–16	292	82	109	29	72	4
1920–21	389	104	127	54	102	2
1921–22	397	103	131	47	112	4
1922–23	426	111	140	45	122	8
1923–24	446	105	157	45	132	7
1924–25	471	112	146	46	160	7
1925–26	482	114	140	51	171	6
1926–27	423	104	123	44	147	5
1927–28	413	103	115	45	147	5
1928–29	386	92	111	40	140	3
1929–30	390	104	98	37	145	6
1930–31	401	107	96	42	153	3
1932–33	345	86	93	38	126	2

The largest establishments are in the main public companies which have frequently extended their operations by amalgamation and often have branches in different parts of the country.

B. POWER SUPPLY

In many parts of the country electrical power is available, but very few mills use it. In most cases steam provides the motive force and waste products are used as fuel, operating costs being thereby reduced. There is also a considerable number of small portable plants operated by internal combustion engines, and utilizing small stands of timber, and water power plants, once common, have not wholly disappeared. Frequently such plants are owned by the settlers themselves and they have proved very useful in exploiting small exotic plantations.

C. TRANSPORT TO MILLS

In a few cases logs are still hauled by bullock teams. In others a stationary engine or cable is used and the modern caterpillar tractor is increasing in use. Water transport of logs is less common than in many other countries, partly because waterways are not usually suitable or conveniently placed, partly because many types of timber do not float when green, though it is by no means an uncommon sight to see large log rafts of kauri pulled by tugs along the coasts or harbours of the North Island. When the road system is satisfactory, motor lorries are being used to an increasing extent, while many larger companies construct their own light railways and establish contact with mill, railhead, or waterway.

D. Milling

The technique of milling calls for little comment. In the smaller mills, the scale of operations precludes the adoption of the most efficient methods, but in the larger mills the technique is more advanced, investment in fixed capital is heavy, and up-to-date machinery and labour-saving devices are more common. The timber may be sawn to fulfil orders or it may be sawn and stacked in the open till required by a timber merchant or builder. Kiln-drying is at present practised only to a very small extent.

E. Transport from Mills

The bulk of the transport is by rail or coastal vessels, though motor transport is increasing in importance from mills adjacent to population centres and is causing much concern to roading authorities. Of recent years, the amalgamation of timber interests and pooling arrangements have facilitated the elimination of unnecessary transport by promoting delivery at fixed prices from the nearest mill or company. The Dominion Federated Sawmillers' Association represents millers in endeavouring to secure from the Government and shipping companies modifications in timber freights which are considered unfair or onerous.

F. Utilization of By-products

The main by-products are waste timber from the saws and sawdust. Where steam power is the motive force, these are used as fuel, while waste timber is sold as firewood where there is a convenient market. In most cases, however, the market is too remote to cover transport costs, and unless used as fuel, the by-products are wasted. The relative shortage of timber at the present time and stricter Government regulations, however, have had the effect of lessening waste in cutting and much material which would at one time have been discarded is now cut into narrow strips and sold for a variety of purposes such as trellis work and gardening stakes.

G. The Planted Forests

The State exotic plantations have not yet reached the stage at which an appreciable amount of saw-timber can be sold, and at present the only exploitation is the selling of a small amount of fencing material and fire wood obtained from thinnings. None of the company plantations exceeds twelve or thirteen years in age, but at least two large companies are preparing plans for utilization in the form of pulping. In several instances farmers who have had small mature plantations of *Pinus radiata* have sold the whole of the trees either for a lump sum or on a royalty on the sawn output of sawn timber from the plantation. In both of these cases the

purchaser of the trees erects a small mill (generally portable) on the plantation, and the sawn product, which is mainly case timber, is removed by means of motor lorries.

H. Costs of Milling

Owing to the small-scale operations, the high wages, and the generally broken nature of the country, costs of production of timber in New Zealand, as compared with other countries, are high. Dealing with the Dominion as a whole, and taking the year 1923, the total cost (including an average royalty of 2/- return on investment and depreciation) per 100 board feet, at the railway, was 14/7, of which wages form 43 per cent. The average wholesale selling price was then 19/8 per 100 board measure (it has dropped in the last two years), which allows the miller 27 per cent. on a gross turnover of 2,500,000 feet of timber, the output of the average New Zealand mill.

Definite figures with respect to the cost of production of timber on the Pacific coast of North America are not at present available to the writers, but they remember having seen statements that with the large mills there the cost of production is only in the region of 5/- or 6/- per 100 board feet.

VIII. LABOUR SUPPLY AND LABOUR CONDITIONS

A. The Demand for Labour

The labour required for timber exploitation may be divided into two groups, which we may designate 'primary' and 'secondary.' The primary aspect of production relates to the progress of the timber from the forest to the mill, the secondary from the mill to the consumer. In the primary phase which involves the felling of the timber, and its transport to the mill, standardization is practically impossible, conditions varying from tree to tree and log to log. Hence the work requires initiative and judgment as well as physical strength and a high degree of skill. Since workers must follow the timber, workers tend to be more mobile and less permanently localized, than at the milling stage, though mobility is within, rather than between localities.

By contrast the demand for labour during the 'secondary' processes is more definitely localized and conditions of work are more stable. Since the mill is usually situated near a town, even though a temporary one, the social amenities are greater and there is greater opportunity for social and industrial intercourse. This strengthens the tendency towards trade union organization. Further the greater possibilities of standardization and division of labour leads to a greater specialization of tasks among workers. There is some tendency towards a seasonal demand for labour, work being slacker in the winter months, though the seasonal movement is probably

less than in industries ancillary to farming. Discharged workers tend to drift to the cities and swell the ranks of the seasonally unemployed.

B. Supply of Labour

The supply of labour for the primary processes is drawn mainly from professional bushmen who move from place to place in response to demand. In districts adjacent to farming areas, settlers and their sons are frequently expert bushmen and the supply of labour is supplemented from this source. Bush-felling thus provides a useful means of supplementing the farm income, and accumulating capital for farming purposes. This phase is now passing.

In general the supply of labour for the secondary processes is drawn from those who have entered the industry early in life, and who become permanent, specialized workers. For the less skilled operations, the supply is largely met, however, by casual workers, in the sense that they are not permanently attached to the industry. In more remote districts, settlers or casual farm labourers are drawn on largely for this class of work. The supply of labour for the less skilled operations tends to fluctuate more than for the more specialized tasks about the mill or for bush-felling.

C. Organization of Labour

By contrast with most groups of workers, those engaged in primary aspects of the industry are not, in general, highly organized and unionism is weak. This is attributable, in the main, to the mobility of the workers, their remoteness from centres of population, the isolation of groups of workers from each other, the independence of spirit and individualism engendered by the nature of the work, and the fact that, except perhaps of recent years, they were able to demand good wages.

By contrast, 'secondary' workers are more effectively organized into unions, mainly because of the greater extent and permanence of localization. Apart from the impetus towards combination which greater concentration and permanence of location would encourage, it was possible to bring them under the Industrial Conciliation and Arbitration Act because awards could be more effectively supervised and enforced. The effect of recent legislation which has abolished the compulsory element in arbitration is yet to be seen.

D. Wages

On the whole, wages of bushworkers are higher than those paid to workers at the secondary stages, though they show greater district variations because of the comparative weakness of unionism and the fact that workers do not come under the awards of the Arbitration Court.[9]

9. The latter condition is now less important than formerly. Amendments to the Industrial Conciliation and Arbitration Act have largely destroyed the protective value of the Court to workers.

The higher wages paid to bush workers are accounted for partly by the more exacting nature of the work, longer hours, remoteness and consequent lack of social intercourse, and the less favourable living conditions. It is extremely doubtful if the *net advantages* of work at the primary stage are higher.

The conditions of work at the secondary stage conform more closely to those of orthodox industrialism as also does the outlook of the workers. Duties are classified, conditions of work laid down, and wage rates are calculated with regard to what is considered the relative importance of various tasks. Working hours are shorter and working conditions more satisfactory.

IX. MARKETS AND MARKETING

A. The Demand for Timber

1. *The Local Demand*

Of the mill output of 154,000,000 feet board measure in 1931-32 all but 27,000,000 feet board measure (the amount exported) was consumed locally. Of this amount about 41 per cent. is used in the building trade. Exports have shown a falling trend of recent years, but imports have been increasing.[10] The average quantity of timber imported for the five years up to 1932 was 40,000,000 feet board measure. Australian hardwoods, Douglas fir and Californian redwood were the most important of the timber imports. Since New Zealand is deficient in hardwoods, the supply of these timbers from Australia is not, in the main, competitive with New Zealand timber and is used largely for telegraph and electric power poles, sleepers, bridges and wharves. The principal overseas competition in the home market is in softwoods from the Pacific coast of North America, the timber being used mainly for building. At some of the smaller ports, American timber can be landed more cheaply than New Zealand timber, but local timber appears to be under no disadvantage in the four main cities.

Most of the timber produced in New Zealand and used locally is for housebuilding. Most of the houses in New Zealand have been built of wood mainly because wooden houses are less expensive than brick, concrete, or stone houses. Moreover, since it has been proved by the disastrous Hawke's Bay earthquake of January, 1931, that wooden buildings were generally less damaged than others, the preference for wood as a building material in New Zealand is likely to be increased in the future. A large quantity of locally-produced timber is used for furniture, dairy produce containers, fruit cases, tallow casks, beverage cases, jam cases, pickle-bottle cases, soap cases, railway-carriage building, railway sleepers, telephone poles, boat building, and many minor purposes.

10. There was a very heavy drop in the value of imports in 1931 and 1932.

2. The Foreign Demand

Taking the five years up to 1932, the average quantity of sawn timber exported was about 30,000,000 feet board measure, of which white pine (Kahikatea) represented about 75 per cent. Most of the timber exported from New Zealand goes to the Australian States. This is mainly because of the fact that the Australian States have few softwoods of their own. The New Zealand softwoods imported into Australia are used for butter-boxes, shelving, flooring, panelling, lining and furniture. The other principal species exported, mainly to Australia, are rimu, beech and kauri. Southland beech is used in Australia for motor bodies, agricultural implements and turnery. A small amount of *Pinus radiata* timber is exported to the Pacific Islands where it is used in fruit cases.

Recent developments include the exportation of beech timber to Portugal for wine cases, and enquiries from certain motor firms in the United Kingdom for use in the building of motor car bodies. Both markets appear to offer promising possibilities.

B. Marketing

In practice the marketing methods followed fall more or less naturally into well-defined classes.

(1) The smaller sawmiller, operating more or less independently, may draw supplies of logs from his own land and dispose of the sawn product locally. In such cases the marketing of the output will probably follow no clearly defined plan.

(2) There is also the small concern which disposes of the greater part of its output to a timber merchant whose headquarters are probably in one of the main centres. In such cases there is usually no very minute system of grading or classification with finely-computed price lists as in the retail trade, and prices, being subjected to individual bargaining, are not uniform. In such cases the relatively weak bargaining power of the small miller may tend in the direction of low prices. Timber is bought by the merchant in the stack, or even before cutting, at an average price per unit. On arrival at his yards it is graded by specialists. Much of the timber thus purchased is re-cut before classification. By re-cutting such boards, it is possible to secure a fair proportion of all-heart timber and since the whole has probably been bought at the wholesale price of sap timber, a considerable margin of profit presents itself.

(3) A third type is to some extent a combination of (2) above with the addition of a sash and door factory to the re-cutting plant. Such establishments are normally owned by large-scale building

firms, in order to secure steady supplies for use in construction work. Supplies of timber drawn from small mills at wholesale rates enable such large-scale builders to eliminate the middleman, thereby securing some of the economics of large-scale enterprise.

(4) Again, there is the large concern which owns or controls all types of property relating to timber production—land with standing timber; timber growing on land owned by others; transport facilities, both land and water; logging equipment; sawmills; sash and door factories, and finally, selling facilities.

(5) A fifth and final type is of more recent development. This is the concern in which the sale of timber is only a part of a wider field—that of supplying practically every type of material required in the building trade, e.g., oils and paints, glass, sashes, doors, wallpapers, ornamental ceilings, hardware of all kinds, roofing materials, bricks, concrete wall and foundation blocks, etc. In such types of business, the sawmilling process is not in general included, supplies of timber being drawn from country mills in large lots, loosely classified.

The sale of timber in large quantities by sawmillers to timber merchants may be considered the wholesale market. In general, sawmillers do not confine their activities to supplying this market alone, but accept retail orders in addition. Again, many sawmillers have their own selling organizations which put them into direct touch with the consumer, so that in such cases, the wholesale and retail aspects are combined within the one concern.

Where a large proportion of the output from a mill is purchased by a timber merchant the classification or grading is not as exacting as in the retail trade. In all mills there is a system of grading, but until recently this was a matter for the discretion of the grader. Thus there were considerable variations from mill to mill and from district to district. About 1929, however, a definite move was made in the direction of uniformity, and a conference between representatives of the Government and of the sawmillers was held. The outcome was the setting up of a 'Timber Committee' to enquire into matters concerning the grading of timber. This Committee formulated and recommended a series of rules for the standard grading and classification of timber. These rules have been adopted by the Sawmillers' Association and are in use in most districts. Criticism by the Timber Merchants' Association would suggest that this body by no means wholeheartedly supports the measure.

C. Price Agreements

At an earlier stage mention was made of a merger involving a majority of the timber millers of the Dominion. This, the Dominion Federated Saw-

millers' Association, is not a selling organization, but is established for marketing purposes on a district basis. These district organizations fix prices for their districts and since at least 80 per cent. of the sawmillers (controlling by far the greater part of the output) are members of the wider association, the district organizations are, in effect, able to control prices within their own districts during normal trading periods. The non-member minority, being unorganized, could have very little influence on district markets, so that, virtually, monopoly conditions exist.

As expressed in its book of rules, the objects of the Association are as follows:—

'The promotion and protection of sawmilling interests in the Dominion of New Zealand.

'The collection and publication of information affecting sawmilling interests.

'The redress and removal of grievances in connection with the timber industry.

'The settlement of disputes between members or between any member or members and those with whom they may be commercially connected.

'The improvement of facilities for the purpose of providing cheaper timber for the community.

'The restraint of any influence relative to the timber industry detrimentally affecting the public interest.

'The co-operation with other Associations with the purpose of advancing the foregoing objects, and for that purpose, to delegate any of its members with power to act in that behalf.

'The settlement of rules whereby the transaction of the business of the Association may be facilitated.

'The promotion of the co-operative principle among those engaged in the sawmilling industry in respect to:—

(1) Marketing their product.
(2) Procuring supplies.
(3) Indemnifying members in respect to accident and for fire insurance.
(4) Any other channel in which co-operation would be of benefit to those engaged in the industry.'

A further important development took place in 1929 with the formation of a merger comprising most of the mills from Hamilton to Palmerston North. This organization is known as 'The Sawmillers' Timber Trading Co. Ltd.,' and is capable of an output of nearly 30 per cent. of the total for the Dominion.

The methods of operation as described by the first Deputy Chairman shortly after the formation of the merger, are as follows:—

(1) Associated companies agree to sell to the central marketing company their whole output. The central company sells to customers, and all dealings are between it and them. The timber produced by the several mills is sold to the customer, not by these mills, but by the central company which invoices the product and receives payment from the purchasers. Thus the timber goes from the mill to the customer, who will obviously draw supplies from the most conveniently situated concern, but all accounts are furnished by, and all payments made to the central company.

(2) Payments made to the central company in respect of supplies drawn from the several mills are pooled and payment is made to member concerns in proportion to the value of timber supplied by each. By this means, any gains or losses are widely distributed and the effect is in the nature of insurance of member concerns against undue loss. This obviously makes for uniformity of operation within the membership group, and a measure of stability is secured.

D. The Finance of Marketing

1. In general, timber sales are characterized by a system of short-term credits only, with the usual cash discounts for prompt payment. The present depression, however, which, in the timber industry, has been felt since about 1927, has brought about a change of policy on the part of many selling concerns. In normal times any customer of sound financial standing, integrity, and business ability, will find credit available, but a number of firms have been, and in some cases still are, prepared to supply materials to builders, taking over a mortgage on the property on completion of the building. Some have even gone to the extent of accepting second mortgages as security. This would appear to be a risky practice which few firms could afford to indulge in. These risks are, however, modified by law.

2. The 'Wages Protection and Contractors' Liens Act' provides that a merchant who supplies timber to be incorporated in a particular building can establish a lien for the value of the timber supplied upon the land and building or a charge upon the contract moneys becoming due to the head contractor upon giving notice of his lien within thirty days of the supply of the last portion of timber, if supplied under a continuous contract. The lien can be enforced by court proceedings, and if the amount owing is not paid the property may be sold subject to mortgages existing.

The practice among timber merchants is to take their orders from builders in such a way as to make it possible for them to give notice of a lien within thirty days of the supply of the last portion of the timber. This custom is more common in the North than in the South. The effect is that

timber merchants are protected to a considerable extent and legal opinion appears to be that the effect of this legislation has been to facilitate the granting of credit to builders. Enquiries have established the fact that so much credit has been given by some timber merchants that they are financially involved with speculative builders. This is more especially true in the case of those merchants who, in addition to supplying timber, have provided credit in respect of other materials, payment of wages, and even to meet part of the purchase price of the land. In such cases, the merchant will no doubt protect himself by taking out a mortgage over the property as a whole. Should the builder become bankrupt, claims of the holders of liens take precedence over those of ordinary creditors.

3. The ability of the timber merchant holding a lien to establish a preliminary claim upon the property concerned, appears to enhance his security. The effect of this feeling of security could be seen in the ease with which builders obtained credit during the boom period of 1925-26. There seems little doubt that the over-building which took place during that period has been, in large measure, responsible for the unhappy position of the timber industry to-day.

Many builders erected houses which were sold on very small deposits (often 5 per cent. or less of the purchase price). Forfeitures by purchasers were common for several reasons:—

A slight downward trend in property values would suffice to eliminate altogether the purchaser's equity in the property. The effect, in many cases, was that the purchaser found it to his financial interest to 'walk out,' leaving the liability to the builder. In other cases the purchaser stood loyally to his contract, but examples of the former action were by no means uncommon.

The uncertainty of employment owing to depression resulted in much reversion of property. This position has been accentuated during the past two or three years, and present indications suggest no immediate improvement.

The extreme effects of depression upon purchasers of dwellings on small deposits has been that, equities having disappeared, the continuance of payment of purchase money has, in many cases, been impossible owing to lack of employment.

X. PRESENT POSITION OF THE TIMBER INDUSTRY

A. The Pre-war and War Periods

Timber production in New Zealand reached its peak round about 1907, the output increasing from 261 million superficial feet in 1900 to 432 million superficial feet in 1907.[11] By 1915 production had declined to 251

11. Statistics of timber production prior to 1920 are far from reliable, so that the figures are useful only for rough comparison.

million superficial feet, approximately the same as in 1900. Exports showed a rising tendency until 1912 when 94½ million superficial feet were exported. Thereafter the trend of exports was downwards. Imports, on the other hand, increased substantially. At the beginning of the century, imports did not greatly exceed 10 million feet. The increase after 1905 was rapid and by 1908 the annual import was over 50 million feet. Imports consisted largely of Australian hardwoods required in railway construction which was then proceeding rapidly. Thereafter, imports declined, the total at the outbreak of the War being about 25 million superficial feet.

The decline in timber production from about 1908 was accelerated during the War period, and reached its lowest level in 1918. The main factors were the decline in the demand for houses owing to the absence of a large number of men on active service and a low marriage rate, and general commercial and industrial uncertainty owing to the War. At the same time there was a substantial decline in exports owing to similar conditions in other countries and the difficulties of obtaining shipping space, and to the fact that export was only under licence. Imports were affected by the same difficulties.

B. The Post-war Boom and Subsequent Depression

The repatriation of soldiers after the War, and an increase in the marriage rate from 5·65 per 1,000 in 1918 to 10·21 per 1,000 in 1920 led to a marked increase in the demand for houses. House construction was stimulated also by generous financial assistance by the Government to returned soldiers, the expenditure of deferred military pay, high wage rates, and a general feeling of prosperity. The Government also stimulated a building boom by the expansion of its activities under the State Advances to Settlers on particularly generous terms as regards security.

At the same time, arrears of construction for industrial and commercial purposes were made good, and a general condition of business prosperity and speculative activity encouraged the expansion of plant and premises. Financial accommodation to builders was available almost without reserve. The shortage was quickly made good, and building operations showed a tendency to slow down. This movement became accentuated after 1925, recovered somewhat in 1929, and thereafter gathered a very rapid momentum until, at the present time, building is almost at a standstill.[12]

12. The following figures, showing the increase in unemployment in the building trades, throw some light on the position:—

APPLICANTS ON REGISTER OF GOVERNMENT EMPLOYMENT BUREAU

Date	Building Trades	Total	Building Trades as Percentage of Total
8/12/1930	1,014	9,630	10 5
8/6/1931	4,768	43,453	10.9
7/12/1931	4,939	47,096	10.6
13/6/1932	6,589	54,122	12.2

XI. FUTURE PROSPECTS

Some recovery in building activity seems likely to take place in the immediate future, when repairs and renewals can no longer be deferred, though any substantial recovery must await the return of business confidence and prosperity.[13] Of more interest from the point of this study are the long run prospects.

A. Prospective Shortage of Indigenous Timber

Both the domestic demand and the New Zealand output fluctuate considerably from year to year. Nevertheless there is no reason to assume that domestic demand will decline in the future. On the contrary, there is reason to expect an uncertain, but appreciable expansion as population increases. Despite the rapidly increasing use of ferro-concrete and other building materials, all but a small proportion of houses are built of wood. With increasing population, requirements for this purpose, for scaffolding, panelling, floors, posts, boxes, crates, furniture, paper and other wood products can scarcely fail to increase. New Zealand is faced, therefore, with diminished timber resources and a demand which is not likely to be permanently less than the present demand, and which is likely to be greater. Even if the export surplus is diverted to meet New Zealand needs, our present resources cannot be regarded as adequate for all time. Writing in 1923, the Director of Forestry stated: 'It is apparent that this country's annual consumption of forest products is greater than its net annual increment by several million cubic feet. This deficit can only be satisfactorily met by a speed-up in utilization efficiency or by an increased increment production; otherwise the usable supplies will be exhausted in from thirty to forty-five years.'

B. The Prospective World Position

This is a matter on which there is considerable difference of opinion. Firstly, the world's supplies are by no means definitely known. The forests of Siberia are known to be very extensive, but the area of merchantable timber and the stand are not known with any degree of accuracy. Secondly, though the world's present consumption is fairly accurately known, it cannot be said to what extent new inventions, such as the fabrication of boards from disintegrated wood, will cause a saving in the consumption of the raw material, and on the other hand, it cannot be said to what extent chemical discoveries will bring about an increased use of wood. Thirdly, the soft hardwoods—the quantity of which there is no reliable information on—of the extensive tropical forests are likely to gain a wider use as substi-

13. Some recovery took place in 1933 largely as the result of subsidies to building made by the Unemployment Board.

tutes for true softwoods. Fourthly, the extended application of silvicultural management to American and Canadian forests will minimize waste and should secure a sustained reasonable yield from the permanently reserved forests.

However, that a serious world-shortage of softwoods—they form about 85 per cent. of the total world consumption—will occur in less than forty years' time is the opinion of most competent authorities, both British and American. Fraser Story, writing on the subject in the *Empire Forestry Journal* (Vol. 8, No. 1, 1929), says: 'The estimated stand being about 985,000 million cubic feet and the annual drain about 25,700 million cubic feet, it follows that, at the present rate of consumption, very little will remain of the accessible virgin forests of the world forty years hence.'

The calculation does not take into account increment of second-growth conifers in the intervening years, but the amount of this cannot in any case affect results appreciably, and new forests from artificial formation will, for the most part, be immature at the end of the period indicated.

Assuming that second-growth and reafforestation from now onwards make satisfactory progress, there is still the danger of an awkward gap between the virtual exhaustion of primeval forests and the time of harvesting the young crops.

C. The Future Position as Regards Imports

Future importations of timber will, of course, to some extent be governed by Government policy. With a view to affording employment in the Dominion the import duty on timber in small sizes has already been made high.

As regards softwoods, the greatest quantity imported comes from the western States of the U.S.A.; but Canada is making a strong effort to capture this trade. However, if the predicted shortages in the United States and Canada occur, these countries will not have a surplus to export. The eastern regions of Canada and the United States are already drawing heavily on the supplies of their western regions, and they could readily absorb the surplus of European production. The inaccessibility of Siberia would probably prevent its timber being produced at a low enough price to admit of its being able to profitably stand an import duty in New Zealand. In the circumstances, therefore, it is a matter of national importance that New Zealand grow her own requirements of softwoods, even if tariff policy should be modified.

As regards hardwoods, the position is different. Australian hardwoods are of high quality for railway sleepers, electric line poles, bridge and wharf construction. The importations are mainly for Government and local authority purposes. No indigenous timbers of equal value now exist

in sufficient quantity to compete, without preservation treatment, with these Australian hardwoods. On the other hand, supplies of mature timber of the best species are getting comparatively scarce in Australia, and within a few years that country will probably have little first-class material beyond her own requirements.

There appear to be sound economic reasons, therefore, for New Zealand to endeavour to make herself independent of foreign supplies of timber, except those required for exceptional purposes. This she is doing mainly by extensive afforestation.

D. Competitive Capacity

In considering the competitive capacity of New Zealand, we must distinguish between the problem of the immediate future and the long run problem when existing plantations mature.

Although some timber imported is not strictly competitive with New Zealand timber, a great deal of it is. In view of the fact that the tariff on imported timber has increased substantially of recent years, and that meanwhile domestic production has declined, the stability of import values affords presumptive evidence of the weak competitive position of the New Zealand timber industry on the domestic market. Whether or not its competitive position will be strengthened as overseas sources of supply are depleted is an open question.

The main overseas market for New Zealand timber is Australia. In technical values New Zealand timbers are well able to compete with the other timbers imported into Australia. Being free of knots they are superior to the Baltic softwoods, though they may be equalled by Douglas fir, western red cedar and Californian redwood from the Pacific coast of America. The chief adverse factor to their more extended use is their cost as compared with Douglas fir, etc. New Zealand timbers have a preferential tariff as against timber from non-British countries; but as Canada enjoys the same preference, the competition of that Dominion for Australian trade will have to be met. The Canadian timbers cannot compete in quality with New Zealand white pine for butter boxes; but whether for other purposes New Zealand timbers can compete with Canadian timbers has to be proved.

The prospects of the timber industry in the more distant future when afforested areas mature are difficult to evaluate with certainty. It is clear that future prospects turn mainly on capacity to export timber products, more especially paper, at a profitable price. The favourable elements in the situation are the anticipated world shortage in softwoods, the increasing use of cellulose products and the phenomenally rapid growth of many exotic species in New Zealand. The areas under planted forests are also

sufficiently large to permit of large-scale operations, which should be conducive to the economical operation of pulping mills, provided that the necessary skilled direction and labour are available. On the other hand, labour costs are high, and it will be necessary to build up marketing organizations and establish trade connections. New Zealand is also remote from large markets, except the Australian market. Some of the larger afforestation companies no doubt offer reasonable prospects of commercially profitable operation, but the future is not likely to be free from serious problems. Many of the concerns are too small to be able to operate a mill successfully, and they will require to dispose of timber, some of which is inconveniently located, to mills owned and operated by rival concerns.

Some foresters are already uneasy lest fires or pests starting in small, abandoned or inadequately patrolled forests may endanger other areas.

XII. PLACE IN THE NATIONAL ECONOMY

A. General

The timber industry has played a large part in the national economy, and will continue to do so. In the early years of New Zealand's history, timber was the chief export, though the decline has been rapid during the present century. The value of the industry, as an avenue for employment and as a source of raw materials for construction and the wood-using industries, wood pulp and fuel, is perhaps inadequately realized by New Zealanders, while the prodigality with which our timber resources have been used has shocked many overseas observers. In addition the industry has promoted settlement in many areas by enabling the costs of clearing to be wholly or partly met. The industry has also provided a useful source of supplementary income to farmers in many districts.

The depletion of indigenous forests and their increasing difficulty of access, except perhaps on the west coast of the South Island, warrant the conclusion that plantations of exotics will be more significant in the national economy in the future than indigenous forests, though careful forestry may permit of perpetual cropping in existing areas. In this connection timber production only is considered.

There are, of course, other aspects, besides the purely commercial aspects. In many European countries, afforestation has been considered justifiable even though it yielded substantially less than current rates of compound interest. Many of the advantages are indirect; the regularity of stream flow, the minimizing of floods, the avoidance of erosion, the conservation of moisture, the clothing of scarred hillsides with a mantle of beauty. If, as in New Zealand, there is a reasonable prospect that afforestation will be commercially profitable, the case for afforestation is strengthened.

B. Utilization of Land Not Suitable for Farming

There has always been an insistent demand for land in New Zealand, and this demand has been satisfied to a large extent by throwing open for selection areas of land without any previous soil survey or investigation by trained and experienced persons to determine those portions which were suitable for successful farming and those portions which were not so suited. In many cases steep-sided ranges have been cleared of forest with the result that after a few years the cleared land has been a succession of landslides with alternating strips of bracken or scrub. The original occupant of the farm has lost his capital and wasted several years in useless effort, valuable protection forest has been uselessly destroyed, and the streams of the adjacent plains have had their beds so raised by the detritus brought down from the eroded hills that the fertile lowlands are made subject to floods and the deposition of shingle. Now that such lands are denuded of forest, they should, in the interest of national economy, be re-forested, although in many cases soil deterioration has gone so far that re-forestation is not likely to pay the cost. There is also the case of the settlement of lands on which, through some chemical soil deficiency or excess, stock cannot be kept in a state of health. Such lands should be used for forestry. Finally, there are the pumice lands and sand-dunes. The former of these classes can often, when arable, be successfully farmed, but broken pumice country cannot be so used and should be used for afforestation. There is, in New Zealand, a very large area of sand-dunes, and the most of this area cannot be profitably used for farming; and though their reclamation is a very expensive matter, some could be handled successfully. Some land should be reserved for amenity and pleasure purposes; some mountain-tops are too rocky and high to be used for any productive purpose; some swamp lands are undrainable; but as a general rule, it can be said that no land should be non-producing. The poor lands previously referred to should be used for forestry and the production of timber.

C. Utilization of Land Suitable for Farming

A country should produce its own timber supplies. If every acre in a country could be used for cropping or grazing, still some areas should be reserved for the production of timber. An examination of topographical plans of the country surrounding Paris in France and the Lower Rhine region in Germany will show that even in these most thickly populated areas, where land has a high value, a large proportion is devoted to forestry. Some of the French forests come within the municipal area of Paris.

The saving of freight charges on the carriage of timber and the procuring of abundant and cheap labour are two very important factors in the growing of timber. If forests, such as those referred to in France

and Germany, are close to population centres, freight charges are saved, cheap and abundant labour—women and children can be used in some of the work in forest plantations—is available when required, minor forest produce such as thinnings, etc., can be readily sold, and subsidiary industries such as the making of wood-wool, wood-distillation, etc., can be profitably carried on. Taking the poor with the good forests in Germany, forestry gives employment to one family for about every 130 acres of the forest. Forests near cities are also of value as pleasure resorts.

From the foregoing, it will be seen that even land which is suitable for farming should in some cases be used for forestry and the production of timber. On such land the expectation of financial profit from forestry is fully justified.

D. Plantations Ancillary to Farming

On farms, shelter and timber are essential. It has been proved beyond dispute that shelter belts of trees enable crops to be grown and stock to be reared more successfully than without such shelter. On farms there is a large use for wood for fencing, buildings, and fuel. By the growing of trees as shelter belts, in addition to increasing the productivity of the farm by the shelter afforded, all the farm requirements of wood can be supplied.

The aggregate production for the State of such timber would be very large.

On farms, also, there are generally some areas of poor land, and on such, timber trees can profitably be planted. Eucalypts and *Cupressus macrocarpa* grown on such land could be profitably sold as telegraph and telephone poles, small bridge piles, scaffolding, etc. In South Africa, the Match Company arranges with farmers for the growing of poplars for the supply of match-making wood.

In addition to the foregoing advantages, tree plantations on farms make them far more attractive and in this way enhance their value.

E. Relation to Employment

It has already been stated that in Germany forestry supports one family for about every 130 acres of average forest. The only other land-use which could compete with this is dairy farming, but on land used for forestry, dairy farming would not be economically possible. For some years the afforestation operations of the British Forestry Commissioners have given valuable relief by using unemployed labourers, and the State Forest Service in New Zealand has for several years absorbed a large number of the unemployed. Relief is given mainly in the winter months when it is most needed. Tree planting in New Zealand ceases at the end of spring, but a considerable number of labourers have to be kept on for road-making,

clearing firebreaks, and other maintenance items. There is now a tendency to restrict State afforestation operations, but the thinning of the established plantations will have to be seriously taken in hand, and that operation will employ a large number of men. By employing the unemployed in establishing forests the State will create an asset which will in later years yield a valuable return; whereas much of the work which has been, and is being done by the unemployed is work which will have no permanent value and is often wasted effort.

F. Protection Forests

Protection forests retard the run-off of water from hillsides and thus lessen the height of floods and the damage done by them. They very much lessen the number of landslips and erosion with its consequential raising of the lowland stream-beds which causes the streams to leave their courses and wash out new ones. On rocky hills, they prevent loose rocks and shingle from gradually rolling down on to the cultivated lowlands. The roots of the trees and shrubs in protection forests help the rains to penetrate to the lower strata of earth and thus to maintain the continuous flow of springs. Protection forests tend to modify the force and temperature of winds which pass over them. In addition to performing these important functions, they are of value for the production of a certain amount of timber, firewood and fencing material. In time, by the introduction of some exotics in suitable places into them, these forests may be made to yield a substantial amount of first-class timber.

G. Forests for Recreational and Amenity Purposes

In New Zealand a large area of land in different parts has been permanently reserved as 'scenic reserves' and 'National Parks.' By the legislation under which these reserves are made, cutting down the vegetation, lighting fires, the killing of native birds, and trespass of stock are offences punishable by heavy fines. Owing, however, to inaccessibility, many of the reserves get little or no supervision. In some of them, deer have become very numerous and are destroying the shrubs and young trees. Though the efficient care of forests can be obtained only by men who have a sound knowledge of forest requirements, these reserves do not come under the administration of the State Forest Service.

The highly interesting and valuable Waipoua Kauri Forest Reserve, since a good road has been formed through, already attracts many visitors who go there to see the groves of this truly magnificent tree. As the forests in the Dominion get cleared, those which have been reserved near cities are becoming more and more holiday resorts for members of tramping clubs and others who delight in wild nature.

Now that the trees in the State Forest plantations at Rotorua are attaining a considerable height, visitors are beginning to go to them, especially to those which border the lakes which make views of great beauty.

The forests of European countries have always drawn large numbers of local and foreign tourists and there is reason to expect that the forests of New Zealand will do the same. In fact, they have already started to do so, for it is mainly the forests which make the scenery on the road from Hokitika to the Franz Josef Glacier unsurpassed by anything of its kind elsewhere in the world.

Bibliography

The Bibliography relating to this chapter will be found in the Appendix.

PART IV

PROCESSING AND MARKETING

Chapter XXVIII

GENERAL SURVEY OF MARKETS AND PRICE MOVEMENTS

By D. O. Williams

I. Analysis of Markets—A. Internal and External Markets: 1. General; 2. Particular Commodities—B. Destination of Products: 1. Sheep Products; 2. Butterfat; 3. Pig, Cattle and Calf Products—C. Characteristics of Markets: 1. Local; 2. Export—D. Main Competitors: 1. Lamb and Mutton; 2. Beef; 3. Frozen Pork; 4. Cheese; 5. Butter; 6. Wool—E. Quotas. II. Price Movements—A. General Trends and Their Effects—B. Prices of Particular Commodities.

I. ANALYSIS OF MARKETS

A. Relative Importance of Internal and Export Markets

1. *General*

A useful approach to the analysis of markets has been made by Professor A. H. Tocker.[1] The classification of industries suggested is as follows:

(a) *Unsheltered Industries.*—Those which sell the bulk of their production in overseas markets where world competition is met and which must therefore accept world prices. The major pastoral industries of the Dominion fall into this category.

(b) *Wholly Sheltered Industries.*—Those whose product cannot be either exported or imported but must necessarily be produced at or near the consumption point; and those which are protected from overseas competition owing to heavy costs of transport. 'Neighbourhood' industries such as internal transport, distributive services, building, repair work and the provision of heat, light and power are one type, while stone and clay goods illustrate the other.

(c) *Semi-sheltered Industries.*—These are secondary industries producing for the local market, and partly protected from overseas competition by tariffs.

Only in the case of the first group does the question of an external market arise. The semi-sheltered and wholly sheltered industries have no direct interest in the overseas market; but are, nevertheless, concerned through the repercussions which the marketing of unsheltered products may have upon them. They serve a local market which, in a time of stable prices and stable tariff policy, is expansible only through the growth of population.

Such a condition of stability seldom exists. The normal condition to which we had grown accustomed in the first two decades of this century was one of expanding overseas markets and rising prices for our unsheltered industries. Upon this there supervened in post-war years a condition

1. Report of Proceedings of the National Industrial Conference, 1928, p. 37-40.

of expanding markets with falling prices; and most recently, of markets limited through quota restrictions in company with collapsing prices. The reactions of these changes on the local market served by the sheltered and semi-sheltered industries have been clear enough. Their contraction and expansion has followed upon the contraction or expansion of net farming income as influenced by overseas economic conditions; and the influence of these overseas price and market conditions has been more important than changes in the size of the local population.

The direct force with which external conditions strike at our whole national economy is due to the facts that our primary products represent so large a proportion of our total national income; that with our major farming products the greater proportion is exported; and that the price of that portion which is locally consumed is directly related to the overseas price. Hence a rise or fall in external prices affects the whole output, locally consumed as well as exported, of our main farming products; and by repercussion affects the demand for the products of other industries.

Estimates of total national income as well as of the value attributable to any industry are subject to fairly wide and obvious errors, but over a period of years the main argicultural and pastoral industries have been reckoned to contribute something in the vicinity of 50 per cent. of our total national income. Our export trade consists almost entirely of the products of these industries, and the amount exported represents about 80 per cent. of the total pastoral production. Roughly, therefore, about 40 per cent. of our national income is directly exposed to external price movements. Since, however, the local market for pastoral products is highly responsive to changes in the external market, practically the whole of the income derived from these sources varies directly and proportionately with changes in external prices.

2. *Particular Commodities*

The extent to which farm products depend on the external market is shown in the accompanying tables, all of which are expressed in terms of standard units.[2]

The final column shows that on the average of the six years, the external market has absorbed about 87 per cent. of the main products of the sheep industry. The overseas proportion in the case of lamb works out at about 93 per cent.; for mutton, at about 54 per cent.; and for wool (allowing for possible errors in calculation) at about 95 per cent. With lamb the external market has, since the beginning of the century, grown much more rapidly than the local market; with mutton the proportion sent overseas is not much greater than in 1900; while with wool no apparent change has occurred.

2. For a full account of the method see N.Z.O.Y.B., 1929, pp. 990-2. Special Article by E. J. Fawcett.

TABLE CXXXVI

Total Production and Export of Sheep Industry Products
(Exclusive of By-products and Live Animals)
(in standard units)

Year	Total Production				Exports				Approx. % of Production Exported
	Lamb	Mutton	Wool	Total	Lamb	Mutton	Wool	Total	
1927–28	598	370	1,313	2,281	580	222	1,279	2,081	90
1928–29	620	350	1,242	2,212	587	192	1,285	2,064	88
1929–30	664	399	1,090	2,153	628	197	1,060	1,885	78
1930–31	820	426	1,285	2,531	782	258	1,253	2,293	89
1931–32	883	523	1,414	2,820	757	234	1,274	2,265	86
1932–33	985	436	1,442	2,863	906	235	1,605	2,746	96
Totals	4,570	2,504	8,247	15,321	4,240	1,338	7,722	13,300	87

In the case of the products of the dairying industry a similar calculation has special difficulties.[3] The figure for total production is that given by Fawcett, except for the years from 1930-31, while the export figures include butter, cheese, dried milk and preserved milk.

TABLE CXXXVII

Total Production and Export of Butterfat
(in standard units)

Year	Total Production	Export	Percentage of Total Production Exported
1927–28	1,651	1,300	79%
1928–29	1,807	1,465	81%
1929–30	1,963	1,615	82%
1930–31	1,900	1,630	86%
1931–32	2,122	1,761	83%
1932–33	2,480	2,083	84%
Totals	11,923	9,854	83%

Butter and cheese are the major items in the dairy exports and represent, on the average, about four-fifths of the total butterfat produced in the Dominion. There is a substantial difference, however, in the relative dependence of butter and cheese on the external market. About 95 per cent. of the cheese output is sold overseas, while in the case of butter the proportion is somewhat under 80 per cent. In both cases the export markets have claimed an increasing proportion of the total output since the beginning of the century when only half our butter, and about three-quarters of our cheese were marketed outside the country.

3. 'In the absence of records of such items as milk and cream consumption per capita, whole-milk fed to calves, losses, etc., estimates are necessary to fill in the blanks. This work was gone into very thoroughly and may be accepted as reliable.'—Fawcett, in N.Z.O.Y.B., 1929, p. 991.

A third class of primary products, pig, cattle and calf products, shows a much greater dependence on the local than on the external market:—

TABLE CXXXVIII

Total Production and Export of Pig, Cattle and Calf Products (in standard units)

Year	Total Production				Exports				Per cent. of Total Production Exported
	Pigs	Beef	Veal	Total	Pork, Bacon, and Ham	Beef	Veal	Total	
1927–28	124	235	8	367	32	51	1·5	84·5	23
1928–29	129	205	20	354	41	52	3	96	27
1929–30	132	184	22	338	39	34	3	76	22
1930–31	125	167	28	320	38	29	4	71	22
1931–32	121	165	30	316	26	23	6	55	17
1932–33	148	202	31	381	47	45	4·5	96·5	25
Totals	779	1,158	139	2,076	223	234	22	479	23

For these products the local market is four times as great as the external market; but they are relatively so much less important than the sheep and dairy products that our aggregate dependence on overseas conditions is not greatly lessened.

This position may be shown by grouping all these classes together:—

TABLE CXXXIX

Total Production and Export of Sheep, Dairy and Pig, Cattle and Calf Products

(in standard units)

Annual Average, 1927-28 to 1932-33

Total Production				Total Export				Per cent. of Total Production Exported
Sheep	Dairy	Pigs, etc.	Total	Sheep	Dairy	Pigs, etc.	Total	
2,553	1,987	346	4,886	2,217	1,642	80	3,939	81

The conclusion is that, excluding minor items, something like 80 per cent. of our pastoral and dairy products are sold overseas. This result is probably accurate within a few per cent. An independent approach to the problem using the known annual values of exports and assessing the value of the local market by means of wholesale index numbers, gives not only an identical final result but places the various commodities in the same order of relative importance.

Tabulated, the relative importance of the products listed is as follows, taking the annual average for the six years:—

TABLE CXL

Relative Importance of Main Primary Products
(Based on standard units)

Commodity	Per Cent. of Total Production	Per Cent. of Export
Lamb	15·7	17·8
Mutton	8·5	5·7
Wool	28·1	32·7
Butter and Cheese	40·6	41·7
Pigs, Cattle and Calf Products	7·1	2·1
Totals	100·0	100·0

As these commodities represent about 90 per cent. of our exports, they dominate the external trading situation.

B. DESTINATION OF PRODUCTS

1. *Sheep Products*

There is no stable market for New Zealand lamb or mutton outside the United Kingdom. In the period since 1920, about 99½ per cent. of our lamb and mutton exports have annually been sent direct to the United Kingdom and the re-exports have been small.

Wool is the only pastoral commodity with important export markets outside the United Kingdom. It is probable that about half our exported wool finds its way to other than the United Kingdom market.[4]

2. *Butterfat*

In recent years the United Kingdom has taken about 85 per cent. of our exported butter and re-exported very little of it. The trend shows an increasing share marketed in the United Kingdom and at present there is practically no other market. In some years both U.S.A. and Canada have taken important shipments, but not recently. Practically all our exported cheese is sold in the United Kingdom.

3. *Pig, Cattle and Calf Products*

The United Kingdom takes 95 per cent. of the frozen pork exported; 98 per cent. of the frozen beef, and about 80 per cent. of the veal. In all cases, the proportion in recent years has shown an increasing tendency. In these products the local market is very much more important than the export, and the share of the total production taken by the United Kingdom is little more than 22 per cent.

As shown in Table CXXXIX, over 80 per cent. of our total production of these commodities is sold overseas. The local market absorbs barely

4. See Chapter XXXI.

10 per cent. of the sheep products and 18 per cent. of the dairy products; but takes about four-fifths of the pig, cattle and calf products.

Of our markets, the United Kingdom is dominant, taking over two-thirds of the total output, or about three and a half times as much as is locally sold. Overseas markets outside the United Kingdom are in the aggregate equal to the local market; but this is due mainly to the importance of European, American and other purchases of wool. In the case of dairy produce and of pig, cattle and calf products, the overseas markets other than the United Kingdom are very small and show a declining tendency. In no case, except wool, has New Zealand at present an important and reliable external market outside the United Kingdom.

C. Characteristics of the Markets

1. *Local*

The per capita local consumption of meat is very large. In our meat diet, beef is the most important item, with mutton next, pig products third, and lamb last. The annual average consumption per head is given[5] approximately as: beef, 109 lbs.; mutton, 90 lbs.; pork, bacon and ham, 18 lbs.; lamb, 16 lbs. The present lamb consumption is much below the normal of prosperous years. There is a marked tendency in New Zealand, even in good years, for consumption of the relatively dearer meats to decline, partly for private economic reasons and partly because the local market tends to be a residual claimant.

The local per capita butter consumption has risen steadily in this century and now stands approximately at the high figure of 40 lbs. Cheese consumption, though higher now than is usual, is still comparatively low at about 7 lbs. No reliable estimates for whole milk consumption are available, but it is believed to be small compared with that of certain Scandinavian countries and the U.S.A.[6]

2. *Export*

Overseas, '. . . there is a downward trend in beef consumption, and a swing over to pork and mutton, both in countries which normally consume more beef than pork, and in those where pork is always the more popular meat—chiefly North America, Germany and some other countries of Northern Europe.'[7] This decline followed on a great Continental increase in beef consumption in the early post-war years and has to a large extent upset the anticipations of a growing Continental market that were then held.[8] Imports of beef by all Continental countries have declined since 1926, in some cases quite substantially. More recently a smaller decline has also occurred in the United Kingdom importations. The result of the

5. N.Z.O.Y.B., 1935, p. 663.
6. New Zealand's per capita annual consumption is probably about 22 gallons per head as compared with about 55 (American) gallons in U.S.A. and about 60 gallons in some Scandinavian countries.
7. E.M.B., Meat, July, 1932, p. 8.
8. Ministry of Agriculture and Fisheries, Ec. Series No. 6.

Continental contraction was to throw the main weight of international trade in beef back on to the English market, which, however, was unable to support it and eventually had to resort to quota restrictions. It now takes about 80 per cent. of the the world's beef trade.[9]

In the case of mutton and lamb, the United Kingdom takes about 94 per cent. of the amount that enters into international trade. The French market, though increasing, is small, while Germany's imports have fallen away to almost nothing.[10] A similar position has arisen in the case of bacon and ham. The United Kingdom buys 95 per cent. of the world's exports, the subsidiary markets showing signs of contraction.[11] For all intents and purposes the present overseas meat markets mean the United Kingdom. Increasing production in primary countries has, therefore, been directed on to a narrower consuming front. The reversal of early post-war tendencies towards a wider European market has been due partly to greater self-sufficiency of production stimulated through tariffs and quotas and partly (probably mainly) to the pressure of standards of living.

Normally the two main markets for exported butter are the United Kingdom and Germany, which prior to the present crisis took over 90 per cent. of the butter entering world trade. The share taken by the former has increased greatly in the past few years but Germany's imports have declined. The meat situation is paralleled here: increasing production has more and more been concentrated on a single market. In the case of cheese, which is of many varieties, the United Kingdom imports about half the amount internationally marketed. Europe as a whole is an important buyer but not of the sort that New Zealand produces.[12]

The broad present tendency of overseas markets is towards contraction. Under the pressure of a universal crisis, industrial countries are tending to seek work for unemployed by developing allotment and small farm schemes which help to promote greater self-sufficiency and therefore less dependence on importations. The market adjustments which exporting countries can make are not at all clear. A diversion from export to local consumption implies a definite modification of our existing economic structure which could not be made very rapidly. A retention or an increase of our share in a restricted overseas market means an economic war in which we succeed only if we can cut our costs more rapidly and dramatically than our competitors. So long as present overseas markets remain at saturation point, or until new markets can be established, or unless production adjustments directed towards diversification can be made, there are no other means by which an expanding production can be absorbed. Both new markets and an increased consumption capacity in

9. E.M.B., Meat, July, 1932, p. 3.

10. Ibid., p. 23.

11. Ibid., p. 31.

12. A full account of trade policies affecting dairy produce is given in the Dairy Industry Commission's Report, 1934.

present overseas markets are likely to wait upon world recovery, but production adjustments are possible through rationalization.[13]

While this is the general situation there are, nevertheless, particular lines of exploration which should be undertaken. A definite obscurity prevails as to the particular requirements of our customers. It was possible a few years ago to indicate clear differences between the requirements of, say, the North of England and the South in regard to cheese, butter and meat.[14] In some cases these differences are less clear now than formerly. Some old prejudices have lost their edge, if they have not entirely disappeared. Other unsuspected differences appear to be emerging; but the evidence we have is too scanty and unrepresentative to be of much value. There is a definite need for a technical-economic survey of the various markets in England and elsewhere by a body which can reach the ultimate consumer and which possesses technical knowledge of our production possibilities. Such a survey might well reveal important possibilities of diversification in such a product as cheese, for instance, or suggest practicable changes in wool production, etc. Within an unchanged general situation, particular adjustments might result which would have beneficial reactions on price. At present, we labour in much ignorance and do little to mend our ignorance. But if we intend seriously to find some escape from an intractable quantity position, we must convert ourselves to a religion of quality and of market specialization, and this calls for a knowledge of our customers' requirements far more detailed and accurate than anything we possess at present.

D. Main Competitors

1. *Lamb and Mutton*

New Zealand is the most important external supplier of the United Kingdom's lamb and mutton requirements. In recent years about half the total imports of lamb and mutton have come from this country. South America is next in importance, with Australia third. In the last decade we have tended to increase our lead over South America and to maintain it over Australia. All these countries sell predominantly on the United Kingdom market. France is the only Continental country which at present is not entirely negligible as a market, but it is very small compared with the United Kingdom market and is served chiefly by Argentina and Uruguay.

Our biggest competitor, however, is the English farmer, not the rival exporter. United Kingdom lamb and mutton from 1926 to 1931 constituted about 45 per cent. of the total supplies, while New Zealand's share has, in the same period, been about 29 per cent.

13. See below under Section 4, quotas.
14. Report of Imperial Economic Committee, 1926—Dairy Produce, p. 92.

2. *Beef*

Our proportion of the total supplies is so small as hardly to constitute a competitive factor. Although all labelled 'beef,' the fresh beef from home farms and the chilled beef from South America, fall into categories separate from the frozen beef of New Zealand. South America dominates the importing market; but the supplies of home-grown beef are greater than the aggregate importation of chilled and frozen beef. For us, the hope of expanding the importance of our beef exports rests primarily on the possibilities of chilling.

3. *Frozen Pork, etc.*

New Zealand is the chief supplier of frozen pork to the United Kingdom. In 1932 approximately 40 per cent. of the importations came from this country. In total quantity there has been a large increase in our exports to the United Kingdom since 1925, although there have also been marked annual fluctuations. The United States, which as recently as 1925 dominated the market, has fallen away rapidly and now occupies fourth place. Latterly there has been a big increase in the amount received from South America, which now ranks next to New Zealand. Australia comes third with a supply which fluctuates considerably.

Frozen pork is a small but increasing proportion of the total imports into the United Kingdom of pig products. Bacon and hams account for about 90 per cent. of the total imports. New Zealand is the smallest supplier of this trade. We do not enter as a competitor into the salt pork trade nor, of course, into the fresh pork market.

The United Kingdom is again an important supplier of her own market. Her estimated pork production, 1925-26 to 1930-31, averaged 5,257 thousand cwts., which is about 30 per cent. of all supplies, home-grown and imported.

4. *Cheese*

In 1933, New Zealand supplied 68 per cent. of the cheese imported into the United Kingdom, and so maintained her position as chief supplier. In the last decade our lead over our only important competitor, Canada, has increased substantially. Ten years ago, Canada supplied a third and New Zealand about half the import requirements; but the quantity supplied by Canada has steadily declined until now her contribution is about one-fifth of all imports. The United Kingdom's own production of cheese is not accurately known at the present time. The Dairy Industry Commission 1934, gives a tentative figure of about 57,000 tons of farm and factory cheese for 1930-31, which would be about one-fourth of the total market requirements and about half New Zealand's present supply.

5. *Butter*

New Zealand ranks almost equal with Denmark in the supply of butter to the United Kingdom, with Australia close behind. In 1933, Denmark supplied 28·5 per cent., New Zealand 28·4 per cent., and Australia 19·2 per cent. of the total imports. Denmark's proportion shows a decline of about 8 per cent. since 1923-4, while New Zealand's has risen by about 7·5 per cent. and Australia's by about 8 per cent. in the same period.

All three countries find the United Kingdom their chief market; but Denmark has also important Continental outlets which as yet are of relatively little value to either Australia or New Zealand.

It would be wrong, however, to suggest that in the United Kingdom the whole of the Danish supply competes actively with the whole of our (and the Australian) supply. Broadly, we sell mainly in the South of England while Denmark sells mainly in the areas from the Midlands northward. 'Thus, it is only the fringe of the Danish trade which actively competes with our butter, and the increased production of New Zealand and Australia has to be absorbed by rather less than half of the British population.' The successful invasion of the specialized Danish marketing territory would require a continuous supply of butter throughout the year; and would also require either that these potential customers acquire a taste for our butter-flavour or that we produce a butter with the flavour to which they are accustomed. Of the two, the latter is likely to be less difficult; but raises problems of cream collection, processing and farm production which may materially modify our present dairy organization.[15]

6. *Wool*

Argentina is the only country of greater importance as a grower and seller of cross-bred wool. South America as a whole provides about one-third of this type of wool and South America and New Zealand together supply most of the cross-bred wool entering the world's markets. Each country sells the overwhelming bulk of its production overseas, mainly in the United Kingdom and Europe. In recent years the increase in production has been of much the same order in Argentina and New Zealand, but Uruguay (though still producing less than half the New Zealand clip) has grown more rapidly. In post-war years there has been a marked increase in the relative importance of Europe and the East as buying units. If the decline of Bradford as a consuming centre is more than temporary, the change in demand thus brought about may eventually have important repercussions on sheep breeding problems in New Zealand.

15. *Problems of the Dairy Industry*, by Riddet and Marsden, May, 1933. See also Dairy Industry Commission's Report, 1934, para. 206, where various conflicting points of view are expressed.

E. Quotas

For fifty years New Zealand has built up its economic life on the assumption of expanding external markets. Refrigeration gave us access to what was supposed (quite reasonably) to be an unlimited outlet for primary products. The Ottawa Conference recorded the fact that, for sometime at least, we would have to organize our production to meet an inexpansible English market. By agreement, our exports of mutton and lamb to the United Kingdom were quantitatively regulated as from 1933; but no limitation was imposed on dairy produce. Until the Ottawa Agreement expires in 1935, New Zealand has the right to export any quantity of butter and cheese to the United Kingdom; but thereafter supplies may be regulated by the British Government.

In the meantime the suggestion has been made that we agree voluntarily to a butter quota at once. The controversy aroused by this proposal has brought forth two competing views: one, that our choice lies between regulation through a price-war or regulation through conscious control;[16] the other, that the problem is essentially one of better organization within the industry aiming at higher quality products, the evening out of seasonal supply, greater diversification of milk products, more specialized production to meet the requirements of specialized markets and an exploration of additional markets.[17] These two views are far from being as divergent as might at first appear, for the application of the quota to butter would inevitably promote most of the changes enumerated. The distinction lies, not in the ultimate results, but in the type of authority producing these results. In one case the results would follow upon the detailed regulations issued by an authority external to the industry; in the other, from an internal rationalization of the industry. Whatever decision is made upon the problem now, it is evident that enforced restriction would lead to important changes in the internal structure of New Zealand dairying. On the side of organization there should emerge a genuinely national body capable of applying a national, long-range policy to the industry. To meet the requirements of special markets it may prove necessary to develop all-the-year-round dairying and to re-organize the whole of the cream collection services; and to develop on a commercial scale a wide variety of milk products of high quality.[18]

II. PRICE MOVEMENTS

A. General Trends and Their Effects

After the initial period of distress and insecurity which accompanied the earlier years of organized settlement, New Zealand participated in the

16. See *A Butter Quota or a Free Market*, by the Rt. Hon. J. G. Coates, May, 1933.
17. See *Problems of the Dairy Industry*, by W. Riddet and E. Marsden, May, 1933.
18. The problem is more fully discussed in the Dairy Industry Commission's Report, 1934, paras. 68 to 71, 275 and 296.

rising prices associated with the gold discoveries. Since the bulk of our export trade in the 'fifties went through Sydney, we benefited directly from the Australian discoveries. The increasing demand at higher prices for food-stuffs was particularly strong and gave a greater emphasis to agricultural than to pastoral products and materially assisted in the temporary progress of the farmers in the Wakefield Settlements. The discovery, in the 'fities and 'sixties, of gold in Nelson, Otago and Westland reinforced this process and brought a rush of immigrants to the country.

When this short-lived boom had died down, New Zealand faced a long period of depression lightened only by the spectacular price-rise in the 'seventies during Vogel's administration. From the late 'seventies until the mid-nineties we shared in the world-wide fall in prices. Although this was one of the most critical phases in our history, it saw the beginnings of new industries and new markets. The success of refrigeration in the 'eighties eventually enabled us to build up an economy based on the exportation of primary surpluses to distant and (apparently) unlimited markets. The period from 1895 to 1920 is the one that clearly defined our economic structure.

Prior to refrigeration our chief exports had been wool, gold and agricultural and forest products. After refrigeration, pastoral products assumed a dominating place in our exports and soon dwarfed the products of mining, agriculture and forestry. This process, begun in response to a technical invention, was accelerated by the development of co-operative processing in dairying, by the expansion of overseas markets, and by the support of a steadily rising price level.

Too little prominence has been given in New Zealand to the importance of the part played by rising prices at a time when new industries, dairying and meat, were struggling for existence. Particularly in the case of dairying has the price factor been neglected. The more apparent influences of factory development, mechanical aids and transport have received a full enough recognition. But it was undoubtedly a matter of great importance that these advances should have been reinforced by a world-wide recovery in prices. The rate at which the new pastoral industries grew was not possible in an unfavourable price-situation; and after all, it is the rate rather than the fact of development which is of main economic significance.

The characteristic outward features of this period were expansion of farming area as well as greater diversity of exportable primary products. In fact, it can be said that the phase of land settlement expansion came to an end with the cessation of the upward trend of prices. From 35 million acres at the turn of the century, the area in occupation increased to over 43 millions by 1920. Since then, under falling prices, the broad tendency has been in the direction of contraction. Moreover, the later expansion

phase was accompanied by a growth in more intensive forms of farming once dairying in particular had become important.[19]

It was in response to the same underlying processes that legislation during this period became active in promoting closer settlement. Closer settlement became more plausible as an economic theory and as a State policy only when more intensive types of farming became profitable. The revolt against land-aggregation had little practical point so long as wool was our chief pastoral export; but once a favourable price situation converted technical advances into economic realities, closer settlement became both possible and desirable and the need for a new land policy more urgent.

The dominating idea was to make the land available. Although most of the best land was already owned in freehold, it was hoped that the normal processes of subdivision would be accelerated by penal taxes against the larger estates and by State assistance in purchase and by State development finance; while generous terms for State leases or for purchase on deferred payments would encourage the pioneering of new territory. The optimism engendered by rising prices and by markets indefinitely expansible promoted an increasing generosity in State farming finance and tenurial conditions. The increase in the maximum sums made available and the decrease in the margin of equities required on the financial side; and the eventual convertibility of practically all leases into freehold on the tenurial side, were the two developments which, in the final phase of the upward thrust of prices, most surely fostered the hectic land boom of the war and early post-war years.

The optimisms thus expressed in State activity were, of course, largely a response to the urgent expansionist desires of farmers themselves. Steadily rising land values, coupled with one of the easiest systems of land transfer in the world, established a virile tradition of farmland trading and speculative dealing in properties. The stream of private finance seeking investment, and the competitive finance of banks and stock and station companies were all caught up in the same process of expansion, inflation and mortgage speculation.

Rising prices, then, were associated with and to some extent responsible for an extended area of occupation, a growth in intensive forms of farming, the development of tenures aiming primarily at ownership, a notable acceleration in the rate at which properties were transferred, easy, sometimes lavish, State and private finance, and land values inflated mainly through mortgage increases. There was an enormous increase in the volume and a large increase in the value of pastoral and other farm products. With prosperity came also a ready adoption of mechanical aids to farming and a marked increase in the per capita output of labour.

19. See Dairy Industry Commission's Report, 1934, para. 10.

In the period since 1920 falling prices have been associated with two distinct attitudes of mind. So long as there was no visible limit to the absorptive power of overseas markets, the dominant idea was to increase production as much as possible in the endeavour to offset lower prices by larger turnover. This policy carried conviction because it was universally believed that the price decline was no more than an irritating interruption to the only process which the modern generation of New Zealand farmers had known—upward-moving prices. In its later impact, however, the fall in prices became so severe and appeared to be so prolonged, that notions of what was 'normal' underwent revision. At this stage, the main brunt of the crisis was borne by the sheep industry, dairy produce being relatively immune. A gradual conversion of properties from sheep to dairying began but had not been carried far before dairying, too, was afflicted. When it was proposed to add quota restrictions of butter to quota restrictions of meat exports, New Zealand realized for the first time that the era of happy-go-lucky expansion was over.

In the meantime a decade of unstable prices with a falling bias had struck at the marginal lands which had been profitable enough in the boom years. The total area of occupied land contracted; but under the stimulus of the ideal of large turnover, intensive forms of farming grew apace so that total output increased considerably in spite of the narrowed farming area.

For a long while there was no apparent change in public policy in relation to farming. Falling prices were looked upon essentially as departures from the normal. Extensions of finance, private as well as public, were justified on the grounds that overhead costs were best met by larger output and that a return to 'normal' prices would come about soon enough to close the gap between costs and receipts. Later, when depression was converted into crisis, the problem of finance became much less the expansion of farming and much more the maintenance of farmers. It was at this stage that the weakness of our farming finance was clearly revealed—not its weakness in depression so much as its weakness in prosperity. The competitive energy with which debt had been fostered on the basis of unreflecting optimism, was now seen to be the legator of unbearable charges. It split the country into mortgagor and mortgagee and so raised a class war not dreamed of in the philosophy of Karl Marx. The reduction or suspension of debt by private treaty was supplemented by the establishment of official tribunals to deal with debated questions of principal, and by compulsory reductions in interest.

The volume of unemployment associated with the crisis gave an entirely new emphasis to closer settlement. In our prosperous days, closer settlement was designed to strike a blow at the 'aggregators' and to speed up the occupation of the land. It functioned as intensified occupa-

tion in an enlarging area. The new policy of small holdings for unemployed is unconcerned with breaking up large estates merely because they are large; and it has to function in a contracting area. The new principle underlying the legislation is an emphasis on efficiency of occupation. Any estate, however, large, is immune from compulsory acquisition if it is efficiently farmed.

Although questions of quality and efficiency have always had a prominent place in the discussions of New Zealand farming, they have received much more urgent attention in the post-war years of declining prices. For its part the State has done much to build up research while the industries themselves are now aware as never before of the necessity both for quality production and improved organization. At the moment progress in both directions is still largely in the form of aspiration rather than achievement; but the will for more effective co-operative improvement is undoubtedly alive.

The reactions of price movements on marketing fall into a special class. Confining our attention to the more modern period, we can distinguish four phases in the development of marketing policy. The period of rising prices up to the outbreak of war was one of individualistic, competitive marketing. During the war period the State played a large part both in negotiating the commandeer agreements and in the development of a system of price-fixing. There followed a reversion to private competitive marketing in the early post-war years. The pressure of falling and unstable prices was so great, however, that one by one, most of the exporting industries established, by sanction of Parliament, Export Boards, whose prime function was the co-operative marketing of the export surplus.

The pre-war years of rising prices presented settlement and production problems rather than marketing problems. To a large extent the products sold themselves. It was a sellers' market. Increasing output, marketed on an upward flow of prices, with no apparent limit to either process, made the question of organized marketing a very secondary consideration. War time necessities of belligerent consuming countries plus inflationary finance merely accentuated the advantage of seller countries; the commandeer agreements were in the circumstances unquestionably generous to us even though competitive buying might have yielded even higher returns. The post-war return to competitive selling revealed its true anarchy once prices began to fall and very early showed the necessity for marketing adjustment through organization. The experimental marketing of the Export Boards has undoubtedly been beneficial to the industries concerned, although the deepening of the depression has shown, particularly in the dairy industry, that adequate organization of marketing is impossible without some control over production. Under the persuasion of prolonged adversity it is becoming more clearly realized that production and marketing are not separate

functions to be separately supervized, but continuous phases of a single process. In general terms the great contrast between the pre-war upward price movement and the post-war downward price movement is that the former was an era of expanding production and (notably in dairying) of co-operative exploration, while the latter has been one of co-operative consolidation. The process of consolidation remains far from complete.

The effect of the movement of prices on the price-cost structure of farming has been clear enough. 'It is a well-known fact that farm costs, and the expenses of placing farm products on the market, move much less rapidly than market prices. Hence, when export prices rise, there tends to be a proportionately greater rise in prices at the farm. Owing to the relative fixity of farm costs, the net income of the farmer tends to rise in even greater proportion. Thus, pending an internal adjustment to the higher prices, the farmer has a net gain over the rest of the community.' The reverse is true during falling prices. The fixity of some costs and the lag in others promote a price-cost disparity which places the farmer, with his relatively slow turnover, in a difficult economic position. The position may become desperate if the preceding rise has been of the speculative boom type. In New Zealand, with its highly efficient land transfer system, its highly competitive finance, and its energetic policy of purchase and sale on the basis of small equities, it was inevitable that over two decades of rising prices (with the later years of soaring prices) should leave a large area of the farming lands hopelessly over-capitalized once prices receded significantly from their peak. In this country the attack of farmers against interest has, during the crisis, been more insistent than their attack on wages. Wages matter less as a cost item where there is such a large body of family labour. Interest matters more where there is such a large amount of mortgage indebtedness.

B. Prices of Particular Commodities

The price movements of individual commodities are discussed in the respective chapters on the marketing of primary produce.

Chapter XXIX

MARKETING OF MEAT

By F. B. Stephens and C. R. Barnicoat

I. The Markets for Meat—A. Growth of Frozen Meat Exports—B. Internal and External Markets: 1. Major Meat Products; 2. Minor Meat Products; 3. Subsidiary Products. II. Marketing Service in New Zealand—A. Organization for Local Consumption—B. Preparation of Export Meats: 1. Delivery to Freezing Works; 2. Freezing and Preserving Works. III. Organization of the Export Trade—A. Selling Systems B. Transport: 1. Allotment of Space; 2. Freight Rates; 3. Inspection and Storage—C. The Problem of Frozen Beef—D. Overseas Marketing Organization: 1. Distribution Among United Kingdom Ports; 2. Surveys on Arrival; 3. Methods of Sale in the United Kingdom—E. Flow of Supplies: 1. Seasonal Nature of Supplies; 2. General Supply Trends. IV. New Zealand Chilled Beef Trade—A. Introductory—B. Difficulties of Chilled Beef Trade—C. The Chilling Process—D. Trial Shipments.

I. THE MARKETS FOR MEAT[1]

A. Growth of Frozen Meat Exports

PRIOR to the discovery of the refrigeration process New Zealand-grown meat was consumed within the country except for some salt meat exported as ships' stores. The development of the frozen meat export trade stimulated a change in the type of sheep and cattle carried on farms. Previously sheep were kept chiefly for their wool-producing qualities and such carcasses as could not be consumed locally were rendered down for tallow. When meat as well as wool became valuable, the dual purpose animal became more prominent, especially on the lower and more fertile country.

The growth of an export trade in frozen meat brought about also the development of a large processing industry for meat products. Meat freezing and preserving works are the largest, from the point of view of capital invested, of industrial works in New Zealand, and rank second only to dairy factories in respect of total value of products and of added value. The average size of individual establishments, measured by value of output, number of persons engaged and capital value per unit, is easily the largest in the Dominion.

The total volume of frozen meat exported has increased rapidly since the 'eighties. The course of development is shown in Table CXLI.

While the growth has not been so marked as in the case of dairy produce, the increase is quite remarkable, particularly when it is remembered that the output of wool has also greatly increased since 1900.

1. By F. B. Stephens.

TABLE CXLI

Export of Frozen Meat

Table Showing the Exports of Frozen Meat of all Kinds Quinquennially since 1880

Year	Quantity in Cwts.	Value £	Index Number of Quantity Exported 1900=100
1880	nil	nil	nil
1885	296,473	373,857	15
1890	898,894	1,087,617	49
1895	1,134,097	1,262,711	61
1900	1,844,831	2,123,881	100
1905	1,690,684	2,694,432	92
1910	2,654,196	3,850,777	144
1915	3,591,260	7,794,395	195
1920	4,629,282	11,673,696	251*
1925	3,414,205	11,174,567	185
1930	4,036,639	10,937,382	219
1932	4,645,480	8,436,306	252
1933	5,203,113	9,845,627	285

*Not strictly comparable owing to post-war disclocation of trade.

B. RELATIVE IMPORTANCE OF INTERNAL AND EXTERNAL MARKETS

1. *Major Meat Products*

With the growth of population there has been a steady increase in the amount of meat consumed locally, although the local market is small relative to the external market. The following tables give the available statistics relevant to this point:—

TABLE CXLII

Sheep

Table Showing Total Number of Sheep Slaughtered, Number Exported and Number for Home Consumption Quinquennially since 1905 (Years Ending March 31)

Year	Slaughtered	Exported	Number for Home Consumption	% Consumed Locally
1905	2,226,593	1,926,748	299,745	13
1910	2,793,878	1,775,090	917,788	33
1915	3,999,460	2,522,448	1,477,012	39
1920	5,512,482	4,127,853	1,384,529	25
1925*	3,906,302	2,037,953	1,868,349	48
1930*	3,992,225	1,971,030	2,021,195	51
1933	4,356,412	2,354,184	2,002,228	46

*1925 and 1930 are not strictly comparable owing to different method of tabulation in these years.

TABLE CXLIII

Lamb

Table Showing Total Number of Lambs Slaughtered, Number of Carcasses Exported and Number for Home Consumption Quinquennially Since 1905

Year	Slaughtered	Exported	Home Consumption	% Consumed Locally
1905	2,042,105	1,894,361	147,744	7
1910	3,675,676	3,356,702	318,974	9
1915	4,471,861	3,692,003	779,858	17
1920	3,280,601	3,420,220	—	—
1921–25	4,968,422	4,401,142	567,280	11
1929–30	6,651,767	6,283,960	367,807	5
1932–33	9,853,930	9,056,071	797,859	8

Note.—Export figures for 1920 are influenced by a large carry-over from 1919 season.

TABLE CXLIV

Beef

Table Showing Weight of Beef Slaughtered, Exported and Consumed Locally, Quinquennially Since 1905 (in cwts.)

Year	Slaughtered	Exported	Home Consumption	% Consumed Locally
1905	780,693	159,133	621,560	80
1910	2,148,571	478,930	1,669,641	78
1915	2,481,093	716,289	1,764,804	71
1920	2,951,471	576,054	2,375,417	80
1925	3,129,244	657,754	2,471,490	79
1930	2,295,825	411,292	1,884,533	82
1932–33	2,531,131	563,305	1,967,826	78

The above three tables show the predominance of the export market in mutton and lamb and of the local market in beef. The most notable fact revealed by these tables is the relatively high local consumption of the cheaper meats. Since 1925 mutton exports have not altered to any appreciable extent but the proportion of total slaughterings locally consumed shows a marked increase over that of pre-war years. In the case of beef the proportion of total slaughterings locally consumed shows little variation over a long period but represents a high and increasing per capita consumption. In the case of lamb, however, comparatively little of the notable increase in total slaughterings has gone into local consumption. It is apparent that in times of depression and also when export prices for lamb are relatively high, local lamb consumption declines and the consumption of the cheaper meats increases.

The volume of mutton and beef exports shows little alteration in recent years. Only in the case of lamb have export developments been both

consistent and important. At present there seems little prospect of New Zealand frozen beef being able to compete effectively with the chilled beef of South America. Experiments in the export of chilled beef, however, open up possibilities of an expansion of beef exports provided that quantitative restrictions on importations to the United Kingdom do not materialize.

Practically the whole export trade in mutton, lamb and beef is now directed to the United Kingdom. For some years a small trade in frozen meat, more particularly in beef, was maintained with Canada, and some small shipments went also to the United States. Both these outlets, however, were closed by prohibitive tariff barriers. A steady but small trade is maintained with certain of the Pacific Islands on the route of the trans-Pacific mail liners some of which are insulated for the carriage of frozen products. For some years a trade of small dimensions was carried on in frozen meat, particularly in beef, with Italy, and at times small quantities are sent to the East. The development of the Eastern trade, however, is impeded by the lack of direct services and of adequate refrigerative facilities.

In recent years markets outside the United Kingdom have diminished rather than increased in importance. In the three years 1931-33, 98 per cent. of our beef exports went to the United Kingdom and the same market took over 99 per cent. of our exported frozen mutton and lamb.

2. *Minor Meat Products*

(a) *Pig Products.*—Since 1926 the export of frozen pork has increased from 70,000 cwt. to 321,000 cwt. in 1933. The most important market has always been the United Kingdom and it now is the only market. In the years 1926-29 Australia took considerable quantities but is no longer a buyer.

The curing of bacon and hams is primarily a factory industry in New Zealand. No extensive export trade has been developed, over 75 per cent. of the total output being locally consumed. Such exports as there are, are mainly with the South Sea Islands, of which the biggest single buyer is Fiji.

(b) *Preserved Meats.*—Most freezing works in the Dominion preserve such meats as tongues, canned beef and pressed beef; but there are also other establishments engaged solely in meat preserving, and some concerns produce meat extracts as well as preserved meats.

Between 1922 and 1926 the output of preserved meats increased considerably. Since then the decline has been even more marked than the previous increase, the output falling from 125,000 cwt. in 1926 to 34,000 cwt. in 1932.

On the average of the last decade rather more than half the output has been exported, although since 1929 the figure has fallen below 50 per

cent. The United Kingdom is the most important single market; but various South Sea Islands together purchase about half our exports and constitute a more reliable market.

(c) *Other Meats.*—During and immediately after the war, the export of frozen rabbits assumed fairly large proportions. Rabbit skins at that time commanded a high price and this was the main stimulus to the development of the trade in carcasses. Rabbits are exported either frozen in skins or without skins. In the latter case the skins are separately exported. The heavy fall in skin values in post-war years caused a rapid falling off in the frozen rabbit trade. Practically all the frozen rabbits go to the United Kingdom but normally half the skins go to the United Kingdom and half to the United States. As in other cases, the more recent trade has been concentrated to a greater extent on the United Kingdom market.

Exports of frozen veal have increased from 54,000 cwt. in 1926 to 134,000 cwt. in 1933. In 1926 Italy absorbed approximately 50 per cent. of our exports, the remainder being taken by the United Kingdom, Hawaii and France. Since then the trade has been increasingly with the United Kingdom which now takes practically the entire export volume.

3. *Subsidiary Products*

The main subsidiary products of the frozen meat industry are wool, manure, pelts, hides and tallow, and these represent nearly one-third of the total value of all the products.

Since 1926 the export of cattle hides and calf skins has declined somewhat, and that of tallow and sausage casings has remained practically unaltered. Wool and woolled sheep skins alone show expansion; but these important items are dealt with fully in a later chapter. The falling off in the export of cattle hides is due to the decline in the beef trade. Normally Australia and the United States are the chief buyers of hides and of sausage casings, while the United Kingdom and the United States take the majority of the sheep skins.

II. MARKETING SERVICE IN NEW ZEALAND[2]

A. The Organization for Local Consumption

Meat for internal consumption in New Zealand is procured by retail butchers, either by direct contract with the graziers, or by purchase at stock sales, which are usually held weekly in the various centres. In the latter case the retail butcher competes with the exporter for stock suitable to the exporter. Heavy and unfinished stock is of no interest to the exporter.

Meat slaughtered for the purpose of sale for human consumption must be killed in a slaughterhouse registered and licensed under the Slaugh-

2. By F. B. Stephens.

tering and Inspection Act 1908 and its amendments.[3] Very stringent regulations are laid down as to the construction, equipment and general sanitary provisions of such slaughterhouses. In the larger slaughterhouses, or abattoirs, a Government inspectorial service is provided, to prevent meat unfit for human consumption going into use. In the case of the smaller slaughterhouses, the onus of preventing the sale of meat unfit for human consumption is placed on the manager, or licensee, of the slaughterhouse.[4] These smaller slaughterhouses are subject to intermittent inspection. In an abattoir, the inspector, and in the case of the smaller slaughterhouses the manager, must stamp on every quarter of the carcass a brand showing, inter alia, the official number of the slaughtering place.

In the case of most of the larger City and Borough Councils, the responsibility is placed on the city or borough to provide an abattoir. The abattoir so provided is given the right to levy charges in respect of meat sold in the particular area whether killed in a slaughterhouse area or at a slaughterhouse in another district, within its area. With very few exceptions, there are municipally-owned abattoirs in all the boroughs with over 4,000 inhabitants.

On arrival at the abattoir, animals are suitably branded for identification purposes, and slaughtered at the butcher's expense. It is usually reckoned that such slaughtering costs approximately ¼d. per lb. Butchers usually hold their stocks alive at the abattoirs, giving their killing requirements daily. Chilling is provided for any surplus killed.

It is extremely difficult to give any statistical account of the retail distribution of meat. Administrative units vary from the small, one-man establishment, to the large multiple shop concern. As a consequence, wide variations in distribution expenses occur. As in most large towns in the world, so in the larger towns in New Zealand, the quality of meat varies in the different areas of the towns, the better class areas taking the better cuts.

Because of the predominance of the export market, stock prices are regulated by values ruling for exports and hence the prices which butchers pay for their meat are also so regulated during the export season (December to June). In the 'off' season values are determined by the supply of stock available. Broadly, retail prices move in the same direction as export prices, although there is a considerable lag, especially on a falling market. In normal times, there is comparatively little seasonal movement in retail prices, as the butchers aim, as far as possible, at stability of prices. Hence retail prices do not rise to a height justified by high seasonal prices for stock, nor fall to a level consistent with low seasonal prices for stock. The

3. This does not prevent the farmer killing for his own consumption but prevents him from selling meat so killed, unless it is killed in a slaughterhouse.

4. Those defects which make meat unfit for human consumption are very exhaustively defined in the various regulations under the abovementioned Act.

net effect is that butchers make a less than normal profit when stock prices are high, and a more than normal profit when stock prices are low, and by maintaining a relatively stable retail price, they aim at making a normal profit over the year.

With the price depression in recent years, there has been considerable price-cutting to maintain or increase custom, as a consequence of which there has been a fairly close correspondence between the movements of retail prices and stock prices. However, the disparity between internal costs and stock prices has prevented a fall of the same relative magnitude in retail prices as in stock prices. Various attempts by Master Butcher organizations to maintain a given schedule of retail prices in an area were more or less successful in normal times, but have collapsed for the reasons stated above.

B. Preparation of Export Meats

1. *Methods of Delivery to Freezing Works*

(a) Ownership of meat killed: Meat for export reaches the freezing works through one or other of three channels:—

(1) Freezing companies may purchase direct either at stock sales or on foot at the farm.

(2) Export houses may buy stock at sales or at the farm.

(3) The farmer may export on his own account.

In cases (2) and (3) above, the freezing company kills and freezes on behalf of export houses, or farmers, who are the principals. By far the greatest amount exported is by freezing companies or export houses. The amount killed on farmers' own account is relatively small.

(b) Method of Payment: The purchase of stock is made either at periodical stock sales (usually weekly) or on the farm. In the former case, the price is per head of stock, and the purchaser bears all expenses from this point. In the latter case, buying is either on a per head basis, or on the basis of schedule rates per lb. Payment is made on freezing works killing sheets. In the case of per head buying, the exporter who purchases pays all expenses from the farm. In 'schedule'[5] buying, the practice differs in the North and South Islands. In the North Island, the exporter pays all expenses from the farm.[6] In the South Island, the farmer pays costs of delivery to the freezing works. As a consequence, schedule rates are ¼d. per lb. higher in the South Island than the North Island.

(c) Relation of New Zealand Buyers to English Merchants: There is a very close connection between buyers in New Zealand and sales organizations in London. Prior to the opening of the season, the New Zealand buyers receive information as to the probable prices of stock and, if possible,

5. In 'schedule' buying the purchaser gets the complete carcass, including all skin and offal, for a 'per lb.' price based on the weight of the dressed carcass.

6. In the 1932-3 season, Auckland and Hawke's Bay schedules were 'on farm' as in the South Island.

a 'firm' offer is obtained for a given parcel. Schedule buying rates are adjusted to the English price. The English sellers are put in possession of the estimated total output for the season, and general information as to weather and so on, and are so able roughly to forecast the price. Because of the very considerable time lag between stock buying and ultimate arrival in England the trade is of a very speculative character. If the New Zealand operator or works cannot get a 'firm' offer, the risk of price changes must be taken; if the distributor or agent in England has placed a 'firm' offer with the New Zealand works without covering himself by a corresponding sale he, of course, takes the risk, while, if he has sold to the English retailer the risk is on the retailer.

During the season, the buyers operate on the instructions of their employers, who keep the English houses daily informed as to killings, and the English houses endeavour to sell parcels on this information. If not sold, they inform as to the best period for shipment. It can thus be seen that prices paid for stock in New Zealand tend to anticipate movements in English prices for the final product.

2. *The Freezing and Preserving Works*

(a) Ownership of Works: There are 35 meat export works operating in New Zealand, of which 20 are in the North Island and 15 in the South Island. Most of the works are proprietary concerns and in some, several world-wide meat interests have considerable investments. In a few cases the works are semi-co-operative, with the share capital held largely by the farming interests; but the nature of the industry makes true co-operation very difficult.

(b) Killing and Storage Capacity: The normal killing season lasts from November to June, the heaviest months being from January to April. The South Island is normally about one month later than the North Island. The average killing capacity of the works in the North Island is about 3,725 sheep and 135 cattle per day; and in the South Island 3,735 sheep and 48 cattle per day. The largest establishment at Petone in the North Island has a capacity of 10,000 sheep and 100 cattle per day. The average frozen storage capacity of the North Island works is about 200,000 freight carcasses of 60 lb. each, and of the South Island works about 175,000 freight carcasses. The largest individual storage is about 420,000 freight carcasses.

(c) Location: Since the capital cost of freezing works is very heavy, and since unit cost of output decreases with increase in size, it is necessary that the works should be placed in a strategic position relative to the farmer on the one hand, and the shipping facilities on the other. Since rail facilities are available for most of the works, the important point would seem to be that the works should be so placed as to tap the maximum area of supply. Thus in a number of cases works are placed as far as 100 miles

from the nearest port. From these places the frozen products are railed in insulated cars to the ships' side.

(d) Regulations as to Quality: As with slaughterhouses and abattoirs, meat export works have to be registered and licensed by the Central Government. Very rigid sanitary conditions are demanded, and strict supervision is maintained over the general conditions of the works. All meat killed for export is inspected by a Government official. The standard of export meat is higher than for meat for local consumption, and no meat can be exported which contains any of the numerous defects or diseases enumerated in the regulations. The official brand, certifying that the meat is up to the standard required is (in the case of export meats) attached by means of a tag or label to every carcass, or portion of a carcass which is exported.

In the case of tinned meats the brand is imprinted on the label over every tin.

A small inspection fee of 4d. per head of cattle or 3d. for every twelve (or portion of twelve) calves, sheep or pigs, is made.[7]

(e) Processing: The meat, after killing and dressing, is hung up in a cooling chamber in order that all body heat may escape before the carcasses pass to the freezing chamber. After freezing, the carcasses are enclosed in bags of cotton webbing and are then passed to storage chambers and stacked lengthwise. Here they are kept at a steady temperature of about 12° F. until they are required for shipment.

While the major product is the frozen meat the by-products are of importance and all are processed in the works. The by-products include preserved meats, wool, manures of the blood and bone variety, pelts, hides, tallow, sausage casings, vells for rennet making and other minor items.

In the larger works where moving chain systems of slaughtering are in operation and where the daily killings are large, specialization of labour is carried to an advanced stage, and the processing of by-products becomes a highly important feature of the organization. Whether operating on a chain system or not, slaughterers are normally paid on a piece rate system and other workers on time wages.

(f) Grading and Standardization: One of the functions of the New Zealand Meat Producers' Board is the institution and maintenance of a standardized grading system for New Zealand as a whole.[8] Meat is graded by the freezing works' graders, according to the standard set by the Meat Producers' Board, which has various supervising graders who visit the various meat export works throughout the Dominion in order to see that the grading conforms to the standards set. The grading system aims at standardization of qualities and weights. Thus all meat is graded either

7. The same fees are levied for stock slaughtered for local consumption.

8. Note by contrast the position as regards dairy produce where grading is a Government function. In the case of meat the Government function is limited to a veterinary inspection.

'prime' or 'second' quality. In addition prime meat is further graded according to the weight of the carcass. The grading marks are as under:—

Lamb:	2's	Up to 36 lbs.
	8's	37/42 lbs.
	4's	43/50 lbs.
	Tegs	Over 50 lbs.
	Second Quality	All weights
Mutton:	1's	Up to 48 lbs.
	7's	49/56 lbs.
	3's	57/64 lbs.
	9's	65/72 lbs.
	5's	73/80 lbs.
	Second quality	All weights

In addition to the above some works have a super grade of lamb known as 'down' grade. All 'down' cross lambs are not classed in this grade but only those showing the particular characteristics of the 'down' breed—the classification based on the conformation of the carcass. These lambs are graded in a similar manner to cross-bred lambs as shown above. In addition each works has its own private brands.

Meat is weighed as soon after slaughtering as possible and is graded as soon as it is on the hooks and before it is placed in the freezer at the works.[9]

III. ORGANIZATION OF THE EXPORT TRADE[10]

A. Selling Systems

Where meat is killed on the farmers' own account, it is shipped on consignment to an English selling broker for sale on behalf of the farmer. Where overseas buyers operate, they usually have direct connection with English chain stores and large retail houses, and ship direct to them. In other cases, that is, where the freezing works kill on their own account or where stock and station agents export the meat, the usual system is for the meat to be sold either C.I.F., ex-ship, or in store London, that is, on landed terms on bills of lading; or it is 'pitched on' Smithfield for open sale. Since bills of lading are normally made up in lots of 250 carcasses of a given grade, selling afloat, or C.I.F. is greatly facilitated. In most cases the meat is consigned to an English house or English representative, who acts on behalf of the New Zealand exporters.

Where a 'firm' offer is obtained, the meat may be shipped direct to the buyer, either on a named steamer or at a certain period. Sales either C.I.F. or ex-ship are usually made on bill of lading weights.

9. A deduction of 4½ per cent. is automatically allowed by the scales to cover shrinkage between hot and cold weights and shrinkage in the period of storage.
10. By F. B. Stephens.

B. Transport

1. *Allotment of Space*

Transport from works to shipside is in specially constructed insulated cars, as a consequence of which the meat is exposed to atmospheric conditions for as short a time as possible.

One of the Meat Producers' Board's primary functions is the regulation of shipments. The Board arranges the freight to ensure regularity and continuity of supply on the English market and the Board's ships' agents are represented on a Joint Body, the allotment Committee, which allots the space to the various ports. The Board's shipping policy as stated in their reports is: 'To keep a steady flow of meat going forward to the British market over the twelve months of the year.'[11]

2. *Freight Rates*

The 1931 Report has the significant addition: '. . . having due regard to the months of the highest consumption of meat.' The Board's policy is thus one of orderly marketing. Space having been allotted, the various companies take out their own bills of lading, pay their own freight direct to the shipping company and arrange their own insurance. The Meat Producers' Board, however, represents the industry in negotiations as to freight rates and some part of the reduction in the freight rates obtained since 1922 must be attributed to its efforts. Freight rates from New Zealand to England have recently been fixed for three-year periods. The rates obtaining under the present contract of three years from the 1932-33 season are ·743d. per lb. of beef quarters, 1·089d. per lb. of lamb, ·929d. per lb. of mutton and ·743d. per lb. of pork and veal.[12] This charge is, of course, for refrigerated transport.[13]

3. *Inspection and Storage Arrangements*

The Meat Producers' Board exercises, within New Zealand, very rigid supervision over the loading of meat, and the condition of the refrigeration and refrigerated space on overseas vessels. In addition the Board maintains an inspectorial service in the United Kingdom, where all the unloading is carefully supervised, and the general condition of the meat in each shipment carefully reported on. The object of the supervision is to prevent any avoidable causes of deterioration in quality during the period of transport from New Zealand to the English market and there seems little doubt that the results of these operations have been very successful.

11. Annual Report, 1926.

12. *Vide Tenth Annual Report*, Meat Control Board, p. 17. One of the very serious difficulties facing the shipping of New Zealand produce abroad is the great length of its coastline and the high cost of internal transport. As a consequence, overseas vessels have to call at a large number of ports before a full cargo is obtained. There are 16 trading ports for frozen meat and only a minority of the vessels load at less than four ports.

13. These charges do not include variations in exchange rate over 10 per cent. from par.

C. The Problem of Frozen Beef

Mutton and frozen lamb deteriorate but little in quality through being frozen. While fresh mutton and lamb will always command a premium the frozen product from New Zealand commands a premium over the Argentine and Australian products, suggesting a qualitative difference in the product. There are, however, technical difficulties involved with regard to beef transport. Under the chilling system the beef is not actually frozen but is kept at cool temperatures. Argentina, which is much nearer the market, can take advantage of the 'chilling' system and hence meat from this area does not suffer the deterioration which New Zealand and Australian beef suffer from freezing. The competitive advantage so gained by Argentina is such as practically to preclude beef from New Zealand from the European markets, although Australia, because of suitable pastoral conditions, can compete in a certain section of the market. However, Argentine chilled ox hinds have, on the average of the past eight years, maintained a premium over frozen Australian and New Zealand ox hinds. Recently trial shipments of chilled beef have been exported, and the success attending these efforts opens up possibilities of future expansion.[14]

D. Overseas Marketing Organization

1. *Distribution Among Ports in the United Kingdom*

By far the greatest amount of frozen meat is unloaded and marketed in London although some is discharged at Southampton, Liverpool, Glasgow, Avonmouth, Manchester and Cardiff. Apart from two very small parcels in 1927-28 and 1928-29, no meat has been discharged at east coast ports other than London. The following table shows the percentage distribution of unloadings amongst the various ports:—

Table CXLV

Ports of Discharge

Percentage Distribution of Imports of New Zealand Meats Amonst the Various Ports in the United Kingdom for the Year Ended September 30, 1932

Port	Beef (Quarters)	Mutton (Carcasses)	Lamb (Carcasses)	Pork (Carcasses)	Boneless Beef (Bags)
London	68	86	77	69	9
Southampton	1	4	4	—	—
West Coast Ports—					
Liverpool	14	7	11	14	6
Glasgow	12	1	1	8	85
Avonmouth	5	2	4	9	—
Manchester	—	—	2	—	—
Cardiff	—	—	1	—	—
	100	100	100	100	100

14. This matter is more fully discussed in section IV of this chapter.

The above table amply illustrates the predominance of London. The importance of London is much more marked in the case of mutton than in beef or pork. The relative importance of Glasgow as a port of discharge for beef is of interest. However, the smallness of the actual quantities of beef and pork rather offset the relative advantages of ports other than London for these commodities.

The Board has endeavoured to build up a west coast of England trade, but although the general trend of absolute quantities has been upwards, the relative position of these ports has not materially changed and in the recent years has varied between 16 and 20 per cent. of the total landings of New Zealand meat in the United Kingdom.

2. *Surveys on Arrival*

Careful surveys are made by the Meat Producers' Board in order to guard against qualitative deterioration in the product. Meat is also insured against deterioration for the voyage and generally 60 days thereafter in cold store. Insurance surveys are made when called for by the buyer or the consignee.

3. *Method of Sale in the United Kingdom*

Some years ago few firms operating solely in New Zealand or Australia had definite market stalls or depots, or definite contracts with retailers in England. This was in sharp contrast to the Argentine trade where the works, in practically every case, owned or had large interests in a distributive system of retailers. Of recent years the New Zealand trade has developed a very considerable contact with the retail system of England. The Meat Producers' Board have concentrated in their advertising and propaganda work in this direction, and to-day the majority of the meat leaving New Zealand is consigned to a definite distributive system. One of the factors making this possible has been the policy of the Board in maintaining a continuity of supplies on the English market. This change has probably contributed to the ability of the English market to absorb the increasing quantities of meat which have been exported.

(a) *Smithfield.*—In discussing the distributive system in England, reference must be made to the 'Smithfield' market, which is unique in England. Smithfield is the meat market of London and is owned by the Corporation of the City of London, which leases stalls to meat interests on a weekly tenancy basis. The whole operation of the markets is carefully regulated. Stall-holders may sell 'home' or 'imported' meat and in the latter case may sell 'on consignment' on a commission basis; or they may sell on their own account meat which they have bought either prior to arrival or from importers.

The market opens at a very early hour and meat is displayed by vendors for sale to wholesalers, retailers, or large consumers such as hotels, etc. From this point of view, Smithfield is a large wholesale market. The connections there established enable forward selling and the selling of goods in store to be carried out. A natural development is the 'walking' jobber who, owning no stall, is yet able, because of the presence of buyers, to make contacts with buyers and prospective buyers and to sell meat which is not 'pitched' on the market. Over 50 per cent. of the mutton and lamb pitched at Smithfield in 1924 was of Australian, New Zealand or South African production and this represented about 30 per cent. of the meat produce imported into the United Kingdom from these sources over that year.[15]

Because of the predominance of London as a discharging port, and because of the importance of the Smithfield market, the control of the meat trade in England tends to be concentrated to a remarkable degree in London. A natural development is, that London firms maintain an enormous cold storage capacity practically equalling that of the whole of the rest of England. Meat in ship usually goes direct to cold store, whence it is drawn for distribution or pitching at Smithfield. Since frozen meat will keep for some time without deterioration, it is quite common for stocks to be held 'in store' by speculators.

(b) *Retail Sale in England.*—Few stores now sell only fresh home-killed meat, although some sell only imported frozen meat. Few retailers purchase New Zealand meat forward, but some importing houses have interests in retail chains. The normal connection is, however, through importers and others who sell wholesale, or through Smithfield. For many years New Zealand products have maintained a premium over the produce of other countries. 'Canterbury' lamb and mutton is now a trade term and because of consistent high quality usually has had a premium over other New Zealand supplies although reports of recent years show a tendency for selected North Island products to bring a price equal to that of Canterbury products.

The New Zealand Meat Producers' Board carries on extensive advertising of New Zealand products and frequently arranges displays at shows and also in retail establishments. The effectiveness of this propaganda is perhaps best seen in the enormous increase in the absorption of New Zealand lamb of recent years. New Zealand products are now in demand throughout practically the whole of England.

15. Later figures are not available in New Zealand, but reports and information indicate that this market has declined in relative importance, due to the fact that more definite connections with retailers have been made by New Zealand exporters. This change is due to the advertising and propaganda work of the Meat Producers' Board.

E. Flow of Supplies

1. *Seasonal Nature of Supplies*

(a) *Lamb.*—Because of the very small supply of frozen beef from New Zealand, attention will be paid only to mutton and lamb. The following two tables show the seasonal distribution of supplies of lamb:—

TABLE CXLVI

Seasonal Distribution of Lamb Imports

Seasonal Distribution of Lamb Imports to the United Kingdom on the Average of the Years 1924-1931, Showing the Percentage Imports Each Month

Month	Imports from			Total
	New Zealand	Australia	South America	
January	2·0	19·9	11·0	7·7
February	7·1	9·5	7·1	7·5
March	11·4	7·5	7·9	9·6
April	14·0	5·9	11·9	12·0
May	12·7	4·3	12·3	11·2
June	11·4	2·3	7·3	8·7
July	15·5	2·1	8·1	11·0
August	9·7	2·4	5·4	7·2
September	6·8	2·5	4·5	5·4
October	5·1	5·2	4·5	4·9
November	2·1	14·1	9·1	6·2
December	2·2	24·3	10·9	8·6
	100	100	100	100

The outstanding fact noticeable with regard to the lamb imports is the greater steadiness of the South American supplies throughout the year than the supplies from either Australia or New Zealand. The range of South American supplies between the highest and lowest months is 7·8 per cent.; of New Zealand supplies 13·4 per cent., and of Australian supplies 22·2 per cent.

As all the sources of supply are in the Southern Hemisphere, seasonal weather conditions make it inevitable that the bulk of the supply is concentrated in the first half of the year. The earlier and shorter nature of the Australian season is shown by the fact that about 60 per cent. of the Australian supply arrives between November and February. The heaviest months of New Zealand supply are from March to July. In these months the consumption of lamb is at its peak. In August and September the home-killed supplies, particularly the Scottish lamb, commence to come on the market in large quantities and from then on the weather gets colder and the demand runs to mutton and beef. Another view of the seasonal distribution of lamb supplies is shown in the following table:—

TABLE CXLVII

Lamb Imports into United Kingdom

Percentage Supplied by New Zealand, Australia and South America, Each Month of the Year on the Average of the Eight Years 1924-1931

Month	New Zealand %	Australia %	South America %	Total %
January	13·7	40·4	45·9	100
February	49·5	20·9	30·6	100
March	61·3	12·2	26·5	100
April	60·5	7·7	31·8	100
May	58·7	6·2	35·1	100
June	68·6	4·2	27·2	100
July	73·3	3·2	23·5	100
August	70·5	5·2	24·3	100
September	65·7	7·4	26·9	100
October	53·9	16·5	29·6	100
November	17·5	35·8	46·7	100
December	13·6	45·2	41·2	100
	52·1	15·8	32·1	100

This table reflects the predominance of New Zealand in the lamb market. Again, the striking fact is the steadiness of the proportion of the supplies from South America, and the relative unimportance of Australia, except in the months from November to February. It is also rather striking that from November to January New Zealand's share of the market is at its lowest, so that the Australian supplies might be said to be complementary to those of New Zealand. In other words, the aggregate of New Zealand and Australian supplies is much steadier than either separately. It is possible that joint action at least in this market might be advantageous to both countries for certain qualities of meat.

(b) *Mutton.*—Tables CXLVIII and CXLIX show the seasonal distribution of mutton imports into the United Kingdom:—

Owing to the nature of the produce the seasonal fluctuations in mutton supply are much less wide than in the case of lamb supplies. The range of New Zealand supplies is 9·5 per cent., of Australian supplies 13·5 per cent., and of South American supplies 14·9 per cent. It will be noticed by contrast that supplies of mutton from South America are less regular than supplies of lamb, and it might be found profitable to take account of the movement of South American supplies of mutton in determining marketing policy in New Zealand.

Further, it will be noticed that the seasonal swing of New Zealand supplies is much less than in the case of either Australia or South America. December to February are the lowest months of New Zealand supply, while

TABLE CXLVIII

Seasonal Distribution of Mutton Imports

Seasonal Distribution in Mutton Imports to the United Kingdom on the Average, 1924-31, showing Percentages Arriving Each Month

Month	New Zealand	Australia	South America	Total
January	5·0	10·8	6·9	6·5
February	4·3	8·4	7·5	6·2
March	8·5	7·9	9·0	8·6
April	12·8	6·5	9·9	11·3
May	10·1	4·8	18·3	13·3
June	7·2	2·7	12·8	9·2
July	9·2	3·4	11·7	9·8
August	9·0	7·8	6·3	7·5
September	8·4	6·9	7·3	7·8
October	11·4	11·1	3·5	7·8
November	7·3	13·5	3·4	6·2
December	5·8	16·2	3·4	5·8
	100	100	100	100

October to February are the highest months of Australian supply. This again suggests the fact noted that to a certain degree New Zealand and Australian supplies are complementary.

The following table shows the same facts from another angle. It also shows, as with lamb, the relatively smaller importance of Australia on the mutton market than South America or New Zealand.

TABLE CXLIX

Mutton Imports into United Kingdom

Percentage Supplied by New Zealand, Australia and South America, Each Month of the Year on the Average of the 8 Years 1924-31

Month	New Zealand %	Australia %	South America %	Total %
January	34·0	17·9	48·1	100
February	30·9	14·6	54·5	100
March	43·4	9·8	46·8	100
April	54·2	6·2	39·6	100
May	33·6	3·9	62·5	100
June	34·3	3·1	62·6	100
July	41·8	3·8	54·4	100
August	51·9	10·9	37·2	100
September	48·1	9·5	42·4	100
October	64·6	15·3	20·1	100
November	51·8	23·2	25·0	100
December	43·9	29·4	26·7	100
	44·1	10·7	45·2	100

2. General Supply Trends

(a) *Lamb.*—The most striking fact in the frozen meat trade to Great

Britain is the very great growth in the lamb trade in the post-war years. This fact is evidenced in the following table:—

TABLE CL

Quantity of Lamb Imported into United Kingdom from New Zealand, Australia and South America

Year	In Millions of Carcasses			
	New Zealand	Australia	South America	Total (including Other Countries)
1924	4·6	1·2	2·1	7·9
1925	4·5	1·4	2·8	8·8
1926	4·7	1·7	1·9	8·3
1927	5·1	1·3	3·2	9·6
1928	5·8	1·2	3·7	10·7
1929	5·9	1·5	4·3	11·8
1930	6·7	1·9	4·8	13·5
1931	8·0	3·4	5·3	16·7
1932	8·5	3·2	4·8	16·5
1933	8·9	3·4	4·5	16·8

It will be seen that total importations have more than doubled in the ten years under review. New Zealand remains the most important supplier although the relatively greatest increase has occurred in Australia.

The following table shows changes in the relative importance of different sources of supply to the United Kingdom:—

TABLE CLI

Lamb Imports

Annual Distribution of Lamb Imports to United Kingdom from New Zealand, Australia and South America, 1924-1933

Year	New Zealand %	Australia %	South America %	Total %
1924	58·7	14·5	26·8	100
1925	50·2	17·1	32·7	100
1926	56·5	19·5	24·0	100
1927	52·2	15·2	32·6	100
1928	54·7	10·8	34·5	100
1929	50·5	12·9	36·6	100
1930	51·1	14·1	34·8	100
1931	47·9	20·5	31·6	100
1932	51·5	19·4	29·1	100
1933	53·0	20·2	26·8	100

(b) *Mutton.*—Mutton imports into the United Kingdom are shown in the following two tables:—

TABLE CLII

Mutton Imports

Supplies of Mutton Carcasses to the United Kingdom from 1924 to 1933

Year	In Millions of Carcasses			
	New Zealand	Australia	South America	Total (including Other Countries)
1924	1·9	0·2	2·7	5·1
1925	2·2	0·3	2·8	5·4
1926	2·4	0·5	2·7	5·6
1927	2·2	0·6	2·5	5·4
1928	2·1	0·6	2·4	5·1
1929	1·9	0·3	2·1	4·3
1930	2·6	0·7	1·9	5·2
1931	2·3	1·3	1·3	4·9
1932	2·8	0·5	1·2	4·6
1933	2·1	1·0	0·8	3·9

The most noticeable fact in these tables is the gradual decline in total imports in recent years. New Zealand supplies have increased but slightly although there has been a large increase in Australian supply. The steady decline in South American supplies is counterbalanced by the great increase in lamb supplies from that area.

The following table shows the relative position of New Zealand, Australia and South America in the English market:—

TABLE CLIII

Mutton Imports

Annual Distribution of Mutton Imports to United Kingdom from New Zealand, Australia and South America

Year	New Zealand %	Australia %	South America %	Total (including Other Countries) %
1924	41·7	3·5	54·8	100
1925	43·2	5·0	51·8	100
1926	44·0	8·8	47·2	100
1927	43·7	8·7	47·6	100
1928	40·7	11·5	47·8	100
1929	42·8	7·7	49·5	100
1930	49·4	13·0	37·6	100
1931	47·2	27·2	25·6	100
1932	60·1	11·0	26·1	100
1933	53·8	25·6	20·6	100

New Zealand and Australia have increased their relative position while that of South America has greatly decreased.

(c) *Beef.*—Little need be said as to the beef position. New Zealand supplies have varied greatly from year to year with a declining tendency up till 1931. Since then exports have increased somewhat.

TABLE CLIV

Exports of Beef Quarters from New Zealand

(In thousands of quarters)

Year	Quantity	Year	Quantity
1923–24	287	1928–29	157
1924–25	317	1929–30	156
1925–26	381	1930–31	141
1926–27	187	1931–32	203
1927–28	387	1932–33	288

IV. THE NEW ZEALAND CHILLED BEEF TRADE[16]

A. INTRODUCTORY

The New Zealand ('Canterbury') frozen lamb and the South American chilled beef trades are now so well established on the meat markets of the United Kingdom that they are each unsurpassed in their respective spheres. This specialization is reflected not only by the relative volumes of the trades, but also by the prices, as is shown in the following tables:—

TABLE CLV

Annual Supply of Beef and Mutton and Lamb to the United Kingdom (1933)[17]

Commodity	Country of Export		Total Imports into U.K.
	New Zealand	South America	
Beef	35,402 tons, 2·5 per cent. } frozen	447,051 tons, 31·7 per cent. } mainly chilled	1,410,335 tons
Mutton and Lamb	186,723 tons, 28·5 per cent. } frozen	79,747 tons, 12·2 per cent. } mainly frozen	653,803 tons

TABLE CLVI

Prices of Beef and Lamb in Pence per lb.[17]

	1912	1922	1928	1933
BEEF—				
N.Z. ox fores (frozen), 160/220 lbs.	3·11	3·08	3·83	2·46
Argentine ox fores (chilled), 160/220 lbs. ..	3·32	3·76	4·28	3·18
Price margin in favour of Argentine ..	0·21	0·68	0·45	0·72
N.Z. ox hinds (frozen), 160/220 lbs. ..	3·87	4·43	5·31	3·03
Argentine ox hinds (chilled), 160/220 lbs. ..	4·67	6·57	6·87	5·35
Price margin in favour of Argentine ..	0·80	2·14	1·56	2·32
LAMB—				
N.Z. Prime Canterbury, 28/36 lbs.	5·84	11·40	10·06	6·62
South American (light), 28/36 lbs.	4·76	10·05	8·26	5·92
Price margin in favour of New Zealand ..	1·08	1·35	1·80	0·70

16. By C. R. Barnicoat.
17. Annual Report Meat Producers' Board, 1934.

While New Zealand prime lamb commands about 1d. per pound more than the Argentine product, the value of New Zealand frozen beef has fallen considerably behind that of the South American product (cf. values for years 1922 and 1912), and has not regained its relative pre-war position.

The success of the South American chilled meat trade may be traced to (a) the steady improvement in quality of their export beef due to the determined efforts on the parts of the producers, freezing works and shipping companies to improve their trade; (b) their adoption and improvement of the chilling process for beef, whereas New Zealand and Australia have, until recently, sent only the frozen article; (c) natural advantages such as suitability of climate, cheapness of grazing, proximity to the United Kingdom, low labour costs, etc., and consequent upon these (d) their excellent system of regular supply and distribution to and in the United Kingdom.

While the prejudice against frozen foodstuffs and their consequent low market value is, on the whole, unwarranted, it is well known that frozen beef loses quality (i.e., its palatability, or appetizing nature) in the freezing process, and it is, of course, on 'quality,' rather than on nutritive properties that the value of most foodstuffs is judged. While frozen beef may be stored almost indefinitely, the storage life of chilled beef—which does not suffer from these undesirable changes when stored for reasonable lengths of time—is limited to a few weeks only.

Naturally, the Southern Dominions are anxious to participate in the more profitable markets for beef in the United Kingdom, and there are three suggested methods of improving their product:—

(a) By more careful attention to the processes of dressing and freezing. Some of the Australian frozen beef is now almost equal in appearance to the South American chilled product, and commands a higher price than the ordinary frozen article.

(b) By rapid freezing of cartoned cuts and joints, as now practised on a commercial scale in the United States. The purchaser chooses and buys the meat from a refrigerated display case. The process is of doubtful value as an improvement on the ordinary frozen beef; and the trade difficulties are at present almost insuperable.

(c) By chilling quarters of beef and transporting on fast steamers for immediate sale in England.

B. Difficulties of Chilled Beef Trade

While the advantages (as shown by prices) of sending chilled beef are obvious, New Zealand and Australian exporters have not entered this trade in the past owing to various difficulties which may now be briefly summarized:—

(a) The great distances of the Southern Dominions from the United Kingdom have made the chilling process in the past a very risky commercial venture, for while it has been known for some years that beef may be preserved satisfactorily in the chilled state for several weeks longer than a rapid journey to England would require, the commercial attainment of this is beset with problems, principally owing to the difficulties of avoiding contamination by mould, and retarding its subsequent unsightly and harmful growth on the surface of the meat.

(b) The heavy type of beef cattle produced in New Zealand as a by-product of the sheep industry is not suitable for the best overseas trade which requires 3-year-old beasts of 650-700 lbs. carcass weight.

(c) Country suitable for raising beef of the desired type has always been more profitably utilized for dairy farming.

(d) The expenses incurred in marketing chilled beef—raising the cattle, freezing works charges and transport expenses—are considerably higher than for the frozen product.

(e) The lesser-known New Zealand product would suffer most during a glut on the market (as it has to be sold almost immediately on arrival), whereas frozen beef can usually be held until the demand is favourable.

When the enormous natural advantages of South America are considered—its vast tracts of grazing country (used for growing the valuable lucerne crop), and the cheap mass production methods (which are well suited to the extensive scale on which their industry is operated, and in which the railway, freezing and shipping companies have co-operated in developing all the detailed requirements), it is seen that New Zealand and Australia would have a formidable task if they considered building a trade to compete with the South American beef industry.

Nevertheless, there is a small beef-raising industry in this country which is now actively interested in the chilled meat trade, and the prices so far obtained for our products have been satisfactory and encouraging whereas the prices received for frozen beef during the last few seasons have hardly repaid either the farmer or the freezing companies. Another impetus to the trade is given by the imminence of a quota on Dominion beef, for in the event of this it will be necessary that this limited export be of the best possible quality and thus bring the highest return.

C. The Chilling Process

The process of chilling meat is a modern mechanical application of the well-known practice of preserving food by keeping it cool. The various ferments (enzymes) present in living biological material, such as meat (or fruit, fish, cheese, eggs, etc.), many of which are responsible for putrefactive changes if unchecked, are markedly retarded at low temperatures.

Similarly the difficulty of avoiding undesirable bacteria (producing 'slimes') and moulds, which are present as surface contamination, is largely overcome by storage at low temperatures. On the other hand, if the temperature is lowered below the freezing point of the foodstuff, the tissues freeze, and while a relatively small bulk of tissue (such as a lamb carcass or fish) can be frozen successfully, a quarter of beef cannot be frozen and stored in a satisfactory condition. Chilled beef is therefore shipped at a temperature of 29-30° F., just above the temperature of the freezing-point of beef muscle. Other undesirable changes in the pigment and the fat are also retarded by low temperatures. Providing no contamination by moulds or bacteria has occurred, meat may be kept chilled in a satisfactory state for two or three months, which is considerably longer than required for the voyage to England. However, delays at either end increase the necessary storage period to about two months as a rule.

The prevention of microbial contamination presents the main difficulty in the handling of chilled beef. Even under the most stringent conditions of cleanliness it is impossible to avoid slight contamination. As is well known, moulds and slimes prefer moisture, so the surface of the meat is kept as dry as is practicable by means of maintaining a reasonably low relative humidity in the freezing works and ships' chillers. The careful control of cleanliness, temperature and humidity is responsible for the success of the South American trade in supplying its consistently satisfactory product to the British markets.

Unfortunately, the extra period required for transport from both New Zealand and Australia (often lengthened by the inconvenient number of small coastal ports at which many overseas vessels are required to call) increases the period considerably beyond that found to be safe for the commercial storage of chilled beef.

During the War period, Linley evolved a method of overcoming the difficulties of shipping chilled beef from the Antipodes by means of the introduction of traces of formalin vapour into the ship's hold, this substance acting as an antiseptic and retarding the growth of undesirable organisms on the surface of the meat. This method was satisfactory, but was declared illegal by the British Government.

Recently, the chilling of beef in an artificial atmosphere—air containing about 10 per cent. carbon dioxide ('carbonic acid gas')—has been found to lengthen the storage life of chilled beef. Similar methods of 'gas storage' are now well established methods in Great Britain and Europe for the preservation of fruit and eggs. Carbon dioxide, which is the chief respiration product of living organisms, is allowed to accumulate, or is introduced from other sources into the gas-tight chamber in which the product is to be stored, until the desirable concentration (usually 10-15 per cent.) is attained,

after which the gas mixture is carefully controlled. Sometimes it is also necessary to lower the temperature of the store by means of refrigeration. The preservative action of the carbon dioxide is due principally to its effect of lowering the concentration of the oxygen of the atmosphere and thus starving the supply normally required for the life processes of the organism. It has long been known that the lower forms of life—such as moulds—are retarded in growth by atmospheres containing carbon dioxide. The Food Investigation Board of Great Britain studied the effect on meat and found that air containing about 10 per cent. and upwards of carbon dioxide definitely delayed the growth of moulds and slime on meat and moreover had certain other desirable effects in retarding deleterious surface changes in the pigments and fat.

D. Trial Shipments

The first commercial shipment of chilled beef using the gas-chamber method was made from Waingawa, New Zealand, in August, 1933, on the *Port Fairy*. Since then numerous satisfactory shipments have gone from various North Island and Australian freezing works, and many modern cargo vessels are being fitted with small holds suitable for this trade. While none of the shipments has yet exceeded a few hundred quarters (filling only a very small hold) it has been amply demonstrated that the main difficulties in the way of developing a Dominion trade in chilled beef—the technical problems of handling and transport—have now been surmounted. It is not known whether the gas-chamber method is to be a permanent feature, or whether later improvements in technique and transport will render its use unnecessary. Overseas criticism is usually directed to details of butchering and dressing (which are steadily improving) rather than to the quality of the selected beef supplied.

It was really owing to certain North Island freezing companies taking the initiative that our chilled beef trade was inaugurated. The type of carcass desired in the British meat markets has, in the main, been supplied. The breeds have been predominatingly Polled Angus, Herefords, or crosses of these. (These breeds together make only a small percentage of the Argentine cattle, which are mainly Shorthorns of an improved type.) The alterations involved in the usual freezing works beef slaughtering and dressing operations were considerable. At present the cattle are killed either by stunning or poleaxing and the well-bled carcass is flayed and opened up by two teams of men (groundsmen and tacklemen), and is then sawn into sides after the customary Government meat inspection. The foregoing operations are paid for on a piece-work basis. The sides are then slid along rails past about 20 other workers, who brush the carcass down with hot water, wipe it well and often (a continual supply of clean sterilized wipers and towels is necessary) and sew and plug veins

likely to exude blood and cause unsightly stains. Dry towels are also skewered at certain portions, and rough surfaces of fat and lean are trimmed. The carcass is placed in the chiller about one hour after slaughter. In South America chilling is done in three days, but locally it is usually complete in only two days. After a certain amount of further trimming the sides are quartered, wrapped in sterilized stockinette and hessian, and are loaded (usually at night) into special railway vans. The New Zealand Railway Department has met the requirements of this new traffic by constructing several specially equipped and insulated ice-bunkered vans which carry the meat in a satisfactory state for long periods even under adverse weather conditions.

As may be seen, the entry of New Zealand into the chilled beef trade now presents many more difficulties than it would have if the trade had been seriously considered and attempted some years ago before the South American industry became so well established. The success of the small trade already established, together with the possibility of a beef quota, indicate that our chilled beef trade may grow to become a profitable, though restricted, primary industry.

CHAPTER XXX

THE PROCESSING AND MARKETING OF DAIRY PRODUCE

BY F. B. STEPHENS

I. Historical Sketch. II. Distribution of Factories. III. Processing—A. Assembly of Products—B. Overlapping and Overcapitalization—C. Company Organization: 1. Types of Administrative Organization; 2. Types of Factories; 3. Place of Proprietary Concern—D. Capital Invested: 1. Statistics; 2. Investment According to Type of Factory; 3. Changes in Capital Invested—E. Size in Relation to Efficiency—F. Relative Importance of Butter and Cheese Production: 1. Utilization of Butterfat; 2. Distribution of Production—G. Overrun. IV. The Problem of Quality. V. Production and Markets—A. Total Quantities Produced—B. Distribution of Exports—C. Subsidiary Products. VI. Internal Marketing—A. Butter and Cheese—B. Whole Milk. VII. Overseas Marketing—A. Selling Policies: 1. F.O.B. versus Consignment; 2. Work of Selling Agents—B. Transport: 1. Transport to Grading Stores; 2. Overseas Transport; 3. Supervision of Unloading—C. Insurance—D. Organization of Selling in London: 1. The English Selling House; 2. New Zealand Producers' Co-operative Marketing Association; 3. Produce on Consignment; 4. Amalgamated Dairies; 5. Packing of Produce—E. Finance—F. Distribution of Produce in United Kingdom. VIII. Prices—A. Seasonal Movements in Supply and Prices: 1. Relation of New Zealand Supply and Prices; 2. Seasonal Fluctuations and Orderly Marketing—B. Prices in Relation to Quality—C. Relation Between Danish and New Zealand Butter Prices—D. Prices and Costs—E. Price Trends. IX. The English Market—A. Increase in Imports—B. The Butter Supply—C. The Cheese Supply.

I. HISTORICAL SKETCH

PRIOR to the development of refrigerative methods of transport the market for New Zealand dairy produce was confined to the small, neighbouring towns, and to replenish the larders of visiting vessels. The modern marketing problem may be said to have commenced in 1882 when the first consignment of frozen butter was sent to the United Kingdom. The extraordinarily rapid growth of the dairying industry since that time is revealed by the following table:—

TABLE CLVII

Exports of Butter and Cheese

(1875-1934, Years Ending March 31)

Year	Butter		Cheese	
	Cwts.	Value (£)	Cwts.	Value (£)
1875	104	660	442	1,862
1885	24,923	102,387	15,245	35,742
1895	66,283	263,244	79,650	160,383
1905	342,853	1,514,156	82,421	180,874
1915	417,138	2,299,473	791,605	2,387,828
1925	1,370,034	12,063,265	1,454,708	6,161,580
1934	2,740,973	11,691,541	1,964,535	4,683,480

The expansion of the industry was related, both as cause and effect, to a number of factors operating within New Zealand itself. Amongst

these may be noted the steady development and improvement of internal transport, the development of an efficient factory system on co-operative lines, and a marked tendency towards the growth of 'family farms,' especially on the better class of land. The interaction of these conditions provides scope for an interesting piece of economic analysis, but it is beyond our purpose to do more than make incidental reference to their bearing on the problems of processing and marketing.

In the early days of the dairying industry, the absence of the milking machine limited the size of herd which could be milked by the farmer and his family. Moreover, methods of pasture control and systems of supplementary feeding precluded the heavy stocking which is becoming increasingly characteristic of the dairying industry of recent years, as a result of the increased use of artificial fertilizers and improved systems of pasture management. At the same time, the perishable nature and bulk of the raw product, milk, limited the area over which supplies could be effectively drawn, until the advent of the automobile revolutionized road transport. Hence the early factories were small, and it was the practice to erect a factory where the supply of milk from 250 cows or over was available.

The recognition of the limitations on efficiency imposed by small size, encouraged the flotation of larger companies by amalgamation or absorption, the small factories being converted into skimming stations. The economies of large factories could not be effectively realized, however, until the development of home separation. Motor transport and improved roads enabled wider areas of supply to be drawn upon by cheaper, co-operative methods of transport. This applied more to butter production than to cheese, for in respect of cheese factories the economical area of collection is still limited, though to a less extent than formerly, by the fact that whole milk must be transported instead of cream of smaller bulk. Butter-making can be centralized more readily than cheese production.

At the same time as productive efficiency has increased owing to larger size and improved technical appliances, quality has been rendered more uniform by the system of State grading of butter and cheese, by cream grading and by the education of suppliers.[1]

II. DISTRIBUTION OF FACTORIES

Table CLVIII shows the distribution of dairy factories in New Zealand.

The table reveals some tendency towards specialization. Taranaki Province, which is closely settled and is almost exclusively devoted to dairying, and which was the main dairying district until the rapid development

1. See Report of Dairy Industry Commission, 1934, paragraphs 9-26, for a fuller account of the development of dairying in New Zealand.

of the Waikato in the post-war years, is predominantly engaged in cheese production. In 1933, 42 per cent. of our cheese was produced in Taranaki, 19 per cent. in Auckland, 17 per cent. in Otago and Southland, and 14 per cent. in Wellington. The Auckland Province, which includes the Waikato district, accounts for over two-thirds of the butter produced, Taranaki and Wellington following with about 10 per cent. each. Dual plants, providing both butter and cheese, are to be found mainly in the Taranaki district, and are prompted by the desire to be able to change from the one product to the other if price movements warrant it. In other parts of New Zealand, where butter factories predominate, the raw material is home separated cream, and any additional advantages accruing from the establishment of cheese plants would be more than offset by the diseconomies resulting from the utilization of whole milk as the raw product, as whey butter factories are really cheese factories which maintain plants suitable for the making of butter from whey cream extracted from whey, a by-product of cheese-making.[2]

TABLE CLVIII

Dairy Factories in New Zealand

Registrations of Creameries, Factories, etc., under The Dairy Industries Act 1905, as at March 31, 1933

District	Number of Factories			Total	Suppliers	
	Butter	Cheese	Dual Plant		Butter	Cheese and Dual Plant
Auckland	69	38	4	111	25,593	1,610
Taranaki	57	71	31	159	3,429	4,045
Wellington	29	51	6	86	6,634	1,859
Hawke's Bay	12	17	1	30	4,673	789
Nelson	7	2	1	10	1,763	92
Marlborough	6	4	1	11	851	180
Westland	10	1	—	11	794	8
Canterbury	13	14	1	28	7,679	531
Otago and Southland ..	10	77	1	88	6,403	3,689
Total (1933) ..	213	275	46	534	56,819	12,803

Dried milk, condensed milk, sugar of milk and casein are all manufactured in New Zealand but relative to butter and cheese production, the amount of these subsidiary dairy products is small.[3]

Dried milk manufacture is localized chiefly in the Auckland Province and of the five factories three belong to the New Zealand Co-operative Dairy Company Ltd. Of the two condensed milk factories one is situated in the Auckland Province and the other in Southland. Sugar of milk is made

2. An authoritative publication issued by the Dairy Control Board states that with whey butter at 1/- per pound F.O.B., there is possible an extra pay-out of .72d. per pound on butterfat. Duncan and Pottinger.'

3. The total value of all subsidiary dairy produce is only about 5 per cent. of the value of butter and cheese manufactured.

only in Southland. Casein factories are situated only in the North Island. For the final processing of casein the New Zealand Co-operative Dairy Company maintains one central factory, to which is sent the semi-processed raw material from eleven precipitating stations.

III. PROCESSING

A. Assembling of Products

Originally, whole milk was delivered to both butter and cheese factories or to creameries as the basic raw material, but the advent of home separation has led to important differences. Home separated cream is now the raw product for practically all butter factories. Home separation was already important before the war, and in the years which followed the war the relative merits of the two systems were hotly debated. The advantages which creamery separation could still maintain in the matter of quality were balanced against the economies in collection and in the larger scale of factories which accompanied home separation. Thereafter, home separation gained ground at an accelerating rate, the movement being strengthened as it was found possible to improve the quality of cream by grading and educative propaganda.

Home separation cheapened the cost of collection, eliminated the local creamery, and encouraged the tendency towards the growth of large, centrally situated factories drawing supplies from extensive areas. At the same time it facilitated the extension of the industry into remote and more poorly roaded areas from which the delivery of whole milk was difficult. Hence the complete change to home separation is one of the most significant of post-war developments in the industry.

As a general rule, each factory arranges for the collection of cream. In more closely settled districts, the cream carrier collects the cream from the farmer's gate each morning, while in less populous districts cream is conveyed to a 'dump' where it is collected by the carrier, 'empties' being returned on the same journey. The cream is delivered to railhead or factory. In some cases collection is made by factory lorries, in others by private carriers on contract. The collection of produce for cheese factories is a much smaller problem because the cheese factory demands whole milk. Hence the radius from which it can draw its supply is very much less and the bulk of the milk is such that collection by carriers is more difficult. Milk is carted by the farmers themselves every morning. The larger farmers use a motor lorry although the horse waggon is still predominant. Because of individual delivery of a bulky product, the radius of supply rarely exceeds three miles, although occasionally a five-mile radius is found. For this reason, centralization of cheese manufacture is not possible as in the case

of butter manufacture, and as a consequence cheese factories tend to be much smaller in size of output than butter factories.[4]

B. Overlapping and Overcapitalization

Efficiency in collection, more especially in regard to cream, is seriously impaired by severe competition between the various companies for supply. This results in a very serious overlapping of collecting systems with a consequent increase in cost. An illustration which is more or less representative will suffice.

In one district which is 12 miles from the nearest factory or railway, there are about 24 farms. No farm would have more than two cans per day in the flush months of the year; four carriers from four factories travel the district every day and each collects less than a quarter of a load.

The loss which must result to the factories throughout the Dominion from this cause must be very great.[5] In the above case three of the factories are co-operative and one proprietary. Attempts to solve the problem are almost always under consideration. Everybody realizes the problem, but parochial jealousies prevent a solution.

In addition to the direct loss due to increased cartage costs, there is also the problem of road maintenance. The heavy lorries which are used involve heavy maintenance costs for roading, and the latest attempts to solve the problem originated with certain county councils who desire to cut costs.

Closely allied to the above is the problem of the radius from which cream is drawn. The average radius over which supplies of butterfat were drawn from a sample of 60 butter factories was 28 miles, or an average area of approximately 175 miles per factory. This is an average, but individual cases are known where factories draw supplies from areas 200 miles away by rail. In one case a proprietary factory maintains a lorry service to areas 60 miles away from the factory, the lorry passing on its daily trip no less than eight or nine factories, while there are at least 20 factories nearer than the factory to which the butterfat is ultimately carted. The waste here is apparent. While this is a separate problem from that of overlapping, it is obviously closely dependent upon it.

Unfettered competition in this sphere is very wasteful and results in considerable loss to the farmer, as well as to the community as a whole. Competition which was very severe a decade ago between proprietary and co-operative factories is not entirely quiescent, but it is of much smaller importance than warfare between rival co-operative factories. The usual resort of members of a co-operative concern who are dissatisfied or dis-

4. See Dairy Industry Commission Report, 1934, paragraph 254.

5. Estimates up to £150,000 per annum are given in the Dairy Industry Commission Report, 1934, paragraph 252; but the Report states: 'It is not improbable that the benefits resulting from improvement in quality will be considerably more important than the savings in costs'

gruntled for any reason is for them to shift to a rival co-operative factory. In the past dissatisfied suppliers frequently seceded and started a new co-operative factory. The waste and overcapitalization which such a method occasioned has recently led to regulations preventing the establishment of new factories except under licence from the Government.

In certain districts proprietary factories, taking advantage of the jealousy and competition among co-operative concerns, have tended to grow in strength of recent years, though the industry is, and always will be, predominantly co-operative, and over a period proprietary concerns have lost ground to the advantage of co-operative enterprises. It is not without significance that a proprietary factory erected in the Waikato of recent years claims to have one of the largest outputs for a single factory in the world.

The prevailing low prices have strengthened the urge towards co-operation between factories, though the extent to which this will progress is an open question.

C. Company Organization

1. *Types of Administrative Organization*

The following table shows the organization of dairy factories in New Zealand for the year ended March 31, 1933:—

TABLE CLIX

Character of Organization

Individual	9
Partnership	1
Registered Companies—	
Public	9
Private	23
Co-operative and Miscellaneous	435*
Total	478

*Includes one municipal.

The above table shows the number of factories. The number of companies will be smaller since many companies operate more than one factory.

The table shows the preponderance of co-operative concerns.[6] Many of the private registered companies are one-man or family concerns and are small in size as also are those owned by individuals or in partnership. Some of the registered (public) proprietary concerns are very large, as also are many co-operative companies. The New Zealand Co-operative Dairy Company is one of the largest (if not the largest) co-operative dairy companies in the world.

6. Since the industry is preponderently co-operative in character, detailed problems of organization, administration, finance, etc., are discussed in the chapter on Co-operation (Chapter XXXIV).

2. Types of Factories

The following table shows the organization of the dairy factories according to type of factory:—

TABLE CLX

Character of Organization

Table Showing for Butter, Cheese and Dual-plant Factories the Type of Control in 1930-31[7]

	Butter	Cheese	Dual-plant
Individual	1	11	1
Partnership	—	1	—
Reg. Companies (Proprietary)—			
Public	4	1	—
Private	23	—	—
Co-operative and Miscellaneous ..	108	183	141
Totals	136	196	142

Proprietary butter factories in the form of private registered companies are fairly evenly distributed throughout New Zealand although in point of number of suppliers and quantity of output Auckland proprietary factories are the largest. Thirteen of the twenty proprietary factories producing cheese are in Canterbury and are practically all of very small size.[8] This merely reflects the fact that dairying is a side line in Canterbury. It is rather significant that there is only one proprietary dual-plant factory and this is situated in Otago. In South Auckland and Taranaki there are one or two fairly large proprietary butter factories. There is only one really large cheese factory. This factory, situated at Te Aroha, Auckland, is, however, organized as a dried milk factory which has made cheese recently owing to the poor market for dried milk. There are no other large size proprietary cheese factories in dairying provinces although there are one or two medium-sized proprietary cheese factories in Otago and Southland.

3. Place of the Proprietary Concern

While, in general, the advantages to the farmer are overwhelmingly in favour of the co-operative form of organization, both directly and because of the competitive influence they exert on the policy of proprietary concerns, it is still true that the proprietary concerns have played a useful part in the development of the industry. In many districts proprietary concerns pioneered the factory movement, and were prepared to take the risks associated with a new, and in the beginning, unfamiliar type of enterprise. Thus the huge New Zealand Co-operative Company had its origin

7. Later analysis not available.
8. These are probably small farm plants, however.

TABLE CLXI

Capital Investment in the Dairying Industry

*Table Showing the Capital Invested in Cheese, Butter and Dual-plant Factories as at March 31, 1929 to 1931**

Year	Cheese			Butter			Dual			Total†		
	Land and Buildings	Machinery and Plant	Total	Land and Buildings	Machinery and Plant	Total	Land and Buildings	Machinery and Plant	Total	Land and Buildings	Machinery and Plant	Total
	£	£	£	£	£	£	£	£	£	£	£	£
1927	298,753	258,138	556,891	517,987	533,329	1,051,316	1,029,042	900,440	1,929,482	2,076,418	1,837,219	3,913,637
1928	314,602	270,132	584,734	577,114	525,783	1,102,897	1,008,678	802,721	1,811,399	2,135,920	1,732,314	3,868,234
1929	341,375	286,519	627,894	549,350	560,994	1,110,344	1,028,308	765,996	1,794,304	2,160,567	1,743,480	3,904,047
1930	316,625	283,524	600,149	574,217	588,795	1,163,012	959,376	768,496	1,727,872	2,095,236	1,799,858	3,895,094
1931	314,644	271,131	585,775	579,704	589,843	1,169,547	968,378	752,467	1,720,845	2,110,184	1,777,940	3,888,124

*Later statistics do not distinguish between butter, cheese and dual plant factories

†Total includes dried and condensed milk and casein factories

in private enterprise. Frequently, though not universally, proprietary concerns cater for the needs of small suppliers with whom dairying is of subsidiary importance. Such concerns tend to be located at strategic points in respect of transport, cream being sent long distances by rail, and often passing co-operative factories en route. It will be apparent then, that the more difficult task of organizing processing for the small supplier has fallen to the entrepreneur. The small suppliers are usually scattered over wide areas. Their interests at stake are usually small, so that the urge to co-operate is not strong, while the scattered nature of suppliers precludes any strong community of interest, which is a necessary basis of co-operation.

D. Capital Invested

1. *Statistics*

As has already been noticed there are three major types of dairy factory in New Zealand: butter, cheese and dual-plant. There are, of course, dried milk factories, condensed milk factories and casein factories, but as the total value of these products is only about 4½ per cent. of the value of butter and cheese manufactured they are of relatively small importance. Further, since the operation of these concerns is in the hands of one or two firms it is impossible to obtain details of figures as to the financial organization.[9]

Hence, in this and subsequent sections, discussion will centre around the butter, cheese and dual-plant factories. Further, while the figures for butter and cheese plants respectively are comparable with the figures for previous years, the figures of output and costs of production in dual-plant factories are not so comparable, as it will be obvious that the output and costs will vary from year to year according to the proportions of butter and cheese made. One further word of caution is necessary. The method of collection of the statistics and the different accounting methods adopted by the different factories make possible large absolute errors. It is impossible to say if these errors will cancel out. However, there is some ground for assuming that they will and that the resultant figures are fairly accurate.

Table CLXII

Capital Invested Per Supplier

Table Showing Total of Paid-up Capital, Loans and Reserves Per Supplier as at March 31 Each Year Since 1927

Year	Cheese £	Butter £	Dual £	Total £
1927	98	31	119	59
1928	108	31	127	62
1929	101	31	143	65
1930	102	33	140	73
1931	101	35	146	75

9. The Government Statistician will not publish figures for industries in which there are less than three separate firms for fear of disclosing information to one or other of the competitors.

One caution is necessary in using these figures, namely, that they are accounting figures and do not necessarily represent either sale value or the actual face value of the capital investments. They are arrived at by the usual accountancy methods of cost less depreciation.[10]

2. Capital Invested According to Type of Factory

The fact that the amount invested in dual-plant factories is almost equal to the total of that in butter and cheese factories combined is of considerable interest. The fact that the capital per supplier is always much greater than in either butter or cheese factories and the further fact that in the last three years it has been greater than both of these combined suggests that interest charges are very much greater in this case than in the other cases. Hence dual-plants can only be profitable if these dual-plant factories are, over a period of years, able to pay out a proportionately increased payment to suppliers. This probably has a bearing on the fact that proprietary concerns do not erect dual-plant factories.[11]

The fact that cheese factories have so much greater capital per supplier arises from the necessity of having so many small cheese factories and the practical impossibility of large-scale cheese manufacture. This again suggests that, other things being equal, the returns to cheese-making would need to be proportionately higher than to butter-making.[12]

3. Changes in Capital Invested

The following table showing the total capital invested in all classes of dairy manufacture gives some idea of the progress of the industry as a whole since 1919:—

TABLE CLXIII

Table Showing Capital Invested in Land, Buildings, Machinery and Plant in the Dairy Industry Since 1919

1919	£1,597,615	1927	£3,913,637
1920	£2,190,329	1928	£3,868,234
1921	£3,160,404	1929	£3,904,047
1922	£3,592,158	1930	£3,895,094
1923	£3,252,830	1931	£3,888,122
1924	£3,595,994	1932	£3,877,375
1925	£3,750,538	1933	£3,764,051
1926	£4,365,891		

Omitting electric power works, gas works and electric tramways, the only industries that have larger investments in land, buildings, plant and machinery are meat freezing and preserving, and printing and publishing works.

10. Land, of course, is not depreciated.
11. It should be noted, however, that a 'dual-plant factory' is not necessarily capable of making a whole season's butter but is equipped with butter-making plant largely to cope with the winter supply of butterfat when cheese is not being made.
12. This is in addition to the extra returns necessary to recompense the cheese farmer for the fact that he has no skim milk for pig raising.

E. Size in Relation to Efficiency

There appears to be no uniformity of opinion as to what is the most profitable size of factory. Even factory managers and company secretaries have very vague and varied opinions. Nor is this surprising when one bears in mind the complexity of the underlying factors.

The conditions determining the optimum size are varied and extremely difficult of statistical treatment, especially as the statistics of different factories are frequently not on a comparable basis. So the problem must be approached on general *a priori* grounds.

At the outset we must distinguish between the most economical size of factory and of company. The most economical size of factory will be determined, in the main, by the point of balance between the additional diseconomies which may result from an expansion of the area over which supplies are drawn—whether expressed in terms of added cost of transport or of an increased expenditure of time and effort by the farmer—and the additional internal economies of production which may result from an increased size of factory. It will be apparent that the cost of collection will be conditioned not only by the area covered, but also by the per acre yield of butterfat, the state of the roads and the nature of the transport service available. For example, if supplies can be carried by rail the average cost of haulage may be very little increased by an extension of the area covered.

There is some reason to expect that, up to a point, the technical economies of processing lead to increasing returns to increasing size, but these are likely to be less marked than in most manufactures, since the scope for the division of labour is less, and after a point fairly quickly reached, an extension of output requires an almost equivalent increase in plant and labour. This applies somewhat more strongly to cheese than to butter. Increasing costs of collection then become the main limiting factor affecting size of factory. For reasons already discussed, the diseconomies involved in collection increase more sharply with increasing area of supply in the case of cheese than of butter, and this factor, together with the smaller technical economies associated with size of factory, cause the optimum size of cheese factories in terms of, say, butterfat used, to be less than of butter factories.

When once the optimum size has been reached in respect of factories, it may still be possible by amalgamation or federation to effect further economies in the direction of lower administrative costs, cheaper supplies, more effective marketing, the development of subsidiary or auxiliary enterprises, the avoidance of overlapping, and so on.[13] On the other hand, it should be mentioned that subsidiary enterprises have not always been suc-

13. For a discussion of these aspects of the problem, see Chapter XXXIV.

cessful, and there may be a temptation for the larger companies to undertake risks and engage in undertakings which they cannot efficiently manage and which are a source of weakness rather than of strength.

It will be gathered that no very satisfactory conclusions can at present be drawn as to the most economical size of dairy factory. All that can be said is that the diseconomies involved in extending the area over which supplies are collected will exercise a more significant influence than increasing technical economies of large-scale production, and that they will so differ from district to district that the optimum size of factories will also differ; that the optimum size of factory will be smaller for cheese than for butter;[14] and that after a point fairly quickly reached, any further economies are more likely to be derived from amalgamation or federation than from extending the size of factory. Even in this last regard, there will be a point beyond which increasing problems of management will limit the extent to which further economies can be derived from an increase in the size of business unit by the process of amalgamation or federation. Except possibly in the case of New Zealand Co-operative Dairy Company, which is possibly as large a unit as can be efficiently managed, it would not appear likely that this point has been reached.

The practical problem is, then, to determine the optimum size of factory unit on the basis of rough practical judgments, and to encourage the extension of units of control by such agreements as are consistent with geographical or commodity community of interest.

One point is worthy of notice, namely, that some of the butter factories with a very large number of suppliers are not necessarily very large butter factories. Thus, in the case of some such factories in Hawke's Bay and Canterbury, the output is relatively small owing to the fact that the supply comes from sheep farming districts where dairying is only a sideline.

14. The Dairy Industry Commission (paragraph 254) classified dairy factory units on an output basis for 1934 as follows:—

Butter Factories		Cheese Factories	
No. of Factories	Output (Tons)	No. of Factories	Output (Tons)
49	1- 200	48	1- 100
38	201- 600	76	101- 200
31	601-1,000	48	201- 300
14	1,001-1,400	50	301- 400
7	1,401-1,800	39	401- 500
7	1,801-2,200	20	501- 600
3	2,201-2,600	9	601- 700
6	2,601-3,000	9	701- 800
3	3,001-3,400	6	801- 900
2	3,401-3,800	1	901-1,000
1	3,801-4,200	4	1,001-1,100
1	4,201-4,600	6	1,101-1,200
—	4,601-5,000	1	2,300-
1	5,001-5,400	Total No. of Cheese Factories = 317	
Total No. of Butter Factories = 163			

The Commission's discussion of size in relation to efficiency is given in paragraphs 255-257 of the Report.

F. Relative Importance of Butter and Cheese Production

1. *Utilization of Butterfat*

The following table, drawn from the Dairy Industry Commission's Report, 1934, page 164, shows the utilization of butterfat for the manufacture of butter and cheese.

Table CLXIV

Utilization of Butterfat

(in millions of lbs.)

Season	Butter	Cheese*	Other Purposes
1903–4	46·5	4·6	9·9
1913–14	63·5	32·5	13·8
1923–24	145·8	63·8	18·9
1933–34	308·0	93·7	25·0

*Including whey butter.

In the decade prior to the war the most rapid development occurred in cheese making, but thereafter the output from butter factories increased nearly five-fold in twenty years while that of cheese factories trebled. At the present time about 72 per cent. of the total butterfat production of the Dominion is processed into butter.

Relevant to the question under discussion here is the butterfat per supplier. The following table gives particulars of this from 1927 to 1933:—

Table CLXV

Butterfat Per Supplier

Butterfat, in lbs., Supplied Per Supplier to Butter, Cheese and Dual-plant Factories from 1927 to 1933 (March years)

Year	Butter	Cheese	Dual	Total
1927	2,785	5,813	7,005	4,115
1928	2,925	6,119	6,738	4,164
1929	3,178	6,419	7,037	4,115
1930	3,475	6,395	7,769	4,802
1931	3,403	6,412	7,994	4,862
1932	4,200	6,540*	—	4,800
1933	4,740	7,400*	—	5,200

*Including dual plants.

The smaller amount per supplier in butter factories illustrates further the point made earlier that though butter factories are larger and have a much greater number of suppliers, many suppliers are very small. The mixed farmer and the farmer with a few cows does not usually supply a cheese factory. The size of the supply to the dual-plant factories is of interest; and it is significant that dual-plant factories are situated not only in the more closely settled districts but also in the more truly-dairying districts where casual and small supply is less important. The general rise

in butterfat per supplier during the past few years is indicative of the fact that lower prices have stimulated greater carrying of stock in an endeavour to offset lower prices.

2. Distribution of Butter and Cheese Production

The following table gives some indication of the distribution of butter and cheese production in New Zealand:—

TABLE CLXVI

Butterfat Per Supplier in the Various Provinces in 1931[15]

Province	Butter lbs.	Cheese lbs.	Dual lbs.	Total lbs.
Auckland	5,039	12,706	7,815	6,268
Hawke's Bay	2,057	7,458	4,339	2,926
Taranaki	5,988	12,465	10,721	9,280
Wellington	4,323	9,373	7,835	5,454
Marlborough	2,009	4,490	4,158	2,478
Nelson	2,182	5,971	—	2,362
Westland	3,157	8,296	—	3,238
Canterbury	1,188	5,559	1,266	1,380
Otago	995	4,090	1,008	1,340
Southland	1,052	4,059	5,850	3,148
New Zealand	3,403	6,412	7,994	4,862

The predominance of Auckland and Taranaki are well marked, followed by Wellington. The concentration of Auckland on butter and Taranaki on cheese is easily deducible. The consistently larger supply to cheese factories is, of course, further indication of the fact that cheese supply is almost wholly from farms which are wholly dairying while butter suppliers frequently include other than purely dairy farmers.

G. OVERRUN

The figures in the above tables relate to butterfat. It is important to note that butterfat is not the only ingredient in butter and cheese (butter includes moisture and salt as well as butterfat) so that butterfat received and butter or cheese produced will not coincide, though there will be a fairly constant relationship between them for the country as a whole.

The addition of moisture and salt to butter is carefully regulated not only in the general interests of the community but also in the interests of suppliers for whose protection provision is made for obtaining a certificate of 'overrun' to be given annually. If dissatisfied, suppliers can obtain an independent certificate.[16] The term 'overrun' signifies the surplus weight

15. More recent figures not available.

16. No supplier has any idea of how much butterfat he is delivering in his milk or cream and slight 'cribbing' in weighing and testing will result in increased overrun in butter and yield in cheese leading to increased price per pound of butterfat but with no advantage to the supplier because he gets this increased price on less pounds of butterfat or on a lower test for his milk or cream. Thus an impression of efficiency can be created while in fact real inefficiency may be masked. This device of under-reading weights on tests is frequently adopted as by doing so an additional 'pay-out' per pound of butterfat is possible.

of butter produced over butterfat supplied. Inefficient manufacture, by having less than the maximum overrun allowed, deprives the suppliers of profit, while too much overrun allowed means that the butter cannot be exported. Hence the manufacturing process is carefully regulated so that approximately the correct amount of overrun is always present. The normal overrun is between 20 and 23 per cent. although overruns of 25 per cent. have been shown. It is certain, however, that this is an error as available annual statements of companies practically all show less than this figure, and, further, an overrun of over 23 per cent. is technically impossible.[17]

IV. THE PROBLEM OF QUALITY

Attempts are made to encourage the production of dairy produce possessing a high and uniform quality. These attempts are in the direction of research, education and Government regulation. Research activities are mainly centred at Massey Agricultural College, in which is housed the Dairy Research Institute, although the Department of Agriculture is also active.

Education and regulation are closely connected, for regulations in regard to conditions of production or quality not only establish ideals as to quality, but also tend in practice, in some direction at least, to be linked with constructive suggestions. In addition, the advice of officers of the Department of Agriculture in farm or factory, and classes for factory managers at Massey Agricultural College, have had a useful influence in improving quality. Regulations in regard to the grading of cream, butter and cheese, associated as they are with price differences, together with the display of dairy produce at annual shows all exercise a competitive influence in improving quality.

The regulations aimed at the maintenance and improvement of quality are very comprehensive and relate, *inter alia,* to the nature and care of dairy machinery, the care of milk and cream and the use of disinfectants on farms; to the registration of factory premises, the grading of milk and cream, the proper branding of containers, the maturity of cheese and the powers of inspectors; and to the grading of dairy produce for export. There can be no doubt that the good reputation of our dairy produce abroad has been largely built up by the efforts of farmers backed by this system of detailed regulation.

Nevertheless there is room for considerable improvement in respect both of farms and factories. The whole matter of quality improvement is fully discussed in the Report of the Dairy Industry Commission, 1934, paragraphs 185-234. The formidable list of recommendations there made

17. See Valentine: 'Overrun,' Bulletin No. 31, Dairy Research Institute.

indicates fairly accurately the defects which, in the Commission's view, still remain. In regard to the production of milk and cream on dairy farms, the Report recommended the introduction of a system of Dominion farm dairy instruction, the licensing of all dairy farmers and the provision of finance for the improvement of deficient farm buildings, equipment and water supplies. In regard to the manufacture of butter, the Report urged the fuller development of daily cream collections, the rationalization of cream collection and the termination of excessive inter-factory competition, the reduction or elimination of bulking-stations for cream, the raising of standards of cream grading and the separate manufacture of cream of different grades. In regard to the manufacture of cheese, the recommendations were directed to raising milk-grading standards, stricter waxing standards, compulsory temperature control of pasteurization and of curing-rooms, prolonging storage periods of spring cheese and modifying the system of pay-out to farmers (now on a butterfat basis) so that the cheese-yielding capacity of milk shall be the chief determinant. In regard to both butter and cheese, the Report recommended bonus-payments for high quality, publication monthly of all factory grading returns, improvement in transport from farm to market, rebuilding or renovation of deficient factories, provision of field laboratories, more frequent inspection of stored products, and greater development of research and education.

Many of these recommendations, when read in conjunction with other proposals for the reorganization of the industry, were clearly designed to remedy abuses which had arisen through the incomplete application of existing regulations. Thus the recommendations by the Commission for the reorganization of the Dairy Board[18] to give it, *inter alia,* powers of internal administration, for the establishment of an Executive Commission of Agriculture[19] to co-ordinate the activities of the several Boards, and for the reorganization of the Dairy Research Institute[20] and the Herd Testing Services[21] are all linked together through their common interest in improving efficiency and through their recognition of the fact that there is, at present, no established 'administrative head of the industry.'

It is impossible to do more than give this brief outline of the problem as seen by the Commission: but it is clear that it was viewed primarily as a marketing problem in which quality was of paramount importance and in which the marketing process was considered as extending from the production of the raw material to the final sale of the finished product.

18. Report: pp. 109-116.
19. Report: pp. 119-121.
20. Report: pp. 116-119.
21. Report: pp. 128-131. The recommendations affecting the Dairy Board and the Executive Commission of Agriculture have now become law.

V. PRODUCTION AND MARKETS

A. Total Quantities Produced

The following table shows the quantity of butter and cheese produced and exported during the ten years 1924-1933.

Table CLXVII

Butter and Cheese Production and Export

(in cwts., 000 omitted)

Year*	Butter†		Cheese	
	Produced	Exported	Produced	Exported
1924	1,653	1,269	1,437	1,594
1925	1,536	1,245	1,520	1,377
1926	1,737	1,168	1,564	1,462
1927	1,809	1,456	1,550	1,493
1928	1,988	1,450	1,782	1,567
1929	2,287	1,636	1,782	1,779
1930	2,342	1,884	1,857	1,813
1931	2,342	1,989	1,858	1,636
1932	2,479	2,186	1,782	1,790
1933	2,975	2,635	2,071	1,983

*Production figures for years ended March 31: export years ended December 31.

†Includes whey butter but not farm butter. Farm butter, which is all locally consumed, approximates 50,000 cwt. annually.

The table shows the rapid increase in production of recent years and the predominating importance of the overseas market which is much more marked in the case of cheese than of butter.

The local market does not offer great scope for the disposal of expanding production. As the butterfat equivalent of all dairy products wasted or consumed locally by humans and by stock amounts to approximately 50 lbs. per capita per annum, the yearly amount required to meet population expansion is in the vicinity of 1,159,000 lbs., equivalent to a 6·38 per cent. increase each year. Therefore it is apparent that overseas markets must be depended upon to absorb our increasing surplus.

B. Distribution of Exports

Of the total butter exported during the seasons 1932-33 and 1933-34, over 98 per cent. went to the United Kingdom. During the same time this market took over 99 per cent. of our exported cheese. The direction of exports is given in the next table. Owing to tariff and quota impositions, trade has virtually ceased with other countries that formerly bought substantial quantities from us. With the closing of these channels of outlet

the position has been materially weakened as we have not yet developed alternative markets. This fact, accentuated by an annual cumulative surplus, presents an acute marketing problem, particularly as other countries have been increasingly dumping their subsidized surpluses in the United Kingdom market.

TABLE CLXVIII

Destination of New Zealand Exported Butter

Country	In cwts., 000 omitted: Years ended December 31st							
	1926	1927	1928	1929	1930	1931	1932	1933
United Kingdom	1,062	1,189	1,158	1,277	1,554	1,962	2,156	2,597
United States ..	23	30	43	10	—	—	—	—
Canada	29	116	200	335	296	4	6	7
Australia ..	35	95	24	—	—	—	2	1
Other	18	26	25	28	34	22	21	35
Totals	1,167	1,455	1,450	1,650	1,884	1,988	2,185	2,640
Percentage to United Kingdom	91	82	81	77	82	99	99	99

This development represents both a rapidly increasing total export and a rapidly increasing concentration on the United Kingdom market. The amount sent to the United Kingdom in 1928 represented about 80 per cent. of our total export while in 1929, although larger in volume, the proportion fell to 77 per cent. Since then our increasing export has been progressively excluded from important markets outside the United Kingdom.

In the case of cheese, the United Kingdom has long been almost a monopoly buyer.

TABLE CLXIX

Destination of New Zealand Exported Cheese

(in cwts., 000 omitted)

Country	In cwts., 000 omitted: Years ended December 31st							
	1926	1927	1928	1929	1930	1931	1932	1933
United Kingdom	1,451	1,479	1,552	1,770	1,809	1,635	1,789	1,981
Other	11	14	15	9	4	1	1	2
Totals	1,462	1,493	1,567	1,779	1,813	1,636	1,790	1,983
Percentage to United Kingdom	99·2	99·1	99·0	99·5	99·7	99·9	99·9	99·9

C. Subsidiary Products

1. *Total Production*

The following table shows the quantities of subsidiary dairy produce exported over the past decade:—

Table CLXX

Quantity and Value of Dried Milk, Condensed Milk, and Cascin Exported during 1926-1933

Year	Dried Milk		Condensed Milk		Cascin	
	Quantity lbs.	Value £	Quantity lbs.	Value £	Quantity cwts.	Value £
1926	10,099,854	309,794	1,224,926	35,278	36,460	106,251
1927	10,865,690	308,101	1,556,695	38,240	46,763	141,388
1928	15,852,086	359,403	1,366,567	33,049	42,134	133,859
1929	11,560,957	301,208	2,175,211	51,379	57,206	167,972
1930	12,870,223	301,688	2,330,612	49,651	57,309	155,575
1931	11,841,170	225,493	1,004,215	20,990	52,917	88,720
1932	14,220,646	236,699	1,812,529	32,422	42,770	59,029
1933	15,679,383	280,578	1,960,689	35,386	48,674	93,742

Figures are not available to show the total manufacture of these subsidiary products, and hence the relation of the quantity consumed locally to that exported cannot be ascertained. However, it is probable that practically all the casein and most of the dried milk is exported, while a larger proportion of the condensed milk is consumed locally. Of recent years some considerable attention has been paid to the manufacture of dried skim milk for local consumption as calf food.

2. *Markets for Dried Milk*

The only large external market for dried milk is the United Kingdom, which, for the past seven years, has absorbed practically 99 per cent. of the exports of dried full-cream powder.[22] Australia has absorbed about 8 per cent. of 'dried milk, other kinds' during the past six years while England has absorbed about 90 per cent.

3. *Markets for Condensed Milk*

As might be expected from the geographical position of New Zealand, a small but steady trade is maintained with the South Sea Islands in all forms of dried and condensed milk, while small shipments have, from time to time, found their way to the East. Until recently Australia was the biggest single buyer, but since 1932 the British West Indies has become the most important market. None of the markets, however, offers a steady demand.

22. Trade statistics classify dried milk under the two headings: (a) Dried, full-cream powder, and (b) Dried, other kinds.

4. *Markets for Casein*

Over a period of years the principal markets have been the United Kingdom, Japan and Germany. The German demand has declined considerably and Japan has become our most important customer, buying rather more than half our annual export in the years 1932-1933.

VI. INTERNAL MARKETING

A. Butter and Cheese

There cannot, at present, be said to be any organized system of local marketing of butter and cheese. In some few cases a definite supply is maintained on the local market, while in a number of other cases firms 'cut in' on the local market to take advantage of any premium obtainable. In some areas several large firms appear to adjust their local supplies of butter so as to prevent any premium being obtained on the local as opposed to the export market. In any case potential competition is sufficient to maintain a parity between local and export returns in the long run, although catch profits are more possible on the local market.

Cheese consumption in New Zealand is very small so that local sales are but a minor factor in the cheese market. However, some concerns who have steady trade connections sell up to half their output locally.

While there is some evidence of a desire for co-operation in local marketing, the present system is haphazard and unorganized. Sometimes direct contracts are made by factories with retailers and this usually results in price-cutting. Again, the exporting agent frequently pirates in on the local market, and, charging only 2½ per cent. commission, thereby gains the product of the factories. Normally wholesalers receive the butter on consignment and sell on a commission ranging from 4 per cent. to 7½ per cent. of the proceeds. In some cases commission is paid on the basis of per lb. of butter sold, the commission then ranging from ½d. to 1¼d. per lb. Like most such agencies there is little permanency in the agreements made as a general rule, and they are usually terminable at will or on short notice.

In the Auckland, Wellington and Hawke's Bay districts the wholesale and retail prices are arrived at by committees which represent distributors and dairy factories. In Taranaki no definite policy is pursued and the supplies to the local market are haphazard and in the long run approximate to the export parity. Owing to the smaller supplies of butter in the South Island, more uniformity is obtained. In Christchurch the price is fixed at the best possible level by the representatives of the three factories supplying the market, while in Otago the factories themselves determine the price.

The net result of such haphazard methods is that there is intense competition for supply on the local market. For instance, butter from the Waikato travels over 400 miles to Wellington where it competes with

butter from surrounding districts. This is possible because the internal wholesale price is usually ½d. to 1d. over the f.o.b. price. A rise in export prices always results in an increase in local prices, but when the market is falling, local prices do not react readily, and this encourages the diversion of supplies to the local market. Retail prices vary from 1d. to 2d. over wholesale prices, but at times even this margin is narrowed by price-cutting.

It is clear that any satisfactory system of local marketing would require some agreement as to the determination of local areas, but concession rates on the railways make the allocation of marketing territory difficult, because distant factories are able to compete with those adjacent to towns.[23]

Butter marketed internally is not graded, but the quality is substantially the same as that of butter exported. Occasionally an inferior churning will be sold internally but as there is a very small percentage of second-grade butter manufactured this is not normal. On the other hand, the cheese marketed internally is of an inferior quality, largely due to lack of maturity. Some processed cheese is marketed and one firm makes Stilton cheeses. These are of very high quality.

Most locally sold butter is patted. The net lowest addition to cost is ¼d. per lb. Usually patting is done by the factory, but sometimes merchants buy in bulk and an allowance of ⅜d. per lb. is made for patting, the allowance being due to losses in the patting process.

B. Whole Milk

In New Zealand, as in other countries, the main problems to be faced in this distribution of fresh milk are to ensure freedom from disease, regularity of supply and economy in delivery.

In New Zealand, as in other countries, it is far from easy to ensure the supply of a milk free from adulteration and bacteriological infection. Stringent regulations govern the production and sale of milk for human use. Milking sheds must be situated in a position free from obnoxious surroundings, and must have concrete floors and suitable cooling rooms and apparatus for the milk. Farmers who sell milk for human consumption must be specially licensed and their appliances are subject to periodical inspection. Milk vendors must have a licensed dairy which must comply with regulations as to milk storage. Frequent inspections for adulteration and quality are made by Departmental Inspectors, and failure to comply with the required standards usually results in a prosecution.

23. The Dairy Industry Commission lists the following defects of the present system of local marketing: uneconomic competition and price-cutting, long-distance invasion of markets accompanied by fierce competition and irregular prices, granting secret rebates, a general atmosphere of suspicion and uncertainty, the use of anonymous butter wrappers to aid price-cutting, excessive number of distributors and consequent high costs of distribution and bad competitive practices, and the use of misleading brands. The Commission considered that 'there is an unanswerable case for control of the local marketing of butter and cheese' and recommended that the task be entrusted to a reorganized Dairy Board.—Report, paragraphs 303-312. The new Dairy Board is vigorously dealing with this problem at the moment, and a rationalized system of local marketing appears certain to evolve.

While the bulk of the supply is 'ordinary' milk in the larger towns, a fair proportion of the milk in the four centres of New Zealand is pasteurized; 'certified' milk[24] is practically not obtainable. The writer knows of only one source of supply for this grade. This dairy is situated near Hamilton and, although the major area of distribution is the Hamilton borough, supplies are daily sent over long distances to special customers.

Although a large proportion of the milk is delivered on the 'dipping' system, since the War there has been a steady development of the 'bottle' system, particularly in the four large towns. Where milk is pasteurized, it is usual for it to be bottled and capped straight from the cooler without human handling at all. In such a case the risk of infection is practically eliminated. Bottled milk usually commands a premium over 'dipped' milk.

The problem of milk distribution costs and methods has been frequently dealt with[25] and it will suffice here to say that uneconomic methods involving overlapping of supply are the rule.[26] In other than the main centres no attempt has been made to solve the problem. Auckland, Christchurch and Dunedin have several large milk supply companies. From time to time these concerns seek to enlarge their control of the market but so far without success. The farmer on the nearby small farm who delivers his own milk, or the small dairyman with a retail shop and a milk round are generally able to compete with the larger firms with their heavier overhead.[27]

In Wellington an interesting municipal milk system is in operation. Under various empowering acts of the general legislature, the municipality was given a partial monopoly of the milk supply of the town of Wellington. The monopoly granted was restricted so as to retain the rights of those dairy farmers within two miles of the city boundary who were vending their own milk within the city. These farmers were on lands which, because of its value as potential building land, was high in price and was subject to high rates. Consequently it was felt that to compel them to sell their milk at wholesale prices to the municipality would inflict a hardship upon them and eventually force them out of business. These farmer-vendors still supply about one-third of the milk of the city of Wellington.

The remainder of the milk vended in the city is supplied by the Municipal Milk Department. The milk is drawn from a radius of 20 miles in the summer months and 60 miles in the winter months. Milk produced within a 30-mile radius is picked up at the farm gate or district 'stand' by lorries under the control of the municipality. In other areas the milk is forwarded by rail. The municipality has an arrangement with two farmer co-operative societies that it will have first claim on the milk supply of the

24. That is, milk from tuberculin-tested cows, handled by disease-free employees, and having a bacterial count of not more than 10,000 to the c.c.
25. See Belshaw: 'The Dairy Industry of New Zealand': Unpublished Thesis, Canterbury College, 1921.
26. The New Zealand *Herald* (Auckland), 9/3/33, quotes one street which was supplied by 29 vendors.
27. Since this was written, a Milk Board regulating the delivery of milk has been set up in Auckland.

members of these associations. In one case it takes all the milk of the society and manufactures the surplus over its requirements into butter at its own factory. In the other case the surplus over the requirements of the municipality is manufactured into cheese by the association.

The milk, on delivery to the Municipal Milk Department factory, is pasteurized and bottled, and no milk is sold other than in bottles. The token system of payment eliminates bad debts. Purchasers buy a supply of tokens and, as a rule, leave a coupon of the requisite denomination in the empty bottle of the previous day. Delivery is undertaken by the municipality and, as the city is divided into blocks, no overlapping takes place. Although considerable savings in distribution expenses have taken place, milk is no cheaper in Wellington than elsewhere; but against that must be set the very marked improvement in the quality of the milk sold.[28]

Although the above system has been successful in Wellington, no similar scheme has been tried elsewhere. The geographical position of Wellington[29] not only demanded some superior control of milk supply to ensure that it would be adequate, but also materially contributed to the success of such a scheme when launched. With the exception of the suburban milk supply, all milk must enter the city by one road or by a railway which runs parallel to the road. Not only are the suburban lands unsuited for dairying, but the main dairying areas lie from 20 to 60 miles away. Hence the process of collection would be very costly if competitive supply was present.

By contrast with this, the other large towns are surrounded by land suitable for dairying without the transport problems facing Wellington. Hence, on the one hand there is not the need for control to secure adequate supply and, on the other hand, there is not the geographical position to ensure its successful working.

'All the year round' dairying in New Zealand is the exception and milk supply for the large towns in the winter is always a problem. On those farms producing milk for human consumption it is estimated that the winter supply is one-third of the summer supply. On account of the regulation governing dairy farms supplying milk for human consumption, the cost of production on such farms is higher than on dairy farms supplying butter, cheese, or other factories. Hence it is usual for such farmers to aim at selling all their milk throughout the year as milk for human consumption. In order to maintain a winter supply, large vendors of milk usually undertake to accept all such supply throughout the year, but since there is normally a surplus in summer months they very often maintain a small butter factory for the processing of the surplus. In cases

28. For the details of the Wellington Municipal Milk Scheme I am indebted to information supplied by Mr. R. E. Herron, General Manager of the Wellington City Corporation Milk Department.

29. At the extreme southern end of the North Island and practically shut in by hills to the north, west and east and by the sea to the south.

where no such contract exists the farmers send any surplus to a butter or cheese factory. With the smaller vendors milk is bought from the farmer or wholesaler at 'per gallon.' The larger factories pay on a 'butterfat' or 'butterfat plus solids' test. The normal price paid is based on the f.o.b. parity of butter and cheese plus a definite allowance for the extra cost involved in producing whole milk for human consumption. Cream for human consumption is normally sold in cardboard bottles of varying capacities.

No adequate figures are available as to the quantity of milk and cream consumed locally. The Wellington Municipal Milk Department estimated in 1931 that the per head consumption was about 12 ozs. per diem. This has fallen since 1931 on account of the depression. Wellington has a large adult population due to the presence of large numbers of Civil Servants. It is thus probable that the per diem consumption is higher elsewhere. A very rough approximation on this basis would give a consumption of over 40 million gallons of milk per annum,[30] or approximately 16 million lbs. of butterfat per annum in the milk and cream consumed. Another computation[31] shows that in the year ended June 30, 1934, 13,200,000 lbs. of butterfat were contained in the milk consumed, and 1,630,000 lbs. of butterfat were contained in the cream consumed locally. These figures represent about 3·2 per cent. and ·40 per cent. respectively of the total butterfat produced in New Zealand.

VII. OVERSEAS MARKETING

A. Selling Policies

1. *Outright Sales Versus Consignment*

Two definite lines of policy are pursued in selling on the London market, to which the bulk of the export surplus is sent: selling on consignment and selling f.o.b. Until recently it was very difficult to obtain adequate statistics as to the quantities sold in these ways, but for the past five seasons 83·2 per cent. of our butter exports and 88·7 per cent. of our cheese exports have been shipped on consignment.[32]

London selling houses maintain representatives in New Zealand and in normal times these representatives negotiate for a considerable quantity of New Zealand dairy produce to be sold to them f.o.b. Several New Zealand houses also operate in a big way in f.o.b. buying. These houses maintain London representatives who sell to London wholesalers the butter which their New Zealand houses have bought, either before or after shipment. The f.o.b. system offers some advantages to the smaller factories

30. This averages about 26 gallons of milk per head per annum.
31. Dairy Industry Commission Report, 1934, p. 164.
32. Dairy Industry Commission Report, 1934, p. 28.

in that they are relieved of the risk of falling prices during the period of transport, while the competition between buyers is such that returns to the dairy companies cannot fall far below the real value of the product. There is some controversy as to the relative merits of selling f.o.b. and on consignment. The latter policy is best if there is an adequate knowledge of the factors likely to affect prices, and probably in the long run losses through falling prices are counterbalanced by gains on rising prices. It also involves either a London selling agency or the use of London houses to sell on commission.

There has been a very marked increase in recent years in the proportion of the produce sold on consignment. The reason for this is the almost complete absence of operations by f.o.b. buyers in New Zealand. Market conditions and market prices have been so uncertain and the risks so great that speculative buying has been practically non-existent. What buying there has been, has been in the nature of 'spot' transactions. Buying 'forward,' that is to say, buying the output for a whole season, has practically ceased. This has certainly led to a greater knowledge of English marketing conditions among dairy factories and, while there is still a marked tendency on the part of the smaller companies to sell f.o.b. when possible, it is not improbable that selling on consignment will become permanently more important among larger companies, though f.o.b. selling is always likely to be more popular among smaller companies. The custom of paying out by way of advances to suppliers up to 90 per cent. of the estimated net realizations in the month following supply means that where a consignment policy is followed, there is always a very real risk of loss should the market fall to any extent; or rather, there is the risk that advance payments will exceed net realizations. In such an event the lack of reserves or the smallness of the reserves of the smaller concerns threatens severe financial strain. Even the possibility of recoupment out of future supply has an element of danger as it might possibly lead to a loss of suppliers to other companies. Hence, with smaller companies the f.o.b. sale provides a minimizing of risk together with an immediate cash return. The fact that f.o.b. buyers prefer small quantities leads them to pay special attention to the smaller factories whose 'lots' are smaller.

2. *The Work of Selling Agents*

The marketing system is haphazard. The usual method in New Zealand is for the directors to notify agents that they will have a disposal meeting at which meeting they will decide to whom they will 'consign' their produce during the year. The representatives of the various agents attend and are admitted one at a time to put forward their propositions. By the very nature of the case, conditions can vary very little and the contract is

usually let to the salesman who is able most effectively to impress the farmer directors. On the other hand some companies maintain a steady connection with one London house. 'F.o.b.' sales are made from time to time during the year.

The establishment of market federations would appear to be a natural development, but mistrust among smaller companies and reluctance to delegate authority have prevented any considerable movement in this direction. It should be noted, however, that the New Zealand Dairy Control Board, which is discussed more fully elsewhere, takes over some of the functions which such federations might exercise, such as bargaining in the matter of freight, arranging insurance and so on.[33]

B. Transport

1. *Transport to Grading Stores*

In the past transport to the point of shipment has usually been by rail in insulated cars. All the grading stores have their own sidings. Of recent years there has been some tendency for motor transport to develop. The obvious advantages are that, since most dairy factories do not have a railway siding, shipping per rail involves double handling which is obviated when motor transport is used, though on occasion the Railway Department has endeavoured to meet this by providing lorries to cart produce from factory to rail. Transport by rail possesses some advantages. Great care is taken to preserve the rail cars in a clean fresh condition. Rail transport also preserves a more even temperature, as butter is exposed to the open air a minimum of time. There may be a serious qualitative reaction when butter is motored long distances which is obviated when it is transferred from the freezing chamber of the company to the insulated rail cars.

Grading stores are always in close proximity to the wharves so that

33. Since the above was written new marketing regulations have been put into operation by agreement between the New Zealand Dairy Produce Importers' Association of London, and the Dairy Board. Under this agreement, which became effective on August 1, 1934, all importers (in the United Kingdom) had to be approved by the Board after consultation with the Importers' Association. Such importers were to be consigning and selling agents only, that is, they could not buy in New Zealand or afloat on their own account, but they could buy 'spot' to fill legitimate trade requirements or purchase f.o.b. to fill the requirements of an ascertained client. These provisions (there are others of less importance) were designed to prevent a firm acting in the dual capacity of consignment agent for a factory or factories and speculator on its own account. They were hotly opposed by firms who had specialized in normal f.o.b. business mainly on the grounds that the regulations prevented their purchasing stocks before they had an assured customer and that without stocks they could not get a 'firm offer.' It was held that all f.o.b. business would cease in consequence.

The regulations were nevertheless brought into operation in August. Their effect was to tighten the Board's control of marketing. The Board prepared a list of some thirty licensed importers, all consignment agents, and of three licensed import brokers who purchase f.o.b. and c.i.f. for United Kingdom clients. For the current season the Board has allotted to each of these licensed importers approximately the same quantities of butter and cheese as they handled during the 1933-34 season and has power to vary the allocations in subsequent years.

These regulations are admittedly experimental. The experience of the few months of the operation makes it clear that the fears of the f.o.b. houses have not been realized. For the five months August to December, 1934, 10 per cent. of butter and 15 per cent. of cheese exports were sold, the balance being shipped on consignment. In other respects the regulations have dangers. The Dairy Industry Commission points out that an Agreement between the Board and the Importers' Association not to add to the list of licensed importers without first consulting the Association may prove unduly obstructive, and that the practice of allotting consignments, for a year ahead, of the whole of our exportable surplus (subject only to subsequent f.o.b. and c.i.f. sales) 'is objectionable because of its inflexibility.'

The regulations are set out in detail and very fully discussed in the Report, paragraphs 53-72.

transport from store to ship presents no important problem. In most cases there is a rail connection and the transfer is usually undertaken by rail.

2. *Overseas Transport*

(a) *Refrigeration.*—Refrigeration is part of the equipment of all overseas steamers trading between New Zealand and England. There is also an insulated service between New Zealand and the east and west coasts of North America. Butter is kept in refrigerated storage throughout the whole journey. With cheese, where the need for refrigeration is not necessary, the temperature is kept at about 50° F. during the journey.

(b) *The Work of the Dairy Control Board.*—Since its inception, the Dairy Control Board has maintained a very keen scrutiny over conditions of transport, particularly transport overseas. Each vessel is examined before, during and after storage of cargo. The general efficiency of the plant is most carefully watched. In this way the Board has done admirable service to the industry.

The Dairy Control Board, acting on behalf of the industry as a whole, negotiates freight contracts and is responsible for the shipping of the produce.

3. *Supervision of Unloading*

The Board's inspection service extends to the English end where the Board's inspector carefully supervises all unloading, including overlooking conditions of barges, cold stores and the general handling of the produce. It is part of the freight contract that London shipments must be unloaded at a specific dock, where all conditions regarding handling the produce are very carefully supervised, and where supervised cold stores are provided.

Prior to the inauguration of this inspection service by the Board, the haphazard methods of handling, together with the varying temperatures in the ordinary stores of merchants, resulted in a definite deterioration of the produce before it reached the consumer. Under present regulations, produce is unloaded into insulated barges and conveyed immediately to cold store where it is sorted under suitable temperature conditions, and whence it is distributed as required to merchants. Similar contracts regarding loading, storage and sorting are in operation at Bristol and Liverpool and arrangements are in train to institute a similar procedure at Manchester and Glasgow when shipments warrant it.

It can thus be seen that, as far as possible, all preventable causes of deterioration during transit are obviated. This must react on the standard of the commodity which reaches the English consumers.

C. Insurance

Marine insurance is also undertaken by the Control Board on behalf of the industry, and covers the product from the delivery of the raw

material to the factory to the cold stores in England. Insurance rates have also shown a sharp reduction since the inception of the Dairy Control Board. It should be noted that this risk is covered under a comprehensive policy with Lloyds in the name of the Board. The valuation rate for insurance is:—

Consignments.—Market price at date of arrival plus 5 per cent.
Consignments Sold Afloat.—Last purchase price plus 10 per cent.
F.o.b. and c.i.f. Sales.—At cost plus 10 per cent.

The fact that the industry is able to act as a unit in relation to inspection and to freight and insurance contracts has been of considerable advantage in many ways, but more particularly financially. Freight rates show a progressive fall; insurance rates likewise illustrate the same movement, and, while some fall would probably have taken place in any case, it seems likely that the united front displayed through the Dairy Control Board has made possible a greater fall than would otherwise have taken place.

D. Organization of Selling in London

1. *The English Selling House*

When dairy produce is sold f.o.b. in New Zealand the buyers are chiefly representatives of English houses. In such cases shipment is made direct to their principals, who organize retail distribution. However, one or two New Zealand houses buy dairy produce in New Zealand. These houses are not agents for English houses but prior to the new marketing regulations, bought on their own account to resell either f.o.b. or c.i.f.e., or 'in store,' England. These firms, having very wide ramifications in New Zealand as stock and station agents, together with very complete statistical knowledge of English market conditions, handle a large proportion of the f.o.b. business in New Zealand.

2. *New Zealand Producers' Co-operative Marketing Association*

One most interesting connection between the New Zealand farmer and the English consumer is the New Zealand Producers Co-operative Marketing Association Limited. Shortly after the War the Co-operative Wholesale Society of England was approached by some representatives of the co-operative side of the dairy industry in New Zealand, with a request that they handle the produce of dairy factories in New Zealand. After consultation it was agreed to form an English company, 'The New Zealand Produce Association Limited,' the two shareholders of which were to be the Co-operative Wholesale Society and the New Zealand Producers' Co-operative Marketing Association Limited. The latter institution was to be formed as the Dominion co-ordinating body. Co-operative dairy factories were to be invited to take up shares in this new concern on the

basis of one share to every 1,000 lbs. of butterfat received by the factory. In this way some 20,000 shares have been subscribed out of a nominal capital of £100,000. Companies joining the Association have the privilege of consigning their produce through it to the London agency, the New Zealand Produce Association.[34] While there is no obligation on this body to sell the produce to the Co-operative Wholesale Society, it normally sells the whole or a large proportion of it, but only at competitive prices. Normal selling commission is charged and profits rebated to the two shareholders.

3. *Produce on Consignment*

Goods for sale on consignment are usually consigned to London houses which act as agents for the New Zealand factories, charging the normal broker's commission of 2½ per cent. In addition to New Zealand produce, these houses also handle other dairy produce, and the diversity of interest was one of the reasons why the Dairy Control Board attempted absolute control. The practice grew up, under pressure of competition, for the New Zealand representatives of the English houses to attend disposal meetings at factories for the purpose of securing consignment business. In many cases factories frequently changed their agents and some divided their output among two or more agents. Under the new marketing regulations whereby the Dairy Board makes the allotments, disposal meetings will probably cease.

4. *Amalgamated Dairies*

The New Zealand Co-operative Dairy Company Limited, which produces over one-third of the butter in New Zealand and has, in addition, a large cheese output, maintains its own selling organization in London, its produce being handled by a subsidiary, Amalgamated Dairies, in which it owns half-shares. The remaining shares are held by its managing director and the London manager of the subsidiary.

5. *Packing of Produce*

Butter leaves New Zealand in 56 lb. boxes and is sold in such form to retailers who weigh out pounds to customers. New Zealand cheeses are normally 80 to 82 lbs., two such cheese being packed in a crate.

Various attempts to develop a 'pat' trade in butter have been tried, but the only considerable operation[35] in this direction is that of the Amalgamated Dairies which maintains a patting factory in London and puts some of its butter on the market in this fashion. Butter is also sold on the Eastern market in pats and tins.[36]

New Zealand butter and cheese must be packed in containers of regula-

34. The privilege of consigning through the Institution is not confined to shareholders, but non-shareholders receive only half of the rebate that shareholders receive.

35. Messrs. Joseph Nathan & Co. Ltd. also maintain a packing factory in England for the use of such factories as wish to sell in pats.

36. A recent development is the export of butter and cheese in 'vacuum tins.'

tion pattern and size. In addition to the fact that each box must be marked with a regulation stencil which shows, *inter alia,* that it is New Zealand produce, the Dairy Board, early in its operations, provided a roller to each butter factory so that each 56 lb. block of butter should be marked with a fernleaf—the national sign of New Zealand. The general purpose of this was to enable the consignee to see that he was buying New Zealand produce.

E. Finance

Banks are the normal source of marketing finance. Butter normally goes to the grading stores immediately it is made, while Government regulations require that cheese be matured for fourteen days before transfer to the grading stores. Before the goods are transferred, the company will have made arrangements as to their disposal. The produce has been sold f.o.b. or has been consigned to a given merchant or merchants.

These merchants lodge a letter of credit with the bank instructing the latter to negotiate drafts drawn on them by a given company (up to a certain amount per month) conditional on the lodging with the bank of bills of lading, invoices, grade notes and specifications. As produce frequently lies at the grade store for considerable periods before shipment, provision is also usually made by means of what is known as the 'Red Letter Clause' in the letter of credit, for banks to advance against store warrants under a guarantee from the merchants. These store warrants are lodged with the banks which then have control over the goods pending shipment, and against these store warrants the banks will make an advance to the dairy companies. When the goods are shipped the advance against store warrants is closed by an advance against shipping documents; the letter of credit being an undertaking by the London house to accept the draft on presentation. The shipping documents are: (1) Government grade notes; (2) specifications of weights (in case of cheese); (3) invoice showing particulars of shipment and amount of advance; (4) draft on merchant to whom produce is consigned for amount of advance. These documents are presented to the banks who purchase the draft. The amount of the advance is fixed from time to time by the London Importers' Association who cable instructions to the banks.

Any surplus over the advance is remitted with an account sales (in the case of consignments) when the butter is sold, or with the invoice in the case of sale when the butter reaches England. Where produce is sold f.o.b. payment in full is made whenever the goods are shipped or in store.

F. Distribution of Dairy Produce in the United Kingdom

The following table shows the predominant importance of London as a port of entry for New Zealand dairy produce going to the United Kingdom:—

TABLE CLXXI

Percentage Distribution of Imports of New Zealand Butter and Cheese into the United Kingdom

	Butter				Cheese			
	1926–7	1931–2	1932–3	1933–4	1926–7	1931–2	1932–3	1933–4
London	90	82	76	75	89	79	79	79
Avonmouth	3	5	6	6	4	6	6	6
Liverpool	2	5	6	6	2	5	5	5
Manchester	2	4	7	7	2	5	5	5
Glasgow	3	4	5	6	3	5	5	5
	100	100	100	100	100	100	100	100

There has thus been a steady increase in volume and proportion of our dairy produce, notably butter, shipped direct to ports other than London. This has been in line with the definite policy laid down by the Dairy Board.

VIII. PRICES

A. SEASONAL MOVEMENTS IN SUPPLY AND PRICES

1. *Relation of New Zealand Supplies to Price Movements of New Zealand Produce*

The following tables and supporting graphs show the monthly averages for ten years of the prices of butter and cheese of New Zealand production:

TABLE CLXXII

Seasonal Variations of Prices

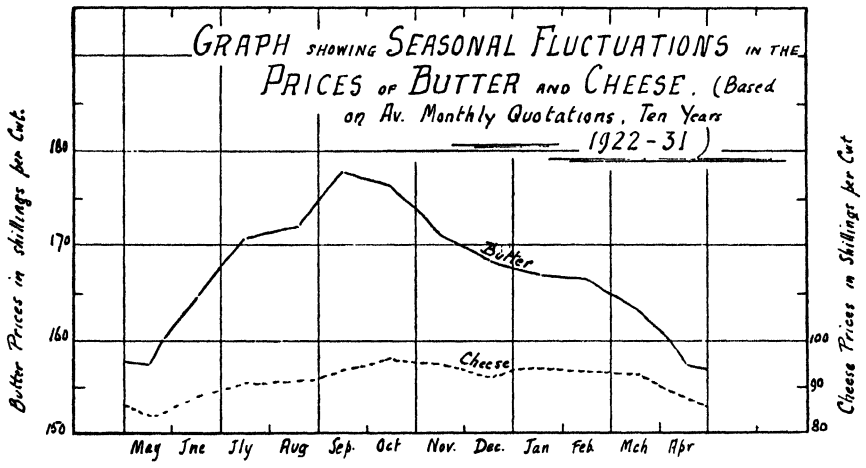
Monthly Average Prices for (a) the Ten Years 1922-31; (b) the Three Years 1932-34, of New Zealand Butter and Cheese on the London Market

(shillings per cwt.)

Month	Butter		Cheese	
	1922–31	1932–34	1922–31	1932–34
January	167	82	94	50
February	166	84	94	50
March	164	85	92	49
April	157	81	88	48
May	157	83	84	49
June	164	84	87	51
July	171	86	90	52
August	173	92	91	53
September	178	98	94	54
October	176	90	96	55
November	171	84	95	55
December	168	75	92	50

The above table and graph No. 1 show unmistakably the seasonal nature of price variations. In each case the low points occur about April-

May and the peaks about September-October. The general contour of the two lines is almost identical, and the seasonal movement is consistent whatever the prevailing level of prices.



Graph 1

2. *Relation of New Zealand Supplies to the Total Supplies on the English Market*

(a) *Butter.*—The following table shows the monthly percentages of total annual imports of butter and cheese into the United Kingdom provided by New Zealand:—

TABLE CLXXIII

Percentage of New Zealand Butter and Cheese to Total United Kingdom Imports of Butter and Cheese Month by Month: (a) 1922-31; (b) 1922-25; and (c) 1928-31

Month	Butter			Cheese		
	1922–31 %	1922–25 %	1928–31 %	1922–31 %	1922–25 %	1928–31 %
January ..	32·3	29·8	32·7	89·7	83·2	96·0
February ..	32·2	33·7	30·4	95·6	92·7	99·3
March ..	32·1	30·1	33·4	94·8	92·5	98·8
April ..	25·5	28·5	24·2	96·2	94·0	98·8
May	23·1	27·3	20·5	92·6	91·5	94·8
June ..	17·6	23·2	13·2	81·7	79·0	81·5
July	13·7	14·4	13·3	52·0	42·1	58·9
August ..	12·8	8·6	14·9	44·0	34·1	48·8
September ..	8·8	5·6	11·7	36·9	17·2	36·6
October ..	10·6	6·0	13·2	9·9	5·4	16·2
November ..	23·5	23·2	26·2	27·6	17·6	35·6
December ..	25·7	23·3	26·8	55·3	46·8	66·6
	21·9	22·3	22·1	63·2	56·7	69·9

There is a very distinct inverse correlation between the price curve of butter and the curve of supply. When New Zealand is supplying a relatively large proportion of United Kingdom imports, prices are relatively low, and vice versa, and the association of the Australian supply with that from New Zealand, makes the relationship between seasonal supply and seasonal price clearer.

The following table approaches the matter from a different angle and shows the monthly distribution of the New Zealand supply to the United Kingdom market expressed as percentages of total New Zealand annual arrivals:—

TABLE CLXXIV

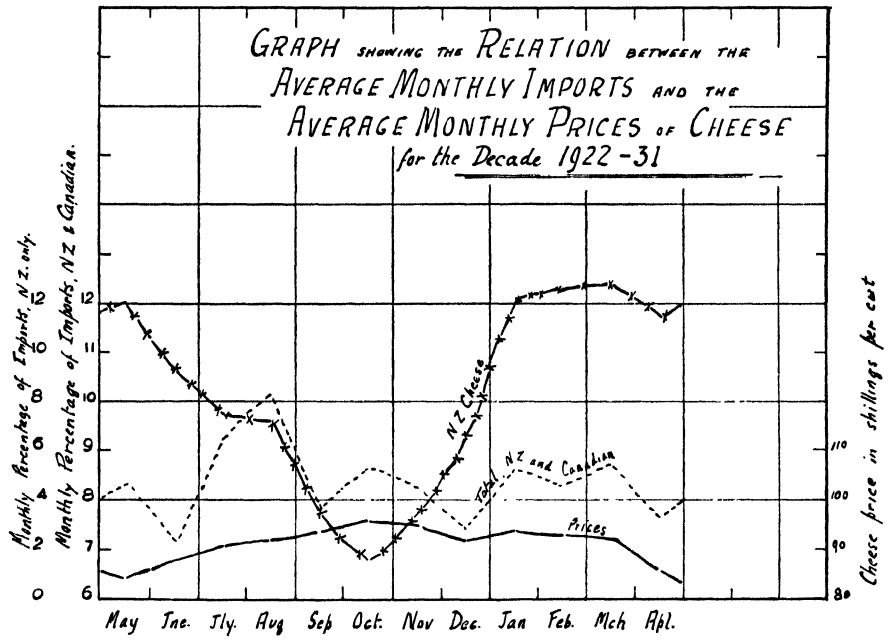
Monthly Arrivals of New Zealand Butter and Cheese into the United Kingdom

Average Monthly Percentages of Arrivals of New Zealand Butter and Cheese into the United Kingdom for the Period 1922-31

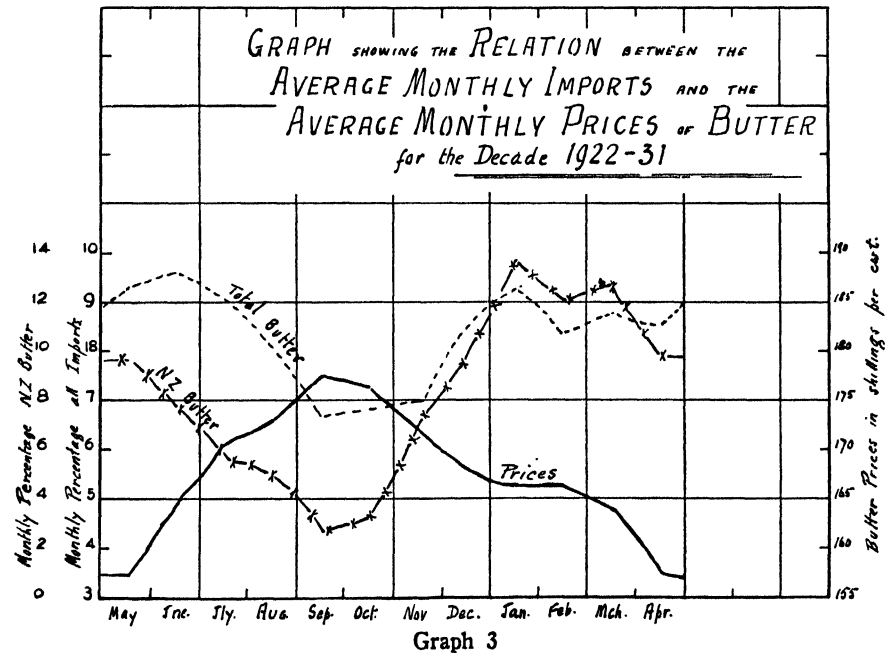
Month	Butter: 1922–31 %	Cheese: 1922–31 %
January	13·7	12·1
February	12·2	12·6
March	12·8	12·8
April	9·8	11·4
May	9·7	12·0
June	7·7	9·4
July	5·7	7·5
August	4·8	7·2
September	2·7	3·2
October	3·3	1·8
November	7·6	3·5
December	10·0	6·5
	100·0	100·0

Graphs 2 and 3 show the relationship between average monthly arrivals and average monthly prices.

It can be seen that there is a relatively large supply of butter on the English market in March, April and May, owing to the overlapping of supply from the Northern and Southern Hemispheres. With the small supplies from the Southern Hemisphere in the Northern summer prices tend to rise in June, July and August. September and October witness a falling off in Northern Hemisphere butter while new season's Southern Hemisphere butter has not arrived. Consequently, there is a relative scarcity and higher prices. Southern Hemisphere butter is present in increasing quantities from November to February, and this, coupled with a decline in demand in the winter, causes a fall in prices. The flattening of the curve in January and February is due to this being the period of lowest supplies from the Northern Hemisphere.



Graph 2



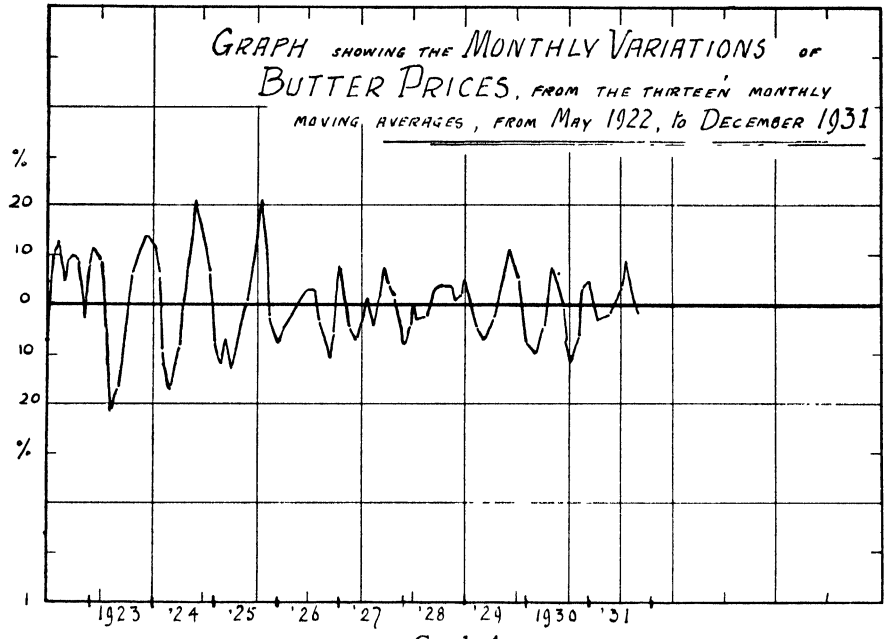
Graph 3

The above discussion makes no reference to butter stocks held. This has a most important bearing on the question of prices. Adequate statistics of stocks are not available for any considerable period, but such as are available show that the curve of stocks follows very closely to the curve of total imports. There tends to be a steady increase in stocks from January to June-July, and then a fairly steady fall to December. Statistics showing stocks of New Zealand butter reveal the same tendency. Stocks of Northern Hemisphere butter are practically nil during the first five months of the year so that the large stocks in June and July are largely Southern Hemisphere box butter. Stocks of Southern Hemisphere butter are greatest in August, falling rapidly to January. The decline in demand in the winter, causing a large increase in stocks in May, June and July, is a definite factor in the lowness of prices in May and June.

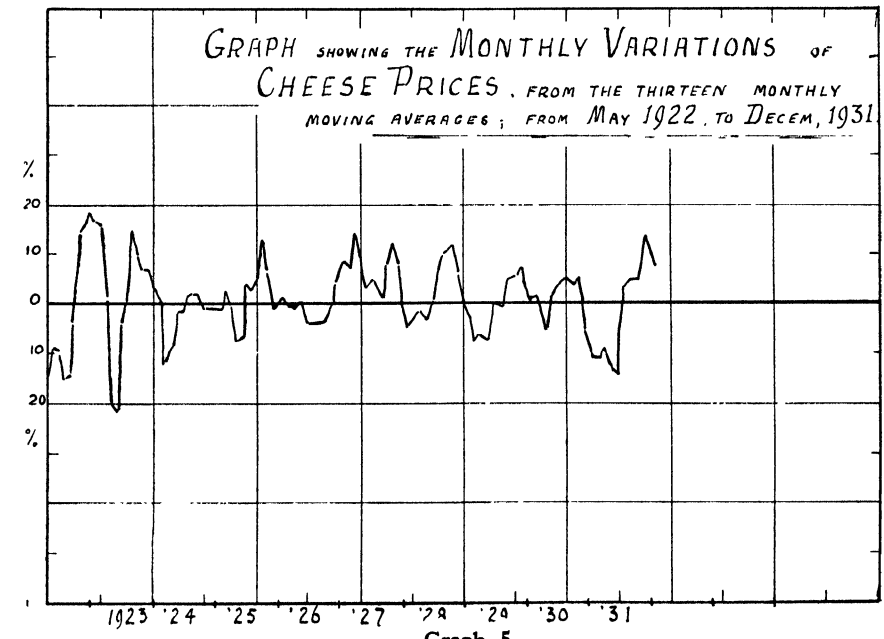
Unlike butter, which is subject to extensive competition from Australia, Argentina, Denmark, some of the Baltic countries, the Irish Free State and England, New Zealand cheddar competes with Canadian and English cheddars only. There will, of course, be some indirect competition from the hard Continental cheeses, but this competition being indirect is difficult to analyse and will not be discussed herein. As noted above, the curve of cheese prices is fairly regular and follows roughly the contour of the curve of butter prices. There is not, however, such a noticeable correlation between seasonal movements in supply and price as in the case of butter. There is some indication of an inverse correlation between the price and the supplies of New Zealand cheese. Since New Zealand has supplied between 60 per cent. and 70 per cent. of the total from New Zealand and Canada during the past decade, this is what might be expected. There is a similar correlation between Canadian price and supply. However, since the New Zealand and Canadian price curves tend to run together between July and November and thereafter prices for Canadian cheese tend to rise fairly considerably during the remaining months of the year which are the non-producing season in Canada, there is the suggestion that for some reason Canadian cheese meets a demand which is not met by New Zealand cheese. With a lag of about two months, the curve of stocks of New Zealand cheese follows the contour of the imports curve and the inverse correlation between stocks and prices is also noticeable.

2. *Seasonal Fluctuations in Relation to Orderly Marketing*

Graphs 4 and 5 show the monthly variation of butter and cheese prices respectively from the 13 monthly moving average and indicate the seasonal swing of prices.



Graph 4



Graph 5

The above graphs reveal wide monthly and seasonal variations between 1922 and 1925. The swing was much less wide between 1925 and 1928, and although marketing conditions caused some extension of the swing in 1929-30 in the case of butter, it is still less than in 1922-25. The graphs seem to indicate some benefit from the Control Board's policy, in the smoothing out of supplies.

It would appear that policy should be directed to concentrating supplies when the seasonal rise in prices takes place in England, i.e., between July and October, rather than in promoting a regular monthly flow. With this end in view, it is sometimes suggested that stocks should be maintained in New Zealand. A further suggestion is that attempts should be made to modify the productive season so that a larger supply might be available on the English market in these months. Both these proposals involve additional costs while the former also raises administrative difficulties. While some advantage might be expected to accrue from a variation in the flow of produce on the London market in the direction suggested, it is not clear on *a priori* grounds how far such a policy might be pursued with profit.[37]

B. Prices in Relation to Quality

The preponderance of finest and first quality butter graded so outweighs lower grade that the price quoted for finest and first can be accepted as the ruling price for New Zealand butter. The proportion of different grades in the season 1929-30 and 1933-34 were:—

Finest	76·30%	78·00%
First Grade	22·33%	20·75%
Below First	1·37%	1·25%

With cheese the position is slightly different, but here again the amount graded as lower than first quality is negligible, the proportion for the same reason being (1929-30 and 1933-34):—

Finest	23·61%	26·04%
First Grade	74·46%	72·06%
Below First	1·93%	1·90%

C. Relations Between Danish and New Zealand Prices for Butter

Except in May and June, Danish butter tends to receive a marked premium over New Zealand butter, in fact over all Dominion butters. The first reason is the superior marketing arrangements of the Danes, who, being only twenty-four hours from the market, are able to maintain direct contracts covering closely arrangements as to the quantity supplied to

37. These two proposals are more fully discussed in Report of Dairy Industry Commission, 1934, paragraphs 105-107.

retailers and distributors. These direct contracts cover most of the butter produced and leave only a small quantity of butter for the open market. As the price of the contract butter is determined by the price of the free butter for which the competition is keen owing to the small quantity, Danish butter usually commands a premium. Further, supply conditions are more closely adjusted to consumer demand, a factor which operates right back to the farmer. Then again, Danish butter is fresh and more spreadable than frozen Dominion butter. Finally, the Danes practically monopolize the markets in the north and east of England and the consumers, having been educated to the quality and flavour of Danish butter, show a marked preference for it over Dominion butters. The fact that price discrepancies between Dominion and Danish butter are least in May and June is caused by the relatively large quantity of Danish butter available then when compared with quantities available in the northern winter.

D. Prices and Costs

The following table gives an estimate of the costs of butter and cheese manufacture from 1925 to 1934. The marked reduction in the period is a reflection of two facts: (1) A fall in internal costs, and (2) a greater efficiency as a result of the stimulus of lower prices for the final products.

TABLE CLXXVI[38]

Approximate Total Costs and Charges from Farm to f.o.b. Ocean Steamer (including cream-collection at per pound of butterfat)

Year	Butter Manufacture d.	Cheese Manufacture d.
1925	2·65	4·00
1926	2·63	3·91
1927	2·59	3·68
1928	2·21	3·41
1929	2·06	3·39
1930	2·00	3·20
1931	1·97	3·02
1932	1·95	2·83
1933	1·69	2·62
1934	1·67	2·50

The steadiness of the fall in costs from farm to f.o.b. is associated with wide fluctuations in the prices received for the final product. Costs and prices follow completely separate trends. This opens up one of the major problems of New Zealand at the present day, for internal costs as a whole are much more intractable than external prices to changed world conditions. On this point the Dairy Industry Commission (Report p. 108) remarks: '. . . Apart from factories which on account of size or special disability are uneconomic, the standard of efficiency in relation to costs

38. From Report of Dairy Industry Commission, 1934, p. 109.

is high. Indeed there are grounds for suspecting that in some cases the limits of efficient cost reduction have been exceeded, and lower quality has resulted. . . . In general, it can be said that possible savings in manufacturing and other costs up to f.o.b. ocean steamer offer no scope for substantial cost reduction.'

Despite the steady decline in costs of manufacture, the fall in prices has been more rapid, with the result that at current prices dairy farming is not paying its way.

Of even greater significance is the relationship between farm expenses and prices. This aspect of the question is discussed more fully elsewhere. Here, it is sufficient to indicate that the high level of prices maintained during and immediately following the War had a great effect on the development of the industry, and a direct effect on land capitalization. The synchronization of high produce prices with a competitive demand for land resulted in the well-known land boom which has been blamed for most of our present ills by many people. Fortunately prices from 1921 and 1929 were maintained at a high level which has facilitated development in production to meet capital costs.

The maintenance of payable prices for a long period had the effect of leading farmers to accept such a level as a permanency, and it was only when a sudden drop was experienced in the early part of 1930 that the seriousness of the capital position was appreciated.

A continuance of a low price level has brought home the fact that the economic structure of the industry is such that high production is essential to enable a reasonable standard of profits to be maintained.

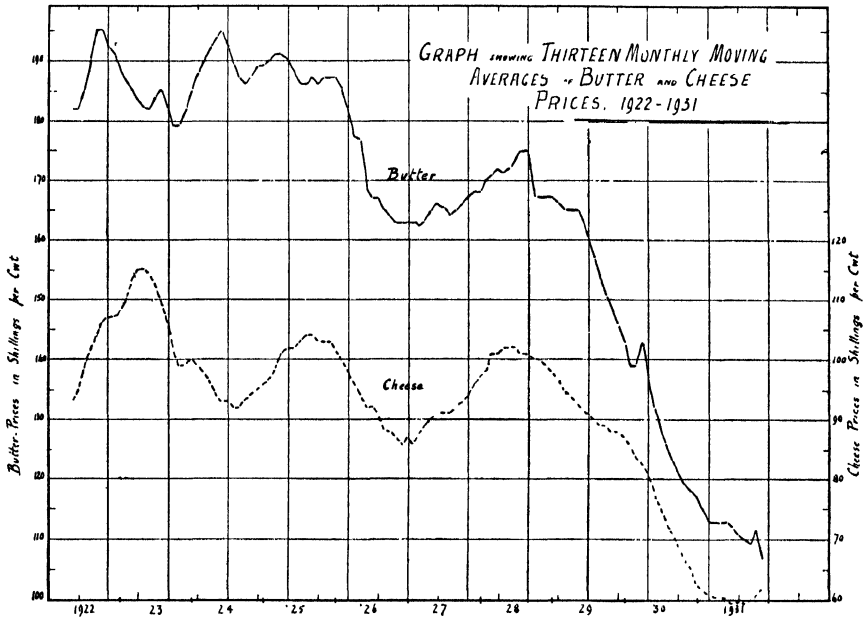
E. Price Trends

Price trends are important in any adequate survey of marketing. The accompanying graph shows the trends of butter and cheese over the ten years 1922-1931.[39] The trends are constructed on a 13 monthly moving average of prices.

A very interesting fact is that the prices of butter and cheese tended to move in opposite directions between 1922 and 1925. This probably reflects a supply factor. Cheese imports have been relatively stable while butter was in relative short supply till 1925. The movement of the cheese curve conforms fairly closely to the curves of general prices, and the quantity consumed has altered only within narrow limits. Butter consumption, on the other hand, increased about 50 per cent. between 1921 and 1923. The increased supply would naturally offset any tendency to rising prices in 1923 while in 1924, since the imports (excluding Irish butter which is included as imports for the first time in 1924) are considerably lower than

39. The range of butter prices in 1932 was from 84/- to 112/-, in 1933 from 68/- to 100/-, and in 1934 from 66/- to 80/-. Cheese prices ranged from 55/- to 66/- in 1932, from 38/- to 55/- in 1933, and from 43/- to 52/- in 1934.

in 1923, the decreased supply would tend to cause a lesser fall in butter prices than would otherwise have taken place. At a later stage again, it will be shown that cheese tended to be more profitable in 1922 and 1923 than butter, and butter than cheese in 1924. This is associated as noted above with a steadiness in the supply of cheese and a falling off in the supply of butter in 1924.



Graph 6

From 1925 both curves follow similar contours. Early in 1927 witnessed a low level while 1928 showed the highest point in recent years. However, it is noticeable that while cheese rose in 1928 to the prices received in 1925, butter did not reach to within 10/- of the price of 1925.[40] It is also rather significant that this upset the normal ratio between butter and cheese and provided a stimulus to cheese-making in the 1929-30 season. Cheese then fell at a greater rate than butter and hence the reverse tendency was noticeable, namely, a change to butter-making.

A fairly detailed statistical investigation failed to give any definite results as to the amount of change in price relations between butter and cheese which were necessary to cause a change from butter to cheese-making or vice versa. There are factories which can make only butter. There are also factories which can make only cheese. Dual factories can make both and it is these factories that are chiefly affected by changes in price relations.

40. Discussion is on the 13 monthly moving average of prices.

IX. THE ENGLISH MARKET

A. The Increase in Dairy Produce Imports

The most noticeable movement in imports of food into the United Kingdom during the present century has been the tremendous increase in the volume of (and of the number of countries supplying) dairy produce. The following table gives an indication of the volume increase:—

Table CLXXVII

Index Number of Dairy Produce Imports to the United Kingdom. Table Showing Index Numbers of the Volume of Butter and Cheese Entering the United Kingdom, distinguishing Between (a) Total Imports and (b) Imports of New Zealand Produce (Years Ended June 30) (Base: 1903-1931 = 100)

Year	Butter		Cheese		Year	Butter		Cheese	
	(a) All Imports	(b) Imports of N.Z. Butter	(a) All Imports	(b) Imports of N.Z. Cheese		(a) All Imports	(b) Imports of N.Z. Butter	(a) All Imports	(b) Imports of N.Z. Cheese
1903	97	30	97	6	1919	34	57	81	85
1904	106	49	102	9	1920	39	39	100	165
1905	99	49	92	9	1921	68	88	115	156
1906	105	47	98	13	1922	92	135	104	158
1907	106	46	94	19	1923	111	199	104	166
1908	98	36	89	30	1924	109	162	104	163
1909	102	43	88	38	1925	135	210	112	161
1910	102	52	92	51	1926	125	166	139	152
1911	108	50	91	46	1927	127	177	114	178
1912	97	51	84	50	1928	133	210	113	193
1913	97	41	88	67	1929	141	203	115	189
1914	104	52	89	77	1930	143	205	109	196
1915	92	56	91	74	1931	164	273	115	219
1916	72	57	95	74	1932	170	303	120	234
1917	60	52	108	54	1933	180	356	122	260
1918	38	56	99	80					

The table makes it clear that United Kingdom imports of butter and cheese from New Zealand have increased much more rapidly than her total imports from all sources of supply.

B. The Butter Supply

As far as butter is concerned the increase in importations has been noticeable from practically all sources of supply. The following table showing the percentage distribution of these imports of butter into the United Kingdom shows certain interesting features. As to butter, there are several noticeable facts:—

(1) The increase in Australian supply.
(2) The decline in relative importance of Danish supply.
(3) The increase of the quantity of New Zealand butter imported.
(4) The change-over from predominantly foreign to predominantly Empire supply.

TABLE CLXXVIII

Gross Butter Imports into United Kingdom from Various Countries

Supply Country	Percentage Supplied by Each Country						
	1900–04*	1909–13*	1922–26*	1927–30*	1931	1932	1933
New Zealand ..	5·3	7·3	21·7	21·3	23·9	25·6	28·4
Australia ..	6·8	14·9	15·3	12·3	19·3	21·5	19·2
Irish Free State	—	—	7·0	8·9	4·7	3·8	4·3
Canada	5·6	0·5	2·1	—	1·0	0·2	0·4
Other British countries ..	—	—	0·2	—	0·6	0·8	0·5
Denmark ..	42·7	40·9	32·5	34·0	30·6	30·9	28·5
Other foreign countries ..	39·6	36·4	21·2	23·5	19·9	17·2	18·7
Total Empire ..	17·7	22·7	46·3	42·5	49·5	51·9	52·8
Total foreign ..	82·3	77·3	53·7	57·5	50·5	48·1	47·2
Total Tonnage ..	193,600	208,350	263,250	313,900	403,000	418,200	441,750

*Annual average.

C. THE CHEESE SUPPLY

As far as cheese is concerned the fact explained earlier as to the different non-competing types of cheese exported from the Continent and the overseas Dominions makes any general statement difficult. The relative decline in Canadian cheese and the relatively great increase in the proportion of New Zealand cheese are the outstanding features, and there has also been a marked decline in the proportion supplied by foreign countries.

TABLE CLXXIX

Gross Cheese Imports into United Kingdom from Various Countries

Supply Country	Percentage Supply by Each Country						
	1900–04*	1909–13*	1920–24*	1925–29*	1931	1932	1933
New Zealand ..	2·7	19·6	48·1	52·2	60·1	61·6	67·7
Canada	65·1	61·8	37·8	31·8	24·5	24·9	20·7
Australia ..	—	0·2	2·4	1·9	2·4	2·5	3·1
Other British countries ..	—	—	0·1	0·1	0·6	0·7	0·5
Netherlands ..	11·2	10·9	5·5	6·6	5·8	5·6	4·0
Italy	0·1	3·7	2·1	4·7	4·6	3·5	3·0
Other foreign countries ..	20·9	3·8	4·0	2·7	2·0	1·2	1·0
Total Empire ..	67·8	81·6	88·4	86·0	87·6	89·7	92·0
Total foreign ..	32·2	18·4	11·6	14·0	12·4	10·3	8·0
Total tonnage ..	130,900	118,000	139,550	150,600	144,300	150,150	152,000

*Annual average.

Chapter XXXI

WOOL MARKETS AND MARKETING

By D. O. Williams

I. Markets and Marketing Methods—A. Markets for New Zealand Wool: 1. Place as a Wool Grower; 2. Destinations of New Zealand Wool; 3. The Foreign Market; 4. The Local Demand; 5. Competing Suppliers—B. Methods of Sale: 1. War-time Control; 2. Bawra; 3. Wool Industry Regulations; 4. Auction and Consignment Sales; 5. Brokers—C. Preparation of Clip for Sale: 1. Condition of Wool at Shearing; 2. Cleaning Wool; 3. Skirting; 4. Rolling; 5. Pressing; 6. Classing; 7. Wool Store Display; 8. Brokers' Valuations; 9. Sale Arrangements. II. Finance—A. Auctions—B. Consignments. III. Price Movements.

I. MARKETS AND MARKETING METHODS

A. The Markets for New Zealand Wool

1. *Place as Wool Grower*[1]

NEW Zealand's wool, which is now 97 to 98 per cent. cross-bred, is produced almost entirely for the external market. The country ranks sixth in the world from the point of view of sheep numbers and fourth as a wool producer, but has the largest number of sheep per 100 acres. As a wool exporting country she now comes fourth on the list following after Australia, Argentine and, in recent years, the Union of South Africa. Her share in total wool supply is about 7 per cent., but she provides about 11 per cent. of the home-grown wool entering into international trade. Of the Empire producers she is third in importance as a producer and exporter, furnishing about 16 per cent. of the Empire supplies and about 15 per cent. of Empire exports.

New Zealand's special place, however, is as a grower and exporter of cross-bred wool. In this sphere we provide close on a quarter of the estimated world production and rank as the second largest producer. Argentine is the only country of greater importance in this respect. In each country the overwhelming bulk of the production finds its way to overseas markets. South America provides somewhere about one-third of this type of wool and South America and New Zealand together provide the great bulk of cross-bred wool entering into international trade. Practically all the other producing countries are unimportant as exporters of cross-bred wool.

As an item of export, wool has for long been the most important single commodity for New Zealand. The annual value of wool exported normally represents over a quarter of the total exports, and despite the great fall in wool prices, it remains one of the few major exports we have and its successful marketing is therefore of great concern to us.

1. For details see Empire Marketing Board Annual Survey, July, 1932.

2. *Destinations of New Zealand Wool*[2]

Despite the great importance of successfully marketing our wool, we have no precise knowledge of the destinations of our raw wool or of the proportions which various markets absorb. The stream of finer raw wool moves mainly from the sparsely-populated countries of the Southern Hemisphere—Australia, New Zealand, Argentine, Uruguay and South Africa—to the densely-populated industrial countries of western Europe and eastern North America. Although all countries buy supplies direct from the producing countries, very large quantities are in addition bought indirectly through other countries. Europe is the centre of this trade of buying and reselling wool. In our own case the United Kingdom acts as an important redistributor of wool, reselling it mainly to Continental Europe and to North America.

The function of the United Kingdom in purchasing produce and reselling large quantities of it is of little importance to us except in the case of wool. On the average, she re-exports about 40 per cent. of all the foreign and colonial wool she buys; and in the case of our own clip her re-exports average about one-third of her importations from us. In the five years 1925-29, these re-exports were valued at over £25m., a sum equal to one-third of the recorded value of our usual exports for these years. The importance of this re-export trade in wool is shown in the following table:—

TABLE CLXXX

Re-exports of New Zealand Produce from United Kingdom

Year	Total Re-exports (£m.)	Re-exports of Wool (£m.)	Approximate Percentage of Wool Re-exports to Total
1921	2·7	·9	33·3
1922	4·7	2·8	60·0
1923	5·4	4·1	76·0
1924	7·3	5·5	75·0
1925	7·4	4·7	63·5
1926	6·4	4·5	70·0
1927	7·5	5·2	70·0
1928	8·0	5·8	72·5
1929	7·0	5·2	74·3
1930	4·6	2·9	63·0
1931	4·1	3·0	73·2
1932	3·8	2·7	71·0

The amount of New Zealand wool re-exported by the United Kingdom shows a marked increase over pre-war years. In the years 1909-13 she re-sold less than a quarter of her imports from us. During the war years re-exports fell to a minimum but with the recovery of Continental demand in the reconstruction period after the war, re-exports increased rapidly until they attained their present figure.

2. See 'Some Factors Affecting the Markets for New Zealand Wool,' D. O. Williams (Massey Agricultural College Bulletin, No. 1).

The following table shows the position in terms of quantity:—

TABLE CLXXXI

United Kingdom Imports and Re-exports of New Zealand Raw Wool

Annual Average for	Weights in Millions of Lbs.		Approximate Percentage Re-exported
	Imports into United Kingdom	Re-exports from United Kingdom	
1909–13	181	41	23
1915–20	166	6	4
1921–25	197	51	26
1923–27	182	62	34
1927–29	190	70*	37

*Estimated: weight since 1927 not available, but an approximate figure may be got from value of re-exports (Table CLXXX).

3. *The Foreign Market*

Nothing could be more inaccurate, in estimating the relative importance of our customers, than to judge them solely by the amount of wool we directly export to them. Yet this is the method most commonly employed in this country. Figures of direct recorded exports have a value in themselves. They help to show that in post-war years foreigners have increasingly come on to the market as immediate buyers; but they definitely do not show the full importance of foreign markets. The obvious procedure would appear to be to investigate the import statistics of the various countries concerned; but unhappily only a few make any satisfactory analysis showing the original source of their wool imports. Before considering possible ways out of this difficulty, however, an inspection of our direct selling to foreign markets should be made:—

TABLE CLXXXII

Direct Exports of New Zealand Wool

Countries	Annual Average, expressed in Millions of lbs.				
	1909–13	1914–18	1919–23	1924–30	1931–33
United Kingdom ..	175·4	158·0	208·0	161·5	187·8
Canada	·7	3·6	1·5	2·4	3·7
Australia	·7	·6	·5	4·8	4·6
France	2·2	5·6	2·0	15·6	17·9
Germany	4·2	2·0	2·7	12·0	9·4
Japan	—	1·4	2·1	4·0	7·7
U.S.A.	3·9	6·5	9·1	8·8	1·5
Others	·5	·3	2·1	5·9	12·8
Total	187·6	178·0	227·0	215·0	245·4
Total outside U.K. ..	12·2	20·0	19·0	53·5	57·6
Per cent. outside U.K. ..	7	11	8	25	23

The results of the table are interesting. The average annual direct export of raw wool to countries other than the United Kingdom shows an increase of about 45 million pounds over the 1909-13 period, while the direct export to the United Kingdom shows an increase of about 12 millions. The most notable increases since pre-war days are those of France, Germany and Japan. Even larger increases are shown in the case of direct exports of woolled sheepskins to countries outside the United Kingdom.

TABLE CLXXXIII

Direct Exports of Woolled Sheepskins

Countries	Weight in Millions of lbs. estimated at 4 lbs. of Greasy Wool per skin.					
	1924	1926	1928	1930	1932	1933
United Kingdom ..	2·3	1·7	3·1	2·9	3·1	4·9
France	·1	·4	·8	·9	2·5	6·0
U.S.A.	·1	·6	1·3	2·0	·3	1·0
Others	·3	·1	·3	·4	·7	1·6
Total	2·8	2·8	5·5	6·2	6·6	13·5
Total outside U.K. ..	·5	1·1	2·4	3·3	3·5	8·6
Per cent. outside U.K.	18	39	44	53	53	64

The last two tables show clearly enough the increased activity of foreign buyers at Dominion sales. Their increased operations here, however, have not been at the expense of purchases by them from England, for as Table CLXXXII indicates, re-exports from the United Kingdom to outside markets have increased greatly. The growing importance of the foreign demand for our wool has, then, been expressed partly by greater direct purchases in New Zealand and partly by greater purchases through the United Kingdom. The real difficulty lies in finding a satisfactory way of measuring the combined effect of these two influences.

The chief difficulty appears when New Zealand export statistics are compared with English import statistics. The two do not agree and often differ by many millions of pounds. In recent years particularly, the United Kingdom annually has recorded much higher importations from us than we have recorded exportations to her. Discrepancies in any one year do not matter and are in any case inevitable, since wool leaving our shores towards the end of the year will not reach England until the next year. It will, therefore, show in our export statistics as belonging to one year and in the English statistics as belonging to another. Such differences, however, can be removed by a simple moving average. But the actual differences are often very much larger than could be accounted for in

this way. The explanation probably lies in the fact that a considerable amount of wool, recorded in our statistics as an export to one country, may be diverted on the water to another country. If our export statistics record the destination as Continental Europe but the shipment is diverted to London, Europe receives less and England more wool than our figures show. A great deal of wool is shipped from New Zealand on an 'open consignment bill of lading,' i.e., it is shipped to London or alternatively to about fourteen other ports. Wool with a Continental destination does not always go direct to the Continent. It may be transhipped at an English port and be treated both as a United Kingdom import and as a re-export. Similarly, wool with an English destination may simply be re-sold at the London sales and be re-exported from the country. On occasions, of course, the diversion en route may be away from England and to the Continent, in which case more wool will have entered Europe by direct shipment than is recorded in our export statistics.[3]

From this end it is impossible to trace these activities. The most likely method available to us for estimating the relative importance of our markets is to accept the English figures of imports and re-exports. Re-exports deducted from imports give the net figure for wool retained by the United Kingdom and may be accepted as a fairly sound measure of its consumption of our wool. This net figure deducted from our total known exports gives the amount consumed by countries other than the United Kingdom. In other words, if we know what proportion the United Kingdom retains out of all the wool that leaves New Zealand, we know what is absorbed by other markets. A computation on this basis suggests that in the 1909-13 quinquennium 75 per cent. of our raw wool or about 140 million lbs. was annually retained by the United Kingdom, while for the three years 1927-29, about 55 per cent., or 120 million lbs., only was retained. Later figures are not available.

Even so, the outstanding defect of this computation is the lack of detail. Figures of direct export to various countries show, as far as they go, the relative importance of each country as a buyer of our wool; but it would be hazardous to assume that their purchases through the United Kingdom are in the same proportion as their direct purchases from us. Hence the above estimate tells us nothing of the total consumption of our wool by France, Germany, the United States and other markets. Some trade journals have, however, collected statistics based on reports from buyers and these figures, if their accuracy can be accepted, help to round out our information:—[4]

3. The matter is more fully discussed in 'Some Factors Affecting the Markets for New Zealand Wool,' D. O. Williams.

4. See Dalgety's Annual Review and the Annual Review Number of the National Association of Wool Manufacturers.

TABLE CLXXXIV

Purchases of New Zealand Raw Wool Through Brokers

Purchased by	Annual Average 1927–8 to 1931–32 (Thousands of Bales)	Per Cent. of Total	Season		Per Cent. of Total	
			1932–33 (Thousands of Bales)	1933–34	1932–33	1933–34
United Kingdom ..	249·5	51·0	240·0	248·6	41·7	38·3
France	73·4	15·0	114·6	101·9	19·9	15·7
Germany and Austria ..	73·0	14·5	96·5	134·9	16·7	20·7
Belgium and Holland ..	13·8	2·5	42·3	40·1	7·3	6·2
Italy and Switzerland ..	7·2	1·5	8·7	14·9	1·4	2·3
Other European countries	4·6	1·0	4·5	10·0	·8	1·5
Total Europe	172·0	34·5	266·6	301·8	46·1	46·4
North America	20·0	4·0	12·8	15·8	2·2	2·3
Japan, India, and China	20·2	4·0	25·7	46·3	4·5	7·1
Local	31·4	6·5	31·3	38·2	5·5	5·9
Grand totals	493·1	100·0	576·4	650·7	100·0	100·0

The table shows that for the five seasons 1927-28 to 1931-32 the United Kingdom absorbed approximately half the clip that was sold through brokers, and that since then the proportion has sharply declined. Europe, mainly France and Germany, has become a solid buying unit, purchasing in recent years over 46 per cent. of the output sold through brokers.[5]

Statistical information available in this country will at present yield no further results. It is, after all, a meagre yield in the case of so important a commodity. There is urgent need for more detailed knowledge of the demand side of our wool trade. We can see, in a rough way, that post-war events have materially altered the national demands for our wool. What, in terms that the producer can appreciate, is the significance of this change? Does it signify a permanently altered balance of demand, or is the situation a temporary one to be associated with the special economic difficulties of the English textile world? Will England regain its former position as the dominating consumer of our product? It matters to us to know at least the approximate answers to these questions; for ignorant as we are of the technical side of the manufacturing industry, it is evident enough that Continental requirements of raw material are not identical with English requirements. We require to know whether these differences are likely to have any important reactions on wool growing policy. What is it our

5. In the 1933-34 season brokers sold about 82 per cent. of the clip. If the balance is treated as consignments and it is assumed that all was sent to the United Kingdom and retained there, the share of our total clip taken by the United Kingdom does not exceed 50 per cent.

customers want? Formerly, the voice of Bradford was the voice of the wool god. But, with Europe (and Japan) of such growing importance as wool buyers, we are forced to recognize a plurality of deities and are bound to serve as many as possible. As a grower-country we need to have the wool scriptures more clearly interpreted. Unhappily, we remain, for want of adequate survey and research, ignorant of most of the things relating to demand which it is important for us to know.

We can make only the roughest guesses as to who our ultimate consumers are. We know next to nothing of the precise commercial uses for which our wool is required and next to nothing of the trend of commercial developments in this respect. We are advised to devote our attention to forms of wool production without knowing whether the demand is ephemeral, increasing or declining, and we are frequently exhorted most vehemently by those who know little of our production problems or who imagine that their special requirements should determine our national policy. In such circumstances production is a blind affair. It is not production for known market requirements and developments: but production which can readily be at the mercy of propaganda or plain misunderstanding. Continuous, systematic market analyses are the only way out.

4. *Local Demand*

The last table places the local demand for raw wool at about 6 per cent. of the marketed clip. There are no means of independently checking this estimate since no detailed statistics of consumption exist except in the case of woollen-mills. The woollen-mills, however, represent the largest local demand for wool. The development of this demand is shown in Table CLXXXV.

TABLE CLXXXV

Wool Used by Local Woollen-Mills

Quantity	1923-4	1924-5	1925-6	1926-7	1927-8	1928-9	1929-30	1930-31	1931-2	1932-3	1933-4
(Millions of lbs. 'greasy')	7·8	5·1	5·6	6·3	6·9	6·5	6·0	6·2	7·0	6·6	6·0

The pre-war consumption of wool ('greasy') was about 6 million lbs. per annum for the years 1909-13. Present-day consumption is therefore about the same as pre-war consumption. There was an appreciable increase during and immediately after the war; but the decline since then has been fairly continuous. The wool is purchased almost entirely as greasy wool. On the average not more than 2 per cent. of the total purchases are of scoured, sliped and washed wool. Cross-bred wool provides about one-third of the requirements, and Half-bred about 40 per cent., the balance consisting of Merino and Corriedale. A small proportion of the wool consumed is purchased from Australia and the United Kingdom.

The chief products are tweed and cloth, flannel, blankets, shawls and rugs, hosiery and yarn. The next table shows the value of these products in recent years.

TABLE CLXXXVI

Value of Woollen-Mill Products

Products	1928–29 £	1929–30 £	1930–31 £	1931–32 £	1932–33 £
Tweed and cloth ..	422,519	403,573	351,337	292,919	342,346
Flannel	124,764	68,716	48,036	52,428	55,793
Blankets	151,643	129,883	122,417	102,956	90,107
Shawls and rugs ..	64,557	47,633	44,467	29,774	21,333
Hosiery	323,784	300,858	240,746	211,619	188,150
Yarn	132,957	119,155	89,329	108,693	187,560
Other	16,354	15,461	345	3,716	3,257
Total	1,236,578	1,085,279	896,677	802,105	888,546

The export trade in manufactured products is small. Altogether, from the farmer's point of view, the local market for wool is of small importance and shows no sign of expansion.

5. *Competing Suppliers*[6]

In 1915 an estimate of the world production of 'cross-bred' wool was made. Here it was shown that South America supplied nearly one-third and New Zealand somewhat under one-fifth of this type of wool, the United States and the United Kingdom ranking next. As a unit the British Empire accounted for 40 per cent. of world production. Since then the Empire Marketing Board has presented estimates for the more important wool-producing countries. These are shown in Table CLXXXVII.

The table shows that there has been no remarkable increase in cross-bred wool. The increase of 11 per cent. shown is small compared with that in the production of Merino wool which, during the same period, increased from 1,068 to 1,422 million lbs.—an increase of over 30 per cent. In 1924 cross-bred wool represented about half the total production of Merino and cross-bred combined. In 1930 this proportion had fallen to about 45 per cent.

The comparatively modest increase in cross-bred production has come from South America, the United States and our own country. Australia and Europe show practically no increase. The increase in cross-bred wool available for export purposes comes almost entirely from South America and ourselves since the United States exports very little wool. So far as the international trade in wool is concerned, therefore, our main interest centres in the developments in Argentina and Uruguay. Since 1924

6. E. M. B., 'Survey of Wool,' 1932, Cp. 4.

Argentina and New Zealand have increased their production by about 8 per cent.; but Uruguay, although even now producing less than half our own clip, shows a 60 per cent. increase during the period. Argentina and Uruguay together have increased their output 20 per cent.

TABLE CLXXXVII

Estimated Production of Crossbred Wools in Principal Producing Countries

(Weight in Millions of lbs.)

Country	1924	1925	1926	1927	1928	1929	1930
Argentina	261	267	196	279	285	267	283
Uruguay	78	93	103	105	111	120	123
South America	339	360	399	384	396	387	406
New Zealand	249	233	249	257	267	267	261
Australia	144	149	155	132	173	159	144
United Kingdom ..	106	112	117	123	124	122	121
France	29	30	31	32	31	31	30
Germany	35	29	25	23	23	21	21
Europe	170	171	173	178	178	174	172
U.S.A.	145	148	153	157	157	160	174
Canada	10	11	12	13	13	13	14
North America	155	159	165	170	170	173	188
Others	18	17	18	19	19	20	19
Total of above countries	1,075	1,089	1,159	1,140	1,203	1,180	1,190

These countries are in much the same position as New Zealand in that they export nearly the whole of their clip. Like New Zealand, too, their main markets are the United Kingdom and Europe. The United States is the only other important buyer. In other words, the chief supplier of the export trade sells in the same markets as we do. The European market, mainly Germany, France, Belgium and Italy, takes about 65 per cent. of the South American supply. The United Kingdom has increased considerably but we still remain the chief supplier of this particular market, providing (so far as can be estimated) about 50 per cent. of the cross-bred wool imported and retained in the United Kingdom.

B. METHODS OF SALE

1. *War Time Control*

Prior to the Great War wool was sold privately or at auction in New Zealand or exported on consignment to London. Sales were quite free in the sense that no limiting regulations were in force. The war period

swept this *laissez faire* system away, replaced it by comprehensive State control and left the principle (and some of the practice) of regulation as a legacy for peace times. A brief outline of these developments is appropriate here.

Wool and sheepskins came within the wide scope of the war-time requisition scheme of the Imperial Government. Under the Proclamation of December 21, 1916, the Crown became the sole purchaser and seller of wool.[7] Wool brokers were given the status of Government brokers and in this respect acted as agents of the Government. Wool growers were required to deliver their wool at the wool store of a Government broker where it was examined, classified and valued by two expert valuers, one of whom was a Government appointee and the other an employee of the wool broker. To meet the convenience of growers additional Government valuers were appointed to other than the customary main centres. These valuers, who were local and overseas buyers, were organized in five groups with headquarters respectively at Auckland, Napier, Wellington, Christchurch and Dunedin, and operated under the control of a supervising wool valuer.

After negotiations in which the new New Zealand Government exhibited an adequate appreciation of the importance of cross-bred wool for military requirements, the Imperial Government agreed upon a purchase price of 55 per cent. above the average ruling prices realized in New Zealand for the 1913-14 clip. A scale of descriptions and basic values of wool was drawn up to represent the 1913-14 average returns and to these values the 55 per cent. addition was made to arrive at the Imperial Government's purchase price. All charges for store handling, cataloguing, invoicing, displaying for valuation, etc., and placing f.o.b. ocean steamer were borne by the Imperial Government. In result, the purchase price was the net cash return to the grower. Payment was made to the broker within fourteen days of valuation, the broker acting as agent for the grower in this matter. The Imperial Government further agreed to share equally in any profits that might accrue from the sale of wool not required for military purposes; but undertook to shoulder any loss that might result. The same general principles applied to the purchase of sheep-skins.

The four clips requisitioned under the scheme (1916-17; 1917-18; 1918-19; 1919-20) amounted to a total of some 2,350,000 bales of wool for which the purchase price was close on £59,000,000. In addition, sheep-skins valued at about £3,280,000 were purchased. The scheme treated the grower well. He received a satisfactory price for his product, he was assured of a market for all his eligible wool, and he could hope for the bonus of a windfall profit.

7. For minor purchases exceptions were made through special dealers' licences. For details of Proclamation: *N.Z. J. of Ag.*, Vol. XIV, 76-7; XV, 362-4; XVI, 59-62; XVIII, 123-4; XXI, 102-3.

2. *Bawra*

When the Imperial purchase scheme came to an end the British Government held huge stocks of unsold wool: about 1,800,000 bales Australian, 800,000 bales New Zealand and 300,000 bales South African. These great accumulations were an obvious menace to wool values once uncontrolled public auctions were resumed. The post-war wool problem was therefore to liquidate these stocks (for which the grower had long since been paid) without slaughtering the values of current production. Civilian demand alone remained to absorb the piled-up supplies. The problem was first faced by the formation of Bawra (British Australia Wool Realization Associated Ltd.) in January, 1921, and later (in New Zealand) by compulsory control of the disposal of new supplies.

Bawra took over for disposal the British Government's stock of wool and sheep-skins, amounting then to nearly 2,700,000 bales, of which the New Zealand portion was some 770,000 bales. With the opening of the 1921-22 season New Zealand wools were estimated to amount to 720,000 bales in Bawra's control, 200,000 bales unsold from the previous season and 550,000 bales current clip. Altogether, Bawra at this time was holding some 2½ million bales of old-clip wool to be marketed with Australian and New Zealand new-clip wool of over 2 million bales.

The Directors of Bawra claimed that '. . . they could not be expected to make the whole sacrifice required in continuing to hold their wool while owners of the new clip were scrambling for the small available demand for wool. It was clear that competition between Bawra and the owners of the new clip for the small demand would lead to lower and lower prices, and would demoralize the buying-market for wool and all the products of wool.'[8] Late in March, 1921, a meeting of wool interests in New Zealand convened by the Board of Agriculture, put forward the following (main) proposals which were acted on promptly by the Government:—

(i) Postponement of all Dominion sales for not more than two months, the Government to prohibit all auction and private treaty sales during that period;

(ii) Negotiations to be undertaken with the British Government, Bawra, and the Wool Importers' Association, London, to arrange for limitation of offerings in England, Australia and New Zealand 'to correspond with the monthly consumptive demand,' the offerings to be allocated proportionally between the Bawra stocks and the new clip;

(iii) Agreed minimum reserves to be placed on all offerings.

8. *N.Z. J. of Ag.*, Vol. XXIII, 189.

3. *Wool Industry Regulations*

Dominion sales were postponed for two months and the wool brokers and the banks entered into a voluntary undertaking not to sell wool shipped by them to London for sale on growers' account for less than the minimum reserve prices agreed upon between Bawra and the Wool Importers' Association. New Zealand wool sales were resumed at the end of May and conducted on the basis of fixed minimum reserve prices. In the following month (June) the Government issued the 'Board of Trade (Wool Industry) Regulations 1921.' These regulations

(i) Prohibited the sale of wool at prices less than the minimum reserve prices fixed by the Board of Trade on the recommendation of the Wool Committee and with the approval of the Minister of Agriculture;

(ii) Prohibited the export of wool purchased at less than minimum reserve prices or of consignment wool unaccompanied by an undertaking by the exporter not to sell overseas at less than minimum reserve prices plus charges to point of delivery;

(iii) Empowered the Wool Committee (a new Body consisting of two wool growers, two wool brokers and a Government nominee as Chairman) to determine the maximum quantity of wool to be offered for sale during any period.[9]

In the application of the regulations a system of registration under which wool brokers, banks and wool exporters gave written undertakings, enforcible by bond if necessary, not to sell wool at prices below the minimum reserves was put into operation in the 1921-22 season. From December, 1921, however, prices had risen materially above the average minimum reserves fixed by the Committee (5d. per lb. for 56s and under, 9d. per lb. over 56s). The registration system was therefore discontinued and in 1922 the clause in the regulations providing for fixation of minimum prices was revoked.

The most valuable of the powers conferred on the Committee were those which empowered it to regulate wool offerings. At first the Committee, after consultation with the Wool Brokers' Association, allocated the quantity of wool which could be offered at each centre, but later it went further and allocated the quantity of wool which could be offered by each broker at any sale. The Wool Brokers' Association was strongly in favour of a continuance of these powers.

In the meantime, stocks of Bawra wool were gradually being liquidated. From July, 1921, to March, 1922, the Imperial carry-over of New Zealand wool was reduced from 740,000 bales to about 550,000 bales. Altogether over 800,000 bales of old and new New Zealand wool were

9. See *N.Z. J. of Ag.*, Vol. XXIII, 63-4; 189-90.

disposed of in these nine months, or 50 per cent. more than the season's production.[10] With the gradual liquidation of carry-over stocks and the emergence of payable prices the question arose (in 1924) whether there was any necessity for the retention of the Wool Committee. It was eventually decided to revoke the 1921 Regulations and replace them by new regulations which retained the Committee with power to determine the maximum aggregate quantities of wool that could be offered for sale at public auction. The Committee has the same constitution as before. In practice, the Chairman is appointed by the Minister of Agriculture, two members by the New Zealand Sheepowners' Federation and two by the Wool Brokers' Association. In this way the control of offerings has apparently become an established auction procedure in this country. It represents one of the chief modifications traceable directly to war-time emergency measures; and, apparently, the system works smoothly enough in practice, although its value must be severely limited by reason of the extremely short selling season. In consultation with the Wool Brokers' Association, the Committee, at the beginning of the season, fixes the quota for each sale and prescribes the minimum average number of bales per lot for each sale. These quotas are subject to alteration during the season if circumstances are held to warrant it.

4. *Auction and Consignment Sales*

There can be no doubt that war-time control greatly accelerated the centralization of wool selling. The great bulk of our wool is now sold at the central auctions, all of which are situated at ports. Country purchases of wool subsequently sent to auction and sales of wool by private treaty generally are now of little importance, while the proportion of the exportable clip which is sold on consignment in London has contracted sharply since pre-war days. The accompanying table shows the increase in the proportion of wool sold through brokers in New Zealand:—

TABLE CLXXXVIII[11]

Wool Sold Through Brokers

Period	Total Bales Exported (000 omitted)	Bales Sold through N.Z. Brokers (000 omitted)	Percentage Sold through Brokers %
1900–1 to 1902–3	1,210	313	26
1903–4 to 1907–8	2,028	793	39
1908–9 to 1912–13	2,544	1,207	47·5
War and control period	—	—	—
1922–3 to 1926–7	3,093	2,449	79
1927–8 to 1931–2	3,212	2,166	80
1932–33	804	576	72
1933–34	806	651	81

10. *N.Z. J. of Ag.*, Vol. XXIV, 315-9.

11. The local consumption is so small a proportion of the total clip as to introduce no important error into this calculation which assumes that the marketed clip is identical with the exported clip. In any case much of the local consumption requirements are bought at auction.

The strain of collapsing prices has in recent years caused a considerable amount of experimental selling by consignment to London. For the two seasons 1930-31, 1931-32, the proportion of the clip handled by brokers declined to about 71 per cent. from a high level for the previous three seasons of 88 per cent. It is, however, highly improbable that this represents anything beyond a temporary departure from the normal selling procedure. The increasing financial embarrassment of the wool grower leaves him little option as to the method of disposal of his clip, and consignment selling on a shaky market can, on the average, be of no advantage to him.

Apart from this point, however, the increasing importance attached by wool consuming centres to purchase at the point of supply places a growing emphasis on auction selling. When England was the predominant consuming centre, London was the predominant selling centre for all wools. Buyers from Bradford, and later from Continental Europe as the textile industries developed there, met in London to purchase their requirements. With the development of the international demand for wool, buyers were sent to the producing countries where auctions soon grew up at the chief ports. 'Clearly there was an economic gain in purchasing at the point of shipment and despatching direct to the consuming area, rather than at a secondary market from which the wool had to be re-shipped to its ultimate destination. Both the growers and those who financed their operations preferred—other things being equal—to sell at the point of shipment, for they were thus relieved of the responsibility for despatching the wool to the consuming centre and financing its transit, and they had much more direct control over its actual sale.'[12] The secondary auction still persists of course, but the war period has hastened previous tendencies to greater emphasis on primary auctions. In addition, the growing importance of Stock and Station Companies and Farmers' Co-operative Companies in the general economic life of the farming community has been a great factor in this centralization of wool selling.

5. *Brokers*

Broadly, brokers fall into two groups—(1) Stock and Station Companies,[13] and (2) Farmers' Co-operative Companies. With both types wool broking is only one aspect of their many-sided activities. Their functions include the purchase of farm produce or its sale on commission; the sale to the farmer of farm and household requisites; advances against the sale of crops and stocks, and the financing of land purchase and improvement. They have become an integral part of the rural economic structure, they are deeply committed financially in farming ventures and they draw some of their capital from the farming community. Of the

12. Ministry of Agriculture and Fisheries: Economic Series, No. 35, p. 72.
13. Including merchant firms of various sorts.

two groups the commercial houses known as 'Stock and Station Companies' are much the more important in wool broking as well as in other economic activities. The following estimate compiled from Dalgety's Annual Reviews gives an approximate measure of the relative wool broking business handled by each type:—

TABLE CLXXXIX

Wool Sold at Auction by Brokers

(In thousands of bales)

Brokers	1927–28	1928–29	1929–30	1930–31	1931–32	1932–33	1933–34
Stock and Station Companies	446	473	351	370	392	470	531
Co-operative Companies..	97	103	75	75	83	106	120
Total	543	576	426	445	475	576	651
	Percentage Sold by Each Group						
Stock and Station Companies	82	82	82·5	83	83	82	82
Co-operative Companies..	18	18	17·5	17	17	18	18
Total	100	100	100	100	100	100	100

Altogether there are some thirty companies who operate as wool brokers. Most of them are small dealers in this commodity and confine their activities to one locality; but the largest firms operate at all Dominion sales centres. Of the thirty-two broking houses, twenty-three operate at one centre only and two at all centres. The number of broking firms in each centre bears no necessary relation to the importance of the centre. Thus, one of the largest centres, Christchurch, has fewer broking houses than Invercargill which is one of the smallest centres. A comparison on this point is afforded below:—

TABLE CXC

Number of Brokers and Average Number of Bales Sold

1933-1934

Centre	No. of Brokers at Each Centre	Average No. of Bales Sold Per Broker at Each Centre
Auckland	6	11,300
Napier	7	14,700
Wanganui	10	8,000
Wellington	8	16,000
Christchurch	6	13,800
Timaru	5	6,900
Dunedin	7	14,800
Invercargill	9	5,500
Totals	58*	11,200

*The 32 broking houses have 58 wool disposal branches.

There are wide differences in the amount of wool handled by the various houses and, despite the large number of operating firms, the bulk of the clip is normally sold through a comparatively few large institutions.

TABLE CXCI

Amount of Wool Sold by Brokers

Annual Average for Seasons 1932-33 to 1933-34

Bales Sold per Broker	No. of Brokers	Average No. of Bales Sold per Broker (In Thousa	Total Bales Sold per Broker nds of Bales)	Cumulative Totals	
				Bales	Brokers
Over 100,000	1	121·0	121·0	121·0	1
50,001 to 100,000	2	63·5	127·0	248·0	3
25,001 to 50,000	4	35·0	140·0	388·0	7
15,001 to 25,000	5	18·6	93·0	481·0	12
5,001 to 15,000	11	9·0	99·0	580·0	23
Under 5,001	9	3·0	27·0	607·0	32
Totals	32	19·0	607·0	607·0	32

Twenty houses handle comparatively small quantities averaging from 3,000 to 9,000 bales per annum. Nearly two-thirds of the auctioned clip is passed through the hands of seven firms whose average turnover is about seven times as great as that of the remaining twenty-five firms. Of these twenty-five firms, ten are co-operative concerns. In general, co-operative broking houses are smaller than proprietary firms and with one exception limit their operations to one centre. During the last five seasons the average annual turnover of proprietary firms was more than double that of co-operatives. On the other hand the latter are much more uniform in size. While the largest of the proprietary houses are much bigger than any co-operative (judged solely by amount of wool handled), the field of very small scale operation is also almost entirely in their hands.

It is interesting to note that the very much larger Australian clip is handled by approximately the same number of brokers as we have in New Zealand. Average turnover per broker is nearly six times as great as that of New Zealand brokers and the proportion of small houses is much less. The dominating importance of a few large concerns is even more marked than in our case since about 80 per cent. of the auctioned clip is handled by about ten firms who average over 200,000 bales each.

C. PREPARATION OF CLIP FOR SALE[14]

Compared with Australia, New Zealand is a country of small flocks. For many years the average size of flock has varied in the vicinity of 1,000 sheep and is now about 950. From a marketing point of view the distribution of our sheep according to flock-size is important both as

14. This section is based on notes provided by Mr. R. Dossor, late of Massey Agricultural College.

influencing the condition of the clip and as affecting the number of lots eventually offered for sale. The question of condition is of first importance.

1. *Condition of Wool at Shearing*

Wool producers may be roughly classified in three groups:—

(i) The large station owners with flocks of from 5,000 to 30,000 or more.

(ii) The flock owner running 1,000 to 5,000 sheep.

(iii) The small mixed farmer with flocks under 1,000.

The smallest percentage of our wool comes from the large station holder. About half the flocks contain 500 sheep or less; and about three-quarters contain 1,000 sheep or less. This means, when the type of management associated with these groups is considered, that by far the largest proportion of our clip comes from farms where the condition of the clip cannot be the primary concern of the farmer when selecting his shearing date.

In the case of large sheep stations the return from the sale of the wool is usually larger than any other item of the income account. As a result the farmer, when deciding on a shearing date, pays as much attention to the condition of the wool on his sheep as to the condition and carcass of the sheep. Two difficulties may appear, however, to prevent his shearing at the best time. In the first place, large sheep stations usually have their sheep shorn by organized shearing gangs who travel the districts shearing at each station in an arranged rotation. Although excellent from many points of view, this system more or less compels the owner to shear when the gang reaches him, for if he does not employ it then, he may have to wait over-long for his shearing unless he can make other arrangements. This difficulty may appear particularly where wool on dry sheep reaches its best condition before or after the wool on wet sheep is ready for shearing. The inelasticity of the gang system may make it difficult to shear the dry and the wet sheep at different times. The second limiting factor which may affect the condition of wool produced on hill country stations is the occurrence of such weeds as burr clover, bidi-bidi, etc. The seeds of such weeds usually ripen and fall in October and November, and cling readily to wool. To save the wool from this trouble many sheep owners have to shear before the wool is in its best condition.

As a rule, the flock owner of 1,000 to 5,000 sheep does not depend on the gang system for shearing. He is generally accessible to labour which he can employ when he wishes. The date of his shearing, and therefore the condition of his wool, is not limited to any important extent by the factor of labour, since he may shear almost at any time he wishes and may shear parts of his flock at different times. Unfortunately, however, he can seldom consider his wool clip alone. The returns from his

sheep either in the form of fat sheep, or lambs, is normally as important as his returns from wool and may be more important. The practical effect is that he generally shears his dry sheep early in the season when their condition is good, but before the wool is in its best condition or has reached its maximum length, and while it is often weak and poor in handle and appearance. The wet sheep, on the other hand, may be shorn late in the season to prevent a set-back to the lambs. As a result the wool is often in a heavy condition, containing much dust and earthy matter and is consequently rather discoloured and unattractive.

The smaller flock owners usually shear under a group shearing system. They seldom own their own shearing shed but arrange with the owner of a shed to use his when it is available. There are obvious disadvantages in such a system, although it would be absurd for each farmer to sink capital in erecting his own shed. The owner of a shed naturally enough reserves to himself the right to shear his own sheep at the time which suits him best. The others must accept such other times as can be arranged, and these may not coincide with the times when their wool is in its best condition. Moreover, the sheep and its carcass are usually of more moment to this type of farmer than the wool, so that the condition of the wool at shearing time is of subsidiary importance.

The general result is that systems of sheep farm management in New Zealand make it difficult, sometimes impossible, to pay as much attention to condition as good marketing would desire. This problem would be less were our flocks larger and specialized more thoroughly to wool production. As it is, wool is not, for most farmers, the chief source of income and therefore it cannot dominate the system of management.

2. *Cleaning Wool*

In many countries sheep are washed in fresh water before being shorn; but this is a rare practice in New Zealand, owing partly to labour costs and partly to the large number of sheep that often have to be handled at one time. Moreover, soot and smoke are not problems in this country. Here most farmers content themselves with dagging their sheep before sending them to the shearing shed; but there are not a few who neglect even this elementary practice.

3. *Skirting*

The removal of stained, dingy, heavy-conditioned and seedy wool improves the evenness of the fleece both in regard to condition and yield, and so assists the buyer to assess its value. It may be taken for granted that a buyer faced with a mass of unskirted wool will, on the average, shade the price as a sort of insurance against the risk he runs in buying it. Individual cases brought to the notice of farmers may apparently contradict

this; but since the buyer is, sensibly enough, out to do the best for himself, the errors he makes in favour of the farmer who offers him unskirted wool will be comparatively rare. Unskirted wool is suspect from the start and the value of the bulk of the fleece is likely to suffer in consequence.

4. *Rolling*

There are several methods of rolling a fleece. The most common method used by farmers in New Zealand displays the weakest and poorest wool—that along the back. Most large wool brokers, however, roll the fleece to reveal the shoulder wool, which is the best wool. This method probably has a sale value. It is not done in the forlorn hope of deceiving the buyer, but to attract his attention.

5. *Pressing*

Competent pressing can contribute to the final appearance of the clip. The average bale of wool weighs about 350 lbs. and contains from forty to fifty fleeces. The practice amongst some farmers of saving a few wool packs by excessively tight packing is unwise. Much of the wool and particularly the heavy-conditioned wool becomes yolk-stained. The difference in final appearance between well and badly-pressed wool is apparent enough at any wool sale.

6. *Wool Classing*

There are two main systems of classing the New Zealand clip. It may be classed in the wool shed at shearing time, or sent to a broking house where it is classed in a commercial wool store by professional classers. Wherever it is classed the objective is to aid the buyer by dividing the wool into lines which contain wool of an even type and condition. Classing is therefore done on the basis of quality, condition, length of staple, soundness, colour, handle and purity. New Zealand grades according to the Bradford system of counts, although the nomenclature used differs in many cases from that employed in England, Australia and other countries who use the Bradford system. The commonest grading system in New Zealand is:—

80s count = Fine Merino
70s „ = Medium Merino
60s „ = Strong Merino
58s „ = Quarter-bred
56s „ = Half-bred
52s „ = Three-quarter-bred
48s „ = Fine Cross-bred
46s „ = Medium Cross-bred
36s „ = Coarse Cross-bred

Special wools such as Down and Corriedale wools are usually classed separately.

The size of the clips is an important factor in determining whether the wool shall be classed on the farm or sent to the wool broker for classing. Most of the large sheep station owners have their wool classed at shearing time by an experienced wool classer. In the case of those smaller farms where the wool is classed at shearing time, the farmer himself often acts in the capacity of classer. Where the clip is too small to admit of adequate farm classing without producing too many small lines, the practice is growing of sending the wool to the broker where it can be interlotted. The problem that faces all classers is to keep the lines as even as possible but as large as possible. Generally, small lines attract the buyer less than large lines. With large, well-grown clips the problem of the classer is obviously easier than in the case of small or of very uneven clips.

(a) *Classing in the Shed.*—From some points of view classing in the farmer's wool shed is better than store classing. The classer can view the whole fleece on the table, the yolk has not set and is still in a perfectly natural condition, and the wool is handled only once before it is sold. Unfortunately many wool classers must work under very difficult conditions at shearing time. Bad lighting, poor tables poorly placed, small bins and not enough of them for the different classes are all too common defects in many sheds. If, in addition to these things, the labour employed is inadequate and not very efficient, it is impossible to keep the wool away from the shearing board without an amount of bustling which results in careless handling and rolling. However competent a classer may be, he cannot give the necessary time and attention to his primary task if he has to work short-handed. Where shed equipment and labour supply are inadequate, producers would do better to send their clips to the store where it can be opened up, classed and repacked by competent men working in proper conditions. Although it is cheaper to class at shearing time, the final result will provide a net benefit to the farmer only if the work is well done, as it is in the best sheds. With good facilities and competent labour, farm classing has much in its favour. For farmers with poor sheds or with small or uneven clips, the commercial wool store offers the best method.

The type and size of clips vary so greatly that no definite system of classing of general application can be laid down. As a rule the ewe's wool which forms the bulk of the New Zealand clip is classed separately. Where there are sufficient wethers to provide a worth-while line or number of lines, their wool is also classed separately. Similarly, all true hogget

wool, which is longer in staple and finer in quality than ewe wool, is classed in separate lines.

In most wool clips, particularly in cross-bred clips, three main lines are commonly made:

(1) *Top Line.*—Fine Cross-bred, Bulk 48s count, of good combing length.

(2) *2nd Line.*—Medium Cross-bred, 44/46s count, of good combing length.

(3) *3rd Line.*—Cross-bred of 44s count and under, of good combing length.

In large clips of 100 bales or more each of these lines would usually be subdivided into two lots, as:

(1) Fine Cross-bred A, Bulk 48s, containing all the best wool.

(2) Fine Cross-bred B, Bulk 48s, containing inferior wool.

The classer is obliged to make many variations on this general scheme, as the size, type and condition of wools vary so greatly from farm to farm. Moreover, in every wool clip, wherever it is classed, there are always some fleeces which cannot be placed in any of the set lines without spoiling its evenness. Such are cotted, dingy, broken and seedy fleeces, usually termed oddments. With large clips special lines of oddments are possible but with small or medium clips they can be dealt with satisfactorily only by interlotting or binning in the store.

The wool removed by crutching is of low value and the amount per clip is usually small. For these reasons 'crutchings' are seldom if ever classed except by the wool brokers when the wool is sent to them for binning. 'Bellies' form the bulk of the skirtings and are seldom classed except for type or condition. 'Necks,' which are generally removed when skirting, are baled separately in the case of large clips. With small clips they are either mixed with the pieces or sent to store to be binned. 'Pieces' are mainly skirtings other than necks or bellies and consist of heavy-conditioned, stained or inferior wool removed from the fleece. In small and medium clips it is seldom feasible to make more than two classes, but with larger clips, three classes based on condition, length and colour are possible. 'Locks' consist mainly of short pieces of wool such as second cuts, sweepings and short wool that falls on to the table during handling. They have little value and are usually sold separately. 'Dead Wool,' removed from dead sheep, has little commercial value and is never an important item. 'Lamb's Wool' comes mostly from cross-bred lambs on hill country farms. Lambs of the fine wool breeds of the South Island and lambs reared for the fat lamb trade are seldom shorn. The quantity

of lamb's wool produced by one flock owner is usually too small to warrant its being classed into many lines.

(b) *Classing in the Store.*—Classing in wool stores owned by wool broking firms is generally done in the most satisfactory conditions and is comparatively cheap. Highly-skilled professional classers work in well-arranged and correctly-designed classing rooms. The stores are equipped with modern machinery for handling the bales, and efficient labour is used for handling, rolling and pressing. The most important difference between store and shed classing is that the wool classer in a store has at his disposal large quantities of wool of all descriptions. This makes it possible to class a clip into many lines which, when interlotted with wool belonging to other growers, will make even, saleable lines.

When a clip is received by the store for classing, all the fleece wool goes to the fleece classing-room which in most stores is on a different floor from the 'bin room' where all the pieces and oddments are sent. If the clip has to be skirted each fleece is unrolled, skirted, classed and re-rolled, the pieces being carefully classed in the bin-room unless they are interlotted in complete bales. If the clip is being classed but not skirted, the fleeces are not unrolled. The wool is re-pressed when there is sufficient of each line. Unless the original wool packs are rotten or torn, they are turned inside out and used for repacking. Most stores avoid tight packing if possible. At the same time they do not like to use more packs than the farmer himself has used. In this way, the practice of the farmer tends to become impressed on the broker who, particularly in bad times, wishes to keep his total charges as low as possible.

(c) *Interlotting, Binning and Pooling.*—The broker always finds himself with many small lines of wool, some sent in by the farmer who has classed on the farm, and others resulting from classing in the store. Lines with less than four complete bales are considered unsatisfactory and the broker therefore endeavours to build up even, saleable lines by a system of 'interlotting.' Bales of wool belonging to different vendors but of the same type and class are grouped together. Interlotted lines thus consist of a number of bales selected from the offerings of several different vendors. Such lines are sold as one sale lot but the separate bales retain the brand of the respective vendor. The system is a simple and satisfactory way of reducing the number of minor lines without breaking open the bales and binning the wool. In recent years, interlotting has gained considerably in importance and is now an established procedure in practically all stores.

In 'Binning,' the bales are broken up and classed into lines. This method of building up saleable lines is generally used in the case of small parcels of fleece wool and bales of oddments which cannot be included in the main lines without destroying their evenness. As each vendor's wool

is classed in the binning-room, the wool in each class is weighed and credited to the owner before being placed in its appropriate bin. The number of classes in the bin-room depends largely on the quantity of wool normally handled by the store during the season. In the smaller stores the separate bins do not exceed 60/70; the largest stores may have as many as 250. The main classes are, however, much the same for all firms. The larger houses are able to subdivide each main class more finely and still secure enough wool to make up saleable lines. The classification into such a large number of bins means that the variation from grade to grade is fractional and the resulting lines are therefore even in type and quality. The ultimate result from the buyer's point of view is that he is able to get what he wants in the quantity he requires. The highly-skilled work of binning can be materially helped or hindered by the manner in which the farmer sends in his clip. The indiscriminate mixing in the bale of pieces, crutchings and such oddments, or of clean, seedy, and log-stained wools, makes the task of binning very difficult. The more careful farmers with small clips separate the types of wool by partitions of paper, old sacks, etc.; but this precaution is not as common as it should be.

'Pooling' is much the same as binning except that a whole clip is group-classed with other clips whereas at present binning applies mainly to the oddments only. Only a few brokers pool wool for their clients, since in most cases interlotting and binning are considered sufficient devices to handle most small lines.

7. Wool Store Display

When a wool clip arrives at the store each bale is checked and weighed. The weight is stencilled on the bale while the weigh-in clerk records the owner's brand and the number, description and weight of each bale. If the clip has to be classed or binned the bales are sent to their respective departments, but if the clip has already been classed on the farm it is sent to the display floor.

With large clips there may be room on the display floor for only a representative number of bales which are picked out at random and opened up for display. With smaller clips all the bales go to the display floor where approximately two-thirds of each lot (or separate selling line) are opened up. The principle of random selection is again employed in picking out the sample bales for inspection.

Many lines on display at every store are known as 'Broker's Lines.' They consist of all wool sold under the brand of the broker and are made up chiefly of binned and pooled wool. Lines of interlotted wool, although not sold under the broker's brand, are also commonly called broker's lines. In many cases these broker's lines constitute a large proportion of the sale

catalogue and since they have been competently put up and classed they are usually eagerly competed for by buyers. Binning, pooling and interlotting in this way can mean much to the owner who cannot himself class his small clip finely enough.

There remains a special category of line known as the 'Star Lot.' Star lots are lines comprising less than four bales and usually represent wool that the broker has found impossible to interlot with other wool, or wool belonging to owners who refuse to have it interlotted or binned. They are not favourite lines with either buyer or broker. As a rule they are sold at the end of the catalogue when most buying requirements have been filled, and they therefore run the risk of attracting little interest or competition. Every broker endeavours to reduce the number of star lots to a minimum.

8. *Brokers' Valuations*

Prior to every sale all lines of wool (except binned and interlotted wool) are valued, usually by the chief wool expert of the broking firm. The valuations placed on the different lines are sent to each vendor a few days before the auction. On the basis of these valuations, which are usually conservative without being excessively so, the vendor can make his decision as to the reserve prices he requires for his clip.

9. *Sale Arrangements*

The dates and number of sales are arranged for each year at an annual conference of wool buyers and wool brokers. Both dates and number of sales vary from year to year but ordinarily sales take place at eight centres during the months December to April inclusive. The selling centres are Auckland, Napier, Wanganui and Wellington in the North Island, and Christchurch, Timaru, Dunedin and Invercargill in the South.

The New Zealand Wool Committee, as previously noted, limits the maximum aggregate quantity of wool that can be offered for sale at public auction during the season. The quantity decided upon initially can, of course, be altered as the season progresses and as circumstances suggest. In practice the limit fixed averages about 30,000 bales per sale at the larger centres and 20,000 bales at the smaller. In recent years the buyer has been interested in securing a reduction in the number of separate lots offered for sale. The large number of small clips has meant a large number of small lots put up for inspection, valuation and sale. Combined with the short selling season and the relatively large number of sales, this has involved very strenuous work on the buyers' part. In recent years, however, the growth of binning, interlotting and pooling has helped materially to increase the average size of lot offered although it still remains comparatively small. An inspection of brokers' catalogues suggests that the

average number of bales per lot is somewhere in the vicinity of nine, although this figure is not typical for those districts which have either many small or many large sheep farms. For the Dominion as a whole, an average lot of nine bales means something like 60,000 separate lots to be valued and auctioned in a short selling season at comparatively numerous sales. In the opinion of some brokers the normal figure is nearer 80,000 than 60,000 separate lots; but the smaller figure is large enough to indicate the difficulty that attends the marshalling for sale of such a variable product as wool produced under such varying farming conditions.

All wool put to auction is bought and sold on the sales catalogue which each broker prepares. The catalogue shows the lots arranged in numerical order, with the tare, owner's brand, description of the wool and the number of bales in each lot, together with any additional information that may be required in special circumstances. The catalogue is of great importance both to buyer and vendor. Most buyers are looking for special and well-defined types of wool to fill their orders; but it may not be possible, particularly at the larger sales, for them to inspect and value all the wool on display at each broking store. It is, therefore, usual for buyers to make a close inspection of the catalogue before visiting the stores, and to note only those lines which are likely to interest them. These selected lines are then inspected at the store and other lines are left unless the buyers have time to see them. The manner in which the clip has been classed and the subsequent description of it in the catalogue play important parts in determining the demand for the clip before the auction begins. The failure of many farmers to class properly, carelessness in branding and inadequacy of description do much to obscure the real nature of the wool offered for sale. In many cases it is quite impossible for the buyer to form any opinion of the type of wool listed under a farmer's brand. Ambiguous wool of this sort is likely to be passed over by the buyer who is looking for specific kinds of wool, and to be left to the bidding of the speculative buyer.

The inspection by buyers usually takes place in the two days prior to the opening of the sale. A buyer looking for classed clips generally first inspects those whose brands are familiar to him from previous experience. Brands which have acquired a good-will as the result of years of careful and honest packing are always sure of keen competition. The bulk of our wool is sold in the greasy state and the buyer has, therefore, to price it on this basis. He works from the clean scoured values which are cabled to him by his principals and has to compute the quality and yield of each type of wool. The more uneven the lines are in quality and condition the more difficult and speculative are his estimates and the wider the margin of his possible error. Buyers who wish to fill specific orders

give their primary attention, therefore, to the better-classed clips. With the purely speculative buyer unevenness in quality and condition is perhaps an advantage if he can secure it at a discount. Well-classed clips are, as a rule, too keenly competed for to attract this type of buyer.

At the sales, which are usually held in the local Town Hall or some other central building, the brokers sell their offerings in a rotation arranged by the Wool Brokers' Association. The sale itself is conducted by the Association and all wool is sold under the conditions of sale jointly approved by the New Zealand Wool Buyers' and the New Zealand Wool Brokers' Associations.

Wool is usually left in its display condition for one clear day after the conclusion of the sale to allow time for the settlement of any disputes that may arise. Thereafter the sold wool is repacked, each bale is weighed and branded with the purchaser's brand, and the overseas lines are forwarded to the shipping company. The shipping company or the harbour board act as agents for the broker until settlement has been made by the purchaser. The purchaser cannot secure delivery until payment has been made. Up to the prompt date every reasonable facility is given to the purchaser to inspect the bulk bales not previously examined. Where false packing is discovered or where the bulk wool is of a different standard from the sample bales, the purchaser may refer the matter to the arbitration of two persons, one representing the buyer and one the broker. If false packing is proved the purchaser can obtain the name of the vendor from the broker and prosecute. If the sale is declared valid the buyer must accept the wool.

It is apparent from this survey that the proper preparation of the clip for sale involves elaborate organization and skilled labour. The broking firms have built up a selling system which, in many respects, is remarkably efficient. It is, perhaps, true to say that the major defects are those for which the farmer is responsible. The excellent manner in which some farmers and brokers can prepare clips for sale demonstrates clearly enough how satisfactory the system can be. But well-presented clips are not yet a large enough proportion of the total offerings. Greater care at the farm and fuller use of the broking store services could do much to remedy the defects that are still too common. In many cases, of course, the problem is more basic than that of preparing the clip for sale, and goes back to difficult questions of breeding. Even so, there is abundant room for improvement in the farmer's handling of his clip. The most outstanding need appears to be a more systematic handling of the small clips which make up such a large proportion of the total. Generally speaking, the smaller the clip, the less chance is there of the grower paying proper attention to quality and the greater is the need, therefore, of careful

classing. At the same time, small clips cannot be efficiently classed by themselves without producing numerous 'star lots.' The only practicable solution lies in such an extension of the practices of binning, interlotting and pooling as will include all the clips which cannot be adequately classed at the farm.

II. FINANCE

A. Auction

The finance arrangements are quite simple. In the case of wool sold at auction, the buyers arrange their credits with the banks in New Zealand or, in some cases, with the brokers. Under the 'Conditions of Sale' promulgated by the Wool Brokers' Association, payment must be made by the buyers on or before 'prompt' which is defined as '2 p.m. on the fourteenth day from the date of sale' with appropriate modifications to meet the cases of Saturdays and statutory and bank holidays. Such payments must be in cash. No cheques other than banker's cheques are accepted; but remittances made by a buyer through a bank to the credit of the broker at the place of sale are accepted as cash on receipt of advice from the banker. The brokers draw their cheques in favour of the vendors almost immediately after the sale but no cheque is actually forwarded until payment has been made by buyer to broker. In practice the arrangements work quite smoothly and vendors receive their cheques within a fortnight of the auction.

In some case the buyer is required to deposit £25 per cent. during or after the sale upon the broker's estimated valuation. If any lots remain unpaid for by the buyer after the expiration of 'prompt,' the deposit is absolutely forfeited to the vendor and the buyer is held responsible for all loss, including storage, interest, commission on re-sale, insurance, etc. At his option, the broker or vendor may, in such circumstances, merely cancel the sale or re-sell the wool at auction or by private contract. Any loss on re-sale is recoverable from the buyer, who, however, cannot share in any surplus. Where the buyer has paid by 'prompt' but has failed to make arrangements for delivery, the wool may be stored at the risk and expense of the buyer.

B. Consignment

The farmer may consign his wool through either a banker or a broker. Both bankers and brokers will make advances at the time of shipment but no conventional percentage is adopted. The proportion advanced depends both on the state of the market and the financial standing of the farmer. The farmers themselves do not always draw the maximum available at the time of shipment but may elect to draw lightly and receive a subsequent advance. Some do not draw at all; but the general rule is that those who ship on consignment accept an advance. Neither the banks nor the brokers

sell the wool themselves in London but market it through brokers there who, after the sale, send back the usual Account Sales. In a highly speculative commodity like wool it has not been uncommon for brokers and banks to find that they have advanced too freely and that reclamations have therefore been necessary. In recent years, however, the general policy of caution adopted has largely eliminated this contingency.

III. PRICE MOVEMENTS

No New Zealand export commodity varies so widely in value as wool. The best available measure of these movements over a long period is the index number for New Zealand cross-bred wool (medium 46s) prepared by the Empire Marketing Board.[15] Our own export indexes do not give an equally clear picture for earlier years since the composition of our clip has altered greatly after refrigeration placed an emphasis on the dual-purpose animal. The prices quoted in the accompanying table are those realized at London Wool Auctions and are the yearly averages of the prices realized at the last auction in each quarter.

The columns giving the per lb. price and the corresponding index number for each year show that the year 1932 set a new record for low prices. The variation between the lowest price (6d.) and the highest (42d. in 1920) represents a percentage variation, in terms of the highest point, of 86 per cent.[16]

The other columns give (i) the lowest price recorded in the last section of each quarter; (ii) the highest price; (iii) the variation between these two points; (iv) the variation expressed as a percentage of the highest price, and (v) a final summary, in five-yearly periods, of the percentage variations. Over quite a long period in pre-war years, wool prices were comparatively steady. From 1890 to 1900 the price (clean scoured basis) varied from 11d. to 1s. 2½d. a lb., representing a reasonably stable and calculable return to farmers. From 1909 to 1914 the general level of prices was on a higher basis, varying from 1s. 2d. to 1s. 6d., but was still highly stable since no year's prices were more than 2d. a lb. above or below the preceding year's prices. The intervening period, 1901 to 1908, was more unsteady, yearly prices rising or falling by as much as 3d. a lb. Even so, this period cannot compare with periods since the war in the magnitude of its price fluctuations.

The war period falls into a special category. Under the Imperial Wool Purchase Scheme, begun in November, 1916, our wools were under control and public auctions in London were suspended. Public auctions were resumed in 1919 but offerings and prices were regulated by the Ministry of Agriculture. Hence although prices were very high they were very stable.

15. Wool Survey, 1932, Ch. 5, and Appendices III, IV and V.

TABLE CXCII

Prices of New Zealand Cross-bred Wool—Medium 46s London

Year	Pence per lb. Clean Scoured	Index Nos. 1909–13 =100	Price Fluctuations*				
			Low Point	High Point	Maximum Variations	Max. Variation as per cent. of High Point	
						Yearly (%)	5-Yearly (%)
			d.	d.	d.		
1890	14·5	91	13·75	15·0	1·25	8	—
1891	14·5	91	13·75	16·0	2·25	14	
1892	12·9	81	12·5	13·75	1·25	9	
1893	13·8	87	13·75	14·0	·25	2	1891–5
1894	13·0	82	12·25	13·75	1·5	11	=23
1895	13·4	84	12·25	14·5	2·25	15	
1896	12·9	81	12·25	14·0	1·75	12	
1897	12·2	77	12·0	13·75	1·75	13	
1898	10·8	68	10·0	11·5	1·5	13	1896–1900
1899	12·7	86	10·5	15·25	4·75	31	=34
1900	11·6	73	10·75	13·0	2·75	21	
1901	8·6	54	7·75	9·5	1·75	18	
1902	9·4	59	8·75	11·0	2·25	20	
1903	12·0	75	10·0	13·0	2·0	15	1901–5
1904	14·9	94	13·5	17·25	3·75	22	=59
1905	17·2	108	14·0	18·75	4·75	25	
1906	18·9	119	17·5	20·0	3·0	15	
1907	16·6	104	15·0	17·75	2·75	15	
1908	11·6	73	10·5	13·0	2·5	19	1906–10
1909	16·1	101	14·5	16·25	1·75	11	=52
1910	16·25	102	15·5	16·5	1·0	6	
1911	14·6	92	13·75	15·0	1·25	8	
1912	15·25	96	14·5	16·5	2·0	12	
1913	17·4	110	17·0	18·0	1·0	5	1911–14
1914	18·2	114	17·0	20·5	3·5	12	=49
1915	25·25	159	24·0	27·0	3·0	11	
1916	28·25	178	25·0	34·0	9·0	26	
1917†	35·5	223	35·0	36·0	1·0	3	
1918†	36·5	230	36·0	37·0	1·0	3	1916–20
1919‡	39·0	245	38·0	40·0	2·0	5	=55
1920‡	30·75	193	19·0	42·0	23·0	55	
1921§	11·2	70	10·5	12·25	1·75	14	
1922§	12·56	85	11·0	16·5	5·5	33	
1923§	17·25	109	15·0	23·0	8·0	36	1921–25
1924§	30·29	194	26·0	37·5	11·0	29	=72
1925	23·25	146	21·0	28·0	7·0	25	
1926	19·5	123	18·75	20·0	1·25	6	
1927	21·6	136	20·0	23·5	3·5	15	
1928	25·4	160	24·0	26·5	2·5	9	1926–30
1929	21·25	134	19·5	24·0	4·5	19	=66
1930	11·8	74	9·0	14·5	5·5	38	
1931	9·25	58	8·25	11·25	3·0	27	
1932	6·75	42	6·0	7·5	1·5	20	1931–34
1933	8·5	53	6·5	11·25	4·75	41	=48
1934	9·75	62	8·5	11·5	3·0	26	

*Wool Survey, 1932, Appendix III.
†In 1917-18 public auctions suspended but limited quantities offered to licensed buyers at fixed prices.
‡Wool auctions again held in London but controlled by Ministry of Munitions.

The reaction from these very high prices was sudden. By 1921 cross-bred prices were 30 per cent. below the 1909-13 level. From a high point of 42d. in March, 1920, they fell to a low point of 10½d. in September, 1921, that is, in eighteen months they fell to one-quarter of the peak price. The fall from the average of 1920 to the average of 1921 was about 1s. 8d. per lb.; and it was not until 1923 that annual average prices were again above the 1909-13 level. The slump in the early post-war years was much more protracted in the case of cross-bred than in the case of Merino wools. The latter showed even more spectacular percentage increases in price during the boom than cross-bred; but they did not fall to pre-war levels and began to rise again in the middle of 1921. It was not until 1930 that Merino wools fell below the level of 1909-13. Although delayed, the rise in cross-bred prices was substantial when it came. From a low point of 11½d. in September, 1922, prices rose until in December, 1924, they reached a new peak of 3s. 1½d.

Since 1924 the fluctuations have been violent on a falling market. The index number shows a fall of 70 per cent. between 1924 and 1926 followed by a recovery of 40 per cent. by 1928, which year marked the last peak. Since then the fall has been dramatic, the index number of 1932 reading about 60 per cent. below the base period, 1909-13, and the lowest recorded in over forty years.

All wools have suffered similar violent price shocks but cross-bred wool has suffered most in this respect. The following table compares the price fluctuations of Merino, carpet and cross-bred wool for five-yearly periods since 1890. The variation between the highest and the lowest point in each quinquennium is expressed as a percentage of the high point.

TABLE CXCIII

Comparison of Raw Wool Price Fluctuations[17]

(Expressed in % high point)

Type of Wool	Pre-War					Post-War		
	1890–4	1895–99	1900–4	1905–9	1910–14	1919–21	1922–26	1927–31
Merino	29	52	31	20	21	72	40	65
Carpet	14	29	48	50	27	73	61	59
N.Z. Cross-bred..	23	34	61	47	33	75	71	69

For all three series, the post-war fluctuations are seen to be much more violent than those of pre-war periods; but in each post-war quinquennium the largest percentage variation is found in the case of cross-bred wool.

The index numbers for these three wools provide an interesting basis of comparison:—

17. E.M.B., Wool Survey, 1932, p. 159.

TABLE CXCIV

Index Numbers of Raw Wool Prices

(Base 1909-13 = 100)

Year	Merino (Clean Scoured)	Carpet (Raw State)	New Zealand Cross-bred (Clean Scoured)
1890–94	67	89	87
1895–99	75	81	78
1900–04	85	75	71
1905–09	98	97	101
1910–14	102	104	102
1915–19	242	202	207
1920	360	188	193
1921	157	74	70
1922	185	97	85
1923	210	143	109
1924	273	182	194
1925	204	170	146
1926	179	135	123
1927	189	160	136
1928	180	181	160
1929	134	170	134
1930	91	118	74
1931	75	87	58
1932	65	81	42
1933	85	?	53
1934	91	?	61

A more recent index (Wool Intelligence Notes, Imperial Economic Committee) makes a comparison between Merino, fine cross-bred (56/58s) and medium cross-bred (46s). With the base period taken as the average of the three years 1926-28, the index numbers given are as follow:—

TABLE CXCV

Index Numbers of Raw Wool Prices

(Clean scoured bases)

Year	Merino	Fine Cross-bred	Medium Cross-bred
1926–28	100	100	100
1933	50	55	38
1934	53	59	44

Until 1928 Merino wools remained much higher above their pre-war (1909-13) level than did either carpet or cross-bred wools. Even in 1921 when these two fell below the base level, Merino wool remained about 50 per cent. above. The courses of cross-bred and carpet wool price movements corresponded closely in the period 1920-28; but in the new price decline which followed, cross-bred fell most and carpet wool least of the three series. At no stage in the period has cross-bred wool made a better showing than either of the other two with the brief exception of 1924 when it made a better recovery than carpet wool. The producer of cross-bred wool, judging the course of prices from the base period of the

years 1909-13, finds himself now in a relatively worse position than other wool growers.

'The wider fluctuations in the prices of cross-bred wool appear to be largely due to its relative inelasticity of supply arising out of the fact that the cross-bred sheep is a dual-purpose animal with wool and mutton as its joint products. There is always a strong tendency for the supply of a joint product to be less elastic than that of a similar product separately produced, since the price variation of two products is likely to be less than that of one alone. In particular, when one of the dual products has a price level distinctly more stable than the other, the supply of the second will be less responsive to variations in price than if it were separately produced. This is the case with wool and mutton. The price of mutton has shown very much less variation than that of wool and has exerted a strong influence to maintain the production of cross-bred wool in periods of low wool prices and to restrain expansion in periods of high wool prices with the result that the automatic adjustment of supply to demand through price has been largely absent.'[18]

The steadiness of lamb and mutton between 1920 and 1925 when wool prices were fluctuating widely is remarkable; and the price decline since then has been much less severe than in the case of wool.

On the supply side, it is an evident fact that price fluctuations in cross-bred wool evoke no appreciable response in increased or decreased production. A slight decline in numbers of sheep and in wool production occurred immediately after the war; but a fairly continuous increase in both has proceeded from 1922 to 1930. From this stage the decline in the price of mutton and lamb as well as wool became so severe as to bring about a decline in sheep population. In the case of Merino, where the carcass is of relatively less importance, wool production is more sensitive to price fluctuations although even here the response is made only to well-sustained price movements.

On the demand side, cross-bred wool suffered immediately after the war owing to the large reserves which had been built up for war supplies; while Merino received the support of a strong demand for civilian clothing. In later years when these exceptional circumstances had gradually disappeared, Merino wool still maintained a relatively superior position to cross-bred, 'probably due to the relatively greater demand for the finer wools to satisfy the demand for lighter tissues and for knitted wear either of wool alone or in conjunction with artificial silk.'[19]

At the average prices of 1909-13, 1 lb. of Merino wool was worth about $1\frac{3}{4}$ lbs. of New Zealand cross-bred. In the slump after the war both fell heavily but cross-bred fell so much further that in 1921 and 1922, 1 lb.

18. E.M.B., Wool Survey, 1932, p. 161.
19. E.M.B., Wool Survey, 1932, p. 163.

Merino was worth 4 lbs. of cross-bred. Since then the value of Merino in terms of cross-bred has averaged about the ratio of 1 lb. Merino-2½ lbs. of cross-bred, a figure appreciably higher than the pre-war average. Similarly, the decline in the value of cross-bred wool compared with mutton may be expressed thus : in 1920, 1 lb. of New Zealand cross-bred wool (clean scoured 46s) was worth in London about 4 lbs. of first-grade New Zealand mutton. In 1930 and 1931 it was worth about 2lbs. of mutton. In terms of first quality New Zealand lamb the decline in value of cross-bred wool has been from about 2¾ lbs. in 1920 to about 1⅓ lbs. in 1930 and 1931.

A final comparison of the course of prices of wool and other commodities may now be made on the basis of our own export statistics. The result is more generalized than in the illustrations previously used since the wool index covers all wool exported, and the meat index covers beef as well as mutton and lamb.

TABLE CXCVI

Index Number of Prices

(Base 1909-13 = 100)

Year	Wool	Meat	Dairy Produce	All Exports	Imports	Wholesale
1922	92	162	149	136	173	166
1923	127	201	165	161	155	160
1924	190	201	166	179	153	163
1925	223	222	152	189	152	163
1926	143	185	141	154	144	155
1927	153	176	137	152	138	148
1928	192	180	148	168	135	149
1929	171	183	146	162	134	149
1930	100	171	121	128	133	145
1931	68	130	99	98	131	134
1932	62	110	93	89	129	130
1933	67	116	84	90	136	131
1934	127	152	77	110	135	133

The extent to which wool suffered relatively to other prices up to 1933 is apparent. Since then dairy produce has fallen upon more evil days and is now the chief sufferer from the depression.

CHAPTER XXXII

THE MARKETING OF ARABLE PRODUCTS

By I. W. WESTON

I. General Methods of Marketing—A. Introduction—B. Grading: 1. For Export; 2. For Local Market. II. Selling Methods—A. Private Treaty—B. Consignment—C. Contract—D. Collective Bargaining. III. Marketing of Individual Products—A. Wheat: 1. Tariff Protection; 2. Wheat Purchase Board—B. Oats and Chaff: 1. Production; 2. General Methods of Marketing; 3. Costs of Marketing—C. Other Products: 1. Barley; 2. Peas; 3. Maize; 4. Linseed; 5. Potatoes; 6. Onions; 7. Hops; 8. Tobacco; 9. Grass and Clover Seed. IV. Price Quotations.

I. GENERAL METHODS OF MARKETING

A. INTRODUCTION

THE actual methods of marketing of arable products vary greatly both for the same product and for different products. A large proportion of arable products is grown on specialized cropping areas, and the amount offered for sale fluctuates greatly with seasonal conditions. Costs of marketing, particularly costs of transport and storage, etc., form a large proportion of total production costs. For example, in years of low price costs of distributing oats, chaff, potatoes, etc., from the South Island producer to the North Island consumer, frequently exceed the total price received by the producer. In seasons of surplus production the price fall may be so great that even the bare costs of marketing alone are not remunerated.

B. GRADING

1. *For Export*

For export trade, except in the case of recent sales of wheat to the East, standards are made up by the Canterbury Chamber of Commerce, and forwarded to the London Corn Trade Association for approval and adoption each year.

This method is embodied in the contracts between the sellers in New Zealand and the buyers in England. This is the system adopted practically all over the world by the London Corn Trade Association, which provides that the standards shall be made up by the Chamber of Commerce in the State or Province in which the port of shipment is situated. This ensures that although the standards may be made up by a committee of technical men engaged in the trade, the final approval has to be by the Chamber of Commerce composed of a general body of business men, instead of by a section solely interested in selling the article represented by the grade. Wheat sold to the East is sold on the New Zealand f.a.q.[1] standard grades, with Government Graders Certificate and weights at port of

1. F.a.q. = Fair Average Quality.

shipment as final and with no recourse to arbitration. The wheat is sold f.o.b.s.i. and not c.i.f.e.s.i.[2] as for London.

2. *For the Local Market*

For internal trade a different system has been adopted. Some ten years ago it was mutually agreed between all the grain merchants of New Zealand that it was desirable, if possible, that permanent standards should be set up. These were prepared by delegates from the local South Island Associations in the districts where the principal crops are produced, and were finally fixed and adopted by the South Island Association, and approved by the New Zealand Grain Merchants' Federation, on behalf of buyers and sellers. In order to retain colour and to prevent deterioration of the samples set up, the standards are re-matched annually by a South Island Committee, who confer with the Grading Committee of the New Zealand Grain Merchants' Federation, and when mutual agreement is arrived at, samples are re-distributed.

For convenience in trading in New Zealand in the same class of goods that are shipped overseas, it is considered advisable, if possible, that the standard fixed by the Chamber of Commerce for export, and that fixed by the merchants for internal trade, should be similar and for that purpose the local combined Committee of the South Island Association and the New Zealand Grain Merchants' Federation, generally confer with the Chamber of Commerce Committee with a view to obtaining uniformity of standards. This is rather difficult as the standards for internal trade are permanent standards, and the samples for export have to be seasonal standards.

A large number of samples of the products were at one time sent to the London Corn Trade Association by the Grain Standards Committee of the Chamber of Commerce but with the decline in export trade a considerably quantity of grass-seed and other produce is now dealt in entirely by buyers representative by sample or by description and purchased in accordance with buying orders. Oats and peas are at present the only lines of which official grades are sent to England, the grades each year being:—

Garton Oats A
„ „ B
„ „ f.a.q.
Maple Peas No. 1 (Mainly Partridge or Prussian Blue Peas in New Zealand.)

In cases of dispute (a) for goods shipped to London (but not for goods shipped to the East), the certificate of local graders is not final but arbitration in London on the basis of the Chamber of Commerce grades or samples under which the produce is sold, occurs; (b) for trade within New

2. S.i. = sacks included.

Zealand certified graders having Government certificates of efficiency as graders and selected and approved as graders first by the South Island and then by the North Island Grain, Seed and Produce Merchants' Associations, grade the produce at the port of shipment and issue a grading certificate which is final, subject to an appeal under certain conditions. An appeal against a grader's certificate for all goods other than potatoes may be made to an Appeal Board situated in Christchurch which acts for the whole of New Zealand. Since potatoes are liable to change condition in a few days, a Grader's Certificate of Potatoes is final, subject to an appeal regarding size, shape or variety.

The grade for any particular parcel of produce is mutually approved of by the broker, and the merchant buying the produce. The graders are paid for the work done by buying and selling merchant in equal proportions. They are usually instructed to grade at the port of shipment but occasionally at the rail siding or in store. The farmer, as the seller, usually pays one-half of the grading charge but has no voice in the appointment of the grader.

II. SELLING METHODS

A. Private Treaty

A farmer may sell to the merchant or his agent under the ordinary Sale of Goods Act and the Law of Contract, the goods being normally bought on sample and no definite arbitration procedure being involved. Offerings are usually heaviest immediately after harvest and the price usually falls. Some growers, however, prefer, and can afford, to wait and sell at whatever time is considered best.

B. Consignment

In times when forward or speculative purchases are not prevalent, consignment by growers to consuming markets is sometimes made. Since the grower is not represented on the market, the necessity for consigning to a recognized merchant, who will procure the best possible sale for the goods so consigned, is important. In most cases sales on the farm are best.

C. Contract

In the case of some crops, in particular barley, peas, oats and potatoes, the crops may be sold before they are grown. Such sales are usually made through a merchant on order for another merchant; or in the case of barley, by a merchant for his own requirements. Other produce is sometimes sold forward, in some cases the merchant providing the seed, the cost of seed and of bags being deducted when the crop is paid for. Dealing in futures particularly in the case of oats and potatoes is common. For example, potatoes may be bought and sold two or three times by merchants and speculators before they are harvested.

D. Collective Bargaining

Only in the case of wheat does any form of farmers' collective sales take place. In this case, organization of the growers has been assisted by the facts that: (a) a large part of the flour made in New Zealand is sold through one seller, Messrs. Distributors Ltd., and (b) the local market is partly maintained for the grower by means of the Sliding Scale of Wheat Duties. By collective sale, the bargaining power of growers is strengthened and any chance seasonal surplus can be exported without causing a collapse of the local price to export parity.

III. MARKETING OF INDIVIDUAL PRODUCTS

A. Wheat

1. *Tariff Protection*

The most important grain crop is wheat. This crop has varied in area from 400,000 acres in 1891-92 to 150,000 acres in 1925-26, and the yield from 13,000,000 bushels to 4,500,000 bushels. A little more than 8,000,000 bushels are needed if New Zealand is to meet its own needs. For flour, about 6,500,000 bushels are required, and for seed and feed for poultry and livestock about 1,500,000 bushels. The growing of this amount has been encouraged in recent years by the sliding scale of duties placed on wheat and flour imports. The rate of duty on wheat is 8d. per bushel (of 60 lbs.), increasing or decreasing by ½d. for every ½d. by which the current domestic value of wheat at the port of export to New Zealand is lower or higher than 5s. per bushel.

The rate of duty on flour is £1 12s. per ton of 2,000 lbs. increasing or decreasing by 1s. for every 1s. by which the current domestic value of flour at the port of export to New Zealand is lower or higher than £13 per ton. With the assistance of this sliding scale of wheat duties and with the fall in relative prices of grazing products, there is a tendency towards production of wheat in years of good seasons in excess of New Zealand's requirements, e.g., in the 1929-30, 1932-33 and 1933-34 seasons £63,000, £89,000 and £50,000 worth of wheat respectively was exported.

For many years past the State has provided support and assistance for the wheat growing industry in New Zealand through a policy of tariff protection. The rate of customs duties on wheat and its products (flour, bran and pollard) has varied from time to time, and up to the time of the tariff revision of 1927 there was a general tendency towards an increase in the duties. In that year a change in the *system of duties* was made and the present 'sliding scale' system of duties was brought into force in regard to wheat and flour. Previously the duties had been of a flat specific character—a certain fixed amount per unit of weight.

During the war and immediate post-war period, State control of

the industry was in operation, usually under a policy of Government guarantee of local wheat prices, implemented by State purchase and re-sale of wheat with fixed maximum prices for flour, bran and pollard. There was an embargo on imports. Any shortages in supply from local production were filled by State importations, sold internally in line with the fixed local values. This State action was not necessarily or wholly dictated by a regard for the interests of local producers, but in some degree at least was designed to ensure national security of supply and control of values. At certain times local values were below values in overseas markets and more often were below the value which would have resulted if importations had been permitted dutiable at the rates fixed in the tariff. On other occasions, of course, the result of the system of State control was to place local values above the parity plus duty and thus additional protection was at times provided.

In 1927 an endeavour was made to ensure a more or less stable value for local production without direct State intervention, by the adoption of the sliding scale duties on wheat and flour. Flat rate duties were maintained on bran and pollard (now removed) and to that extent the value of wheat locally was affected by a 'moving' factor—the import parity value of bran and pollard subject to the flat rate duties above mentioned. Local values under the sliding scale duties are also influenced by the fluctuations in importing costs, i.e., freights and other charges.

The general effect of the new system of duties was and is, however, to fix a value for wheat which is reasonably stable and to give an assurance to growers of a certain return per bushel of wheat produced. This was one of the central features aimed at in the system of Government control operated in earlier years. It was accordingly hoped, and intended in 1927, that the new system of duties would have the same general effect as that previously secured by the much more involved process of State guarantee with Government purchase and re-sale.

The foregoing remarks have been based upon an assumed local production in any year not in excess (or not *materially* in excess) of national needs. The basic policy has, of course, been one of State encouragement of wheat growing with the central intention of national self-sufficiency.

Having regard to the effects of changing financial results or prospects from alternative forms of production available to farmers in the wheat areas, and having regard also to the influence of weather conditions on sowings, growth and harvesting, it is not surprising that there have been fairly wide fluctuations not only in the areas sown in wheat but also in the quantity (and quality) of wheat harvested. In the past few years these fluctuations have been in evidence mainly as a result of weather conditions

in the growing and harvesting seasons, rather than of influences working through the areas sown. (For example, the average production per acre in 1931-32 was approximately 24 bushels while the production in 1932-33 was 36½ bushels per acre.) The average yield ranges about 30 bushels and has been increasing of recent years.

In order to secure the fullest possible price for wheat on the local market, particularly during the harvest delivery season, when the wheat comes with a rush on to the market, and in order to cope with any chance seasonal surplus without a collapse of the whole entire local market to export parity, a farmers' organization known as the New Zealand Wheat Growers' Co-operative Association Limited, was formed in 1928 after a canvass of wheat growers urging them to sign a five-years' contract to supply wheat to the Wheat Pool. About half the wheat growers and a little less than half the total wheat production were signed up. In each of the 1928-29, 1929-30, 1930-31 harvests, wheat was held over by the Pool and in 1929 a surplus was shipped abroad. This has resulted in the holding of the local market, but at the expense of the Pool and to the advantage of free growers.

For the 1931-32 harvest, owing to the expectation of a very large surplus, the whole of the growers were embodied in an organization called The Wheat Marketing Agency Company Limited, upon which growers and millers were each represented by four members to arrange a comprehensive sale for the whole of the crop. Arrangements were completed with millers to take all their requirements at a fixed price. A levy was deducted from growers to provide funds for handling the surplus, if any. Owing to a drought, this surplus did not, in fact, develop. There was some opposition to the levy, mainly on the grounds that the regular, early wheat grower, and skilled financial seller, does not benefit to the same extent as the late grower, because even if he suffered a low payout in one year, the elimination of the weaker and less financial growers in the following year might enable him to more than recoup his losses.

On the average of the last three years, about 10,000 tons of flour or wheat was imported for blending. The use of a proportion of malted New Zealand wheat, and improvements effected in milling and baking as the result of the work of the Wheat Research Institute, are now tending to offset this necessity for importing. This latter organization is financed by voluntary levy on all wheat growers of 1½d. per 50 bushels of wheat that the farmer sells supported by 1½d. levy on every ton of flour that the miller makes, and 1½d. for every ton of flour the baker buys, also to a certain extent by Government subsidy.

In 1931 the Government announced its intention of reducing the basis of the sliding scale of duties as at March 1, 1932. This did not involve

a change in the *system* but merely a reduction in the amounts of the duties with a reduction in the resultant value of local production. This reduction in the amounts of the duties was no doubt dictated by the general reductions in prices of all commodities. It was calculated that the revised scale of duties would enable growers in Canterbury to receive a price of approximately 4s. 6d. per bushel (sacks extra) on trucks, country stations, for the main class of wheat produced—Tuscan. In fact, the price worked out at only 4s. 4d. per bushel.

This forecasted reduction in the amount of the tariff protection (which was duly made effective last year) did not materially affect the area sown but, as already mentioned, adverse weather conditions both during the growing and harvesting seasons, materially reduced the realized production.

2. *The Wheat Purchase Board*

Towards the end of 1932, it became evident that the prospective harvest of the 1932-33 season would be particularly high. The area in wheat was certainly somewhat above that of recent years, but was not, however, so high as to be likely (with the average yield of about 31 bushels per acre) to produce an embarrassingly large total yield. It was the very favourable growing conditions which in the main appeared likely to cause the high production ultimately realized this year, and in contradistinction with 1932, harvesting conditions were also particularly favourable.

In face of this expected abnormal yield, it was recognized that the value of locally-produced wheat would this year not be controlled by *import* parity duty paid, but by the *export* value resulting from the considerable surplus production over national needs. In view of the abnormally low price in the world's markets, this would have involved a particularly low price to growers. A decision was consequently made to institute for the season a system of control which has been referred to as a 'compulsory pool.' The authority for this is contained in Board of Trade (Wheat) Regulations gazetted early in January, 1933. The Board was again set up to operate in respect of the 1933-34 harvest.

The controlling authority under the Regulations is the 'Wheat Purchase Board' representative of the main interests affected—growers and millers—with a chairman appointed direct by the Government. The system of control works through a plan of purchase and re-sale, the price paid to growers being the weighted average return from sales (a) to local millers at something below import parity, and (b) for export at export value. The extent to which export may be necessary under a system of control which enables wheat to be held off the market for future use, will depend upon:

(a) The final realized yield;
(b) The proportion of undergrade wheat in the total crop;
(c) The prospect of anything in the nature of a shortage next year.

In the absence of any system of control the carrying forward of wheat to the following year for local consumption would have involved the acceptance of a degree of speculative risk to private interests which would have made such action highly improbable.

The system of control adopted is very similar to that operated under direct Governmental control and finance in post-war years, but it has the following points of difference:—

(a) Control—within specified limits set out in the Regulations—is in the hands of the industry itself.
(b) Finance is provided by the industry itself through the difference in prices paid—for the commencement at least—to growers in comparison with the price realized for the proportion of the crop immediately sold to local millers.
(c) The ultimate balance of funds from sales—local and overseas—over the prices paid to growers will be returned pro rata to growers at the conclusion of the 'pool.' No 'profit' accrues either to the Government or to any other organization or body.
(d) The central idea is one of orderly marketing of a large crop in excess of (immediate) national needs rather than one of control in times of possible national shortage or to carry into effect a State guarantee of prices given in advance of production.
(e) The other main idea is to protect growers against the results of a serious break in prices consequent upon surplus over national requirements and to ensure that all growers participate equally in sharing the burden of 'loss' arising from the necessity for export of some part of the crop.

The prices paid to growers at the commencement of the 1932-33 season were based upon 3s. 4d. per bushel (sacks extra) f.o.b. main wheat ports for Tuscan wheat. The comparative price paid by millers was 4s. 7½d. (on the same basis), both prices being subject to certain monthly increments from April to September. The price paid by millers in 1933 was approximately the same as was paid in 1932 with the important qualification of a downward adjustment to bring the price of flour in the North Island 15s. per ton or 3¾d. per bushel below last year's prices. This 3¾d. per bushel reduction is partly borne by the miller paying an extra ½d. per bushel over the previous year's prices (included in the 4s. 7½d. above for all wheat used) the balance being borne by the wheat grower over the whole of the wheat gristed. The *effective* price paid by mills for Tuscan at the com-

mencement of the season for North Island consumption was therefore approximately 4s. 4d. f.o.b. (s.e.)[3] main South Island wheat ports.

Owing to the fact that most of the North Island wheat was grown under contract to North Island mills, the wheat grower in the North Island was exempted from the compulsory Pool Regulations in 1933-34 with the proviso that the Board had power to compel the North Island millers to pay to the Board the difference between the price paid by them for North Island wheat delivered at the mill and the cost of importing South Island wheat to their mills. In the following year, however, the North Island grower was brought under the provisions of the Regulations and his price was fixed by the Board at the South Island price plus the cost of delivering to the mill in the grower's district with certain adjustments.

The 1933 and 1934 pools have now been washed up, the final payments to growers for 1933 bringing their total up to 3s. 10d. per bushel f.o.b.s.e. for Tuscan on the March basis and for 1934 to 4s. 5d. per bushel f.o.b.s.e. for Tuscan on the March basis.

The Board is now engaged in the purchase and sale of the 1935 crop, the initial payment for which was fixed at 4s. per bushel f.o.b.s.e. March basis.

A feature of the 1935 operations was the Board's entry into the feed wheat market. On account of a short crop it appeared that fowl wheat would soar to a figure even higher than the milling price, so the Board decided to release some of its milling wheat as fowl wheat. This immediately had the desired effect on the fowl wheat market.

B. Oats and Chaff

1. *Production*

In 1902-03, the area in oats for threshing was 480,000 acres and in 1933-34 about 78,000. Dependent upon the condition of the crop and the condition of the market about half to one-third of the total area of the oat crop is threshed, oats transported long distances being more valuable in relation to the bulk than chaff. The decline in oats for threshing is in accord with the decline of local demand caused by the replacement of the horse by motor traffic.

Oats for chaff in recent years has fluctuated between 200,000 and 300,000 acres. At present, with the difficulty involved in securing a money income from sale of produce sufficient to make the payment for fuel, oil and repairs and renewals profitable, many farmers are turning from tractors towards horses, so that at least a temporary increase in the area of oats for horse-feed can be expected. In the long run, however, with the further replacement of horse power by motor power, the area in chaff can be expected to decline still further. The possibilities of profitable production

3. S.e. = sacks extra.

of oats for crop appears to be definitely limited. The total home consumption of oatmeal would require only about 10,000 acres, while the acreage for horse-feed is likely to decline.

In some years there is a surplus for export, but in other years there is a surplus of imports, mainly from Australia and Canada. Exports of oats (or chaff) are mainly to the United Kingdom and the Islands. Except in the case of imports of chaff from Australia, which are duty free, a small duty is placed on imports of chaff, oats and oatmeal. The possibilities of production of oats for green-feed and hard-feed for other livestock are probably not yet fully explored. Wheat is the main cash crop for Canterbury. On account of the high rainfall and poorer wheat harvest conditions, oats is the main cash crop in the North Island and Southland. High transport costs between different parts of New Zealand considerably hinders specialization in oat growing. The average yield ranges round 40 bushels of oats per acre.

Unlike wheat or barley, oats are mainly grown in the cooler, moister regions of the world and the cheap method of combine harvesting is less applicable. Therefore, oats tends to be a crop in which New Zealand can face foreign competition satisfactorily, the main limiting factors being the cost of transport and the competition of other crops.

2. *General Methods of Marketing*

As with all arable products except wheat, oats are marketed almost entirely through private brokers or merchants operating for private profit. In a very few cases the individual farmer may himself sell direct to the individual buyer and occasionally consignments may be made. The large majority of sales are made through brokers or merchants who are continuously on the watch for buying orders, or the possibility or turning over produce at a profit to themselves. As far as possible, they keep continuously in touch with market conditions through

(a) The sending of samples or quotations by grade and the securing of buying or selling orders by correspondence or cable;
(b) Direct brokers representation in the centre to which it is proposed to make sales; or
(c) Direct contact with merchants' representatives from other centres who desire to make purchases.

A large proportion of sales are made from the South to the North Island. The farmer himself usually has little or no information of market conditions in other than his own district and decides to accept or reject buyers' offers or to hold for future sale, merely according to his own impressions of the trend of the market and of the prospects of better offers from some other merchant or at some later date. There is no scarcity

of brokers or merchants willing to handle the farmers' produce provided profiable turnover can be made. For example, in Christchurch about fifteen merchants and six brokers are in operation and each has his staff of agents, prepared, as openings for sales occur, to make offers to the farmer for any produce he has available for sale.

3. *Costs of Marketing*

The total costs involved vary largely with the amount of handling and responsibility taken by the buyer. For example, if a large parcel of oats or chaff is merely handled by a Lyttleton shipper direct to the ultimate North Island cash buyer who takes delivery ex rail or ship, then the main costs involved are transport; and a margin of 2s. 6d. to 5s. per ton will suffice to cover the profit of the Lyttleton shipper. But if the oats or chaff are bought and put into store by the Christchurch merchant, later forwarded to a North Island merchant, who later retails small quantities of oats or chaff on credit to the ultimate buyer, then middlemen's charges for storage, risk and interest will be very much higher.

C. Other Products

1. *Barley*

The area in barley has declined from 46,000 acres in 1920-21 to 21,000 acres in 1933-34. At present barley production is unprofitable on account of the import of cheap (mainly Australian) feed-barley. Apart from production of barley for malting purposes, on the import of which a duty is placed, barley production is not now assisted by tariff protection. The average yield ranges round 36 bushels per acre and with the development of pure seeds and special treatment of barley seed together with the contract growing of barley for malt purposes, the per acre yield of malting barley has greatly increased. This has meant a decline in the total acreage required for malting. Barley is frequently grown on contract.

The growing of a little Cape and Black Barley for green-feed and animal-feed still continues. Feed-barley is mainly bought for pig and poultry-feeding purposes.

2. *Peas*

The area in peas fluctuates from year to year, there being 25,000 acres in 1927-28, 9,000 acres in 1929-30, and 30,000 acres in 1933-34. The yield averages about 27 bushels per acre. About one-half of the total production of peas in New Zealand is exported. Certain areas in New Zealand are very suited for the production of a high yield of good quality peas. Field peas are usually used for feeding pigeons and the garden peas for selling for seed for production of peas for human consumption. Both the local

and export markets are very limited. Over the past three years there has been an export of peas to the average value of £120,000. Peas are frequently grown on contract, the seed being supplied by the merchant or buyer. Crops may also be grown by free growers who take the risk of being able to secure a sale for the crop after it is grown, and who in seasons of low harvest yields, where the crop has been oversold and shipments have to be completed, may be recompensed for the risk they have taken, by a price much higher than the contract one. To offset this risk, some merchants are now adopting the practice of selling forward the product of a definite acreage, the actual amount being dependent on the yield obtained. The same conditions apply in respect of barley. The merchants are sole judges of grade, and the contract conditions are not therefore very well defined from the farmer's viewpoint.

3. *Maize*

The area in maize has also declined from 11,000 acres in 1920-21 to 8,000 acres in 1933-34. The average yield is about 48 bushels per acre. Maize growing is practically confined to the North Island. A duty of 2s. per cental is placed on imports, 1d. per pound on cornflour, and 1d. per pound with British preferential free on ground maize. The local market could absorb double the present quantity of maize grown. Maize is mainly sold by private treaty between individual growers, and merchants or growers.

4. *Linseed*

The area fluctuates considerably. In 1923-24 there were 12,000 acres; in 1933-34 1,500 acres. The yield ranges round about 7½ cwt. per acre. Linseed is mainly grown in Canterbury on isolated areas prepared too late to be sown in wheat, and on land with a clay subsoil more suited for producing a good yield of linseed than of wheat. The quantity of linseed required depends upon the local market demand for seed for oil purposes. Importation of linseed oil is hindered by a duty, but the importation of the seed is free. The local market is capable of absorbing more than double the amount now produced, but the possibility of growing linseed sufficiently cheaply to overcome outside competition is limited. If a linseed oil manufacturing plant were established in Canterbury, near the source of the locally-grown article, it might be successful. The Auckland plant has now closed down.

No growers' marketing organization exists. Forward sales are sometimes made through merchants, but most linseed is sold after harvest through the ordinary trade channels, either for consumption on the local market or for export.

5. *Potatoes*

The area in potatoes over the past ten years has fluctuated between 19,418 acres and 24,616 acres, and the yield between 105,000 tons and 144,000 tons; the average yield ranges round about 5 tons per acre. About two-thirds of the total yield of potatoes are table potatoes. The main crop potatoes are grown in Canterbury. Early crop potatoes are grown in all other districts. In certain productive districts around Pukekohe, Auckland, two crops of potatoes, an early and a main crop, may be grown on the same area in one year. In certain parts of Canterbury very high average yields up to 10 tons per acre, with individual yields of up to 20 tons per acre are obtained.

There is a small manufacture of potato crisps and flour in New Zealand. There is also a small balance of potatoes for export, mainly to Fiji and the Islands. Exports to Australia are hindered by a microscopical inspection of potatoes for disease on arrival. If it were not for this fact a large trade in potatoes to Sydney would develop, especially in years of high potato prices in Australia. New Zealand can produce potatoes of excellent quality more cheaply than Australia and many other countries. With better machinery for planting and harvesting, with improvements being effected by means of potato seed certification, high costs of transport, and the lack of an Australian outlet, the area required in potatoes is tending to decrease. Even with a lower acreage, in favourable seasons, some organization of marketing and method of removing the surplus would be of advantage to growers. It is apparent that on account of the fluctuation in prices and yield, certain periods of unprofitable production are inevitable. Over the past few years the production of certified seed potatoes has been more than usually profitable. In the growing of table potatoes, modern potato planters, potato diggers and graders, and co-operation with neighbours have considerably reduced the labour and other difficulties involved. More recently still a combined digging, grading and bagging machine has been tried out on one or two farms in South Canterbury. At present, however, labour for potato digging by hand can be readily obtained. Where higher yields than the average are obtained potatoes can be profitably grown while at the same time the ground is put into a suitable condition for following by a very cheaply-grown crop of wheat. Where potatoes are stored for the late season market, loss in weight and re-sorting for disease, etc., will considerably increase costs of marketing.

6. *Onions*

These are grown in small areas, and are specialized, intensively grown crops. Onion production has tended to decline owing to the competition of overseas imports, mainly from the United States of America, Australia and Canada.

No growers' marketing organization exists, although several attempts have been made by growers' organizations to secure a further share of the local market through the imposition of a tariff on imports to New Zealand. Most onions are sold after harvest as required through the ordinary trade channels.

7. Hops

Hop growing is practically confined to the Nelson Province and the growers work in close touch with marketing agencies with a view to securing a stable price for local consumption, and with a view to controlling output. Forward sales are made direct to brewers by the New Zealand Hop Growers' Association through an agent employed by them, and the surplus, if any, is shipped abroad. Australia maintains an embargo on New Zealand hops. The total proceeds from the sales made are pooled. Growers who prefer to stay outside the Association may do so, but since the main buyer, the New Zealand Breweries, has already contracted for its supplies from the Association, their local market will be limited and they will be forced to rely mainly on export.

8. Tobacco

The question of securing a market for the product is more urgent than the mere matter of production. Most of the higher-priced tobacco is grown on contract and graded by the buyers. Unsuitable tobacco, and some tobacco not contracted for is frequently unsaleable, no matter how low the price asked may be. No general grower's organization for the sale or manufacture of the leaf produced exists, although a number of companies have been formed to promote the development of tobacco-growing in special districts. As with the case of wheat and hops the bulk of the crop is bought by one or two large buyers, though smaller buyers operate in addition.

9. Grass and Clover Seed

The acreage cut for seed fluctuates, but in 1933-34 was about 90,000 acres. Both imports and exports occur. Grass and clover as fodder is marketed by feeding off by livestock or is cut for hay and sold as baled hay for supplementary live-stock feed. Grass and clover may also be cut for seed purposes. Most of the marketing, as in the case of hay, is done through merchants either locally or for export. In the case of some grass and clover seeds, growers' organizations exist to assist in the sale of their product, but they do not actually grade or market the produce. The Department of Agriculture, in the special case of certain pure seeds, also provides certificates which assist the sale of these seeds. Most grass and clover seed is machine dressed by the merchants to

eliminate impurities. Export occurs only when high prices in England coincide with low prices in New Zealand.

IV. PRICE QUOTATIONS

Newspaper reports of prices to be paid to farmers, or of current market prices, are the average of the quotations supplied by merchants to reporters. These reports are made regularly. Actual sales may have occurred for different lines at higher or lower prices dependent on the bargaining ability of the grower, the necessity of the buyer to fill orders or the sample supplied. The farmer as seller has no say in the quotations of prices supplied to the press.

The costs of marketing are all summed up in the price differences that occur at the same time for the same commodity in different places. Prices vary greatly, dependent on many factors, including the following:—

(a) the particular grade and quality of the article concerned;
(b) whether quotations are for cash or credit;
(c) whether goods are sold direct ex ship in large quantities or sold indirectly by a retailer in small quantities;
(d) distance from supply areas. At certain times when no sales are taking place, quotations are merely nominal.

In a general way it may be stated that costs of distribution of cash crops from such surplus producing regions of New Zealand as Canterbury to consuming regions as Auckland, are very great. In many cases produce can be transported more cheaply from f.o.b. Canada or Australia to Auckland than from f.o.r. country stations in New Zealand.

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Chapter XXXIII

THE MARKETING OF FRUIT

By J. A. Campbell

I. Extent and Distribution of Markets—A. Local—B. External. II. Technique of Marketing—A. Grading and Packing: 1. Local; 2. External—B. Transport: 1. Local; 2. External. III. Organization of Producers for Marketing—A. Co-operation—B. Control Board—C. Selling Methods: 1. Local; 2. External. IV. Finance of Marketing.

I. EXTENT AND DISTRIBUTION OF MARKETS

A. Local (including Foreign Competition)

WHILE all kinds of locally-grown fruits are distributed throughout the country, as the supplies in the different parts fluctuate and prices rise sufficiently to cover the additional cost of transportation from one point to another, the principal markets are the cities and larger towns in the vicinity of the orchards. The principal exception to this is apricots from Otago, which in season are distributed largely throughout New Zealand, and lemons, which are sent from the northern districts to other parts of the Dominion where they cannot be readily grown.

The demand for locally-grown fruit is in the following order: Apples, pears, peaches, apricots, plums, lemons and cherries. New Zealand is a large per capita fruit-consuming country, for apart from the consumption of approximately two million cases of locally-grown fruit, over thirty million pounds weight of fresh fruit are annually imported from abroad.

In general, fruit from the Northern Hemisphere does not enter into serious competition with locally-grown fruit, since the seasons are different. Oranges and bananas from Australia and the Pacific islands do not enter greatly into direct competition, since the production of oranges in New Zealand is very small, and bananas are not grown locally. Indirectly, however, the competition is more important, since to some extent oranges and bananas will act as substitutes for other locally-grown fruit.

B. External

The fruit export trade of the Dominion is confined to apples and pears. The demand for these fruits is satisfactory and is increasing each year as new markets are being made available. The present overseas markets are the Argentine, Brazil, Honolulu, British Columbia, Eastern Canada, Great Britain and the Continent of Europe. In the Argentine, we are in competition with locally-produced fruit, fruit imported from Chile, and cool stored fruit from the United States. In Canada the main competition arises from cool stored fruit of Canada and U.S.A. In Great Britain and the Conti-

nent New Zealand fruit is in competition with that from the Commonwealth of Australia, and with cool stored fruit from U.S.A.

II. TECHNIQUE OF MARKETING

A. Grading and Packing

1. *Local*

There are no compulsory standards applying to the marketing of local fruit. While a considerable quantity offered for sale locally leaves much to be desired in this connection, the major portion is reasonably well graded and packed.

2. *External*

Very definite standards relative to the grading and packing of apples and pears intended for export have been introduced and maintained by the Department of Agriculture. These standards take into account maturity, colour, blemish, russet and other defects, and stipulate in respect to each grade the maximum tolerance of each. Fruit before being packed is graded in accordance with these grading requirements and sizes. The latter is invariably effected by passing the fruit over a mechanical grader or sizer. Fruit of one size and grade only can be packed in one case. All fruit is wrapped in tissue paper in the process of packing. Packing is carried out on what is commonly termed the pocket or diagonal system. Under this system the fruit never rests directly one upon another, but that of each layer rests in a small pocket or space existing between the fruit of the layer below. The size of the fruit is indicated by the number of fruits in the package.

The standard export case has an inside measurement of 10½" x 11½" x 18", and is otherwise of the same specification as the standard apple case of Canada and the western States of America. Attached to each end of each case of fruit intended for export, is a national label of fancy design, bearing the words 'New Zealand Apples,' a shipping number, the grower's registered number, the name of the variety of apple or pear, as the case may be, the grade indicating the contents of the case, and a number indicating the number of fruits in the package.

Fruit prior to being accepted for export, is submitted to what is termed a grade store, where the consignment is inspected by officers of the Horticulture Division of the Department of Agriculture, and passed and stamped with an export grade stamp or rejected, as the case may be.

B. Transport

1. *Local*

Transportation is reasonably convenient. The motor lorry plays a very important place in this. By this means the fruit is either conveyed directly

to the market, or, if that is too distant, to the local railway station or coastal wharf, where it is conveyed by rail or steamer to its destination.

2. External

The same methods of transportation apply in assembling fruit for export at one or another of the main ports, where it is loaded on to overseas steamers and carried in cool chambers to its destination.

III. ORGANIZATION OF PRODUCERS FOR MARKETING

A. Co-operation

In common with their confreres in other fruit-producing countries, New Zealand fruit growers have endeavoured from time to time to improve their position, particularly in connection with the local marketing of fruit, by the formation of co-operative societies. However, notwithstanding the fact that a few such societies are still carrying on more or less satisfactorily, the movement on the whole has been far from successful.

On the other hand, although co-operative societies for the packing and marketing of fruit have not been altogether successful, the fruit industry of the Dominion has been very greatly assisted by a different form of co-operative society, known as the New Zealand Fruit Growers' Federation Ltd. The constitution of this society has been dealt with earlier and further reference will be made to it and co-operative societies generally in other chapters.[1]

B. Control Board

The New Zealand Fruit Control Board is practically the complement of the New Zealand Fruit Growers' Federation. The latter organization is a highly successful co-operative society, and before the Board was established was handling the fruit export trade of the Dominion, and was quite capable of continuing to do so successfully, but for the fact that it suffered from that disability inherent in all co-operative societies (a disability that has been the main cause of the downfall of so many in the past), namely, the lack of legal power to establish and maintain in its entirety a policy best calculated to serve the general interests of members, and at the same time hold the society together sufficiently to enable anything like a reasonable control of marketing to be maintained. Agreements apparently binding may exist, but such agreements are not looked upon too kindly by the law courts if seeking to bind producers too tightly to any such society, and must always include the right of resignation at a given period. Even though a society, by virtue of such agreement, enforces its policy, it is liable to fail eventually through disintegration brought about by resignations on the part of those who think, or are led to think by others having ulterior motives, that

1. See chapters XXXIV and XXXV.

their personal interests have suffered or will suffer in consequence of the adoption of a policy of control or pooling.

The experience of this country suggests that, at least inasfar as the fruit industry is concerned, much more satisfactory work can be done by building co-operative societies on the sound basis of a statute designed to provide a means of legal control than by forming them in the ordinary way and endeavouring to bind them together by means of legal agreements. With some such thought as this in mind the Federation, which met with serious difficulties in handling the export of fruit from the Dominion and could see others rapidly arising that it was constitutionally unable to counter, moved for the introduction of the present control legislation. This came into force in 1924 in the form of the New Zealand Fruit Control Act. Before becoming operative a poll of producers entitled to vote was taken in accordance with the requirements of the Act and was successfully carried.

Almost immediately following this, however, the growers in the Province of Otago seceded from the control legislation—a privilege granted by the Act to any province on the presentation of a petition to the Minister of Agriculture signed by 70 per cent. of those legally qualified to do so. Consequently the growers of Otago have never been under the jurisdiction of the Board.

The Act also provided for the setting up of Local Control Boards to handle the sale of fruit locally. The voting for the introduction of this part of the Act is on the basis of 60 per cent. of those entitled to vote. So far no province has been able to overcome this heavy voting handicap; consequently no Local Control Boards have been set up.

The New Zealand Fruit Export Control Board was established in 1924 and commenced operations in 1925. The Board, which is financed by the imposition of a levy approximating 1½d. per case on all fruit exported under its jurisdiction, designs the export policy, maintains a representative in London, employs a shipping officer in New Zealand, and attends to the booking of all shipping space required by growers. The Fruit Growers' Federation acts as the local agents of the Board and attends to the actual shipping of the fruit, and all matters relative thereto, including the keeping of growers' accounts, receipts and disbursements, etc. The Board's overseas representative receives and despatches to selected brokers all fruit consigned on behalf of the Board to Great Britain and the Continent of Europe. The operations of the Board have been so successful as to secure the goodwill of practically all engaged in the industry.

C. Selling Methods

1. *Local*

There are three ways in which the orchardist normally places his fruit on the local market. He may sell direct to the consumer or retailer,

he may sell by private treaty to co-operative or proprietary fruit merchants and he may sell by public auction. While the sale of fruit by public auction, which accounts for the disposal of the major portion of the fruit crop of the Dominion, may leave something to be desired, it has the virtue of simplicity. One or more fruit auction marts exist in practically all towns of any consequence throughout the country. In however small a way he might be, all a grower has to do is to pack his fruit and forward it, together with the necessary advice, to any auction mart he might select. The firm will do the rest—namely, pay any charges that may be necessary, including freight, receive and transfer the consignment to the auction room, sell it under the hammer, and forward an itemized account of the transaction to the grower, together with a cheque covering the net proceeds of the sale.

2. External

The methods of disposal of fruit externally include sales through what are termed private treaty fruit merchants, sales by auction, f.o.b. and c.i.f. sales. Most of the fruit from New Zealand is disposed of through private treaty firms. As far as Great Britain is concerned the procedure is as follows. The New Zealand Fruit Board has selected a limited number of fruit brokers in the different markets in England and Scotland, and the sale of New Zealand fruit controlled by the Board is restricted to the firm selected. It has its own representative established in London to whom all fruit is consigned. On receipt of cabled advice as to the particulars of a shipment coming forward, the London representative proceeds to allot it to the selected brokers at the port of destination in such quantities as he thinks best to ensure a ready sale.

The Board's London representative also negotiates c.i.f and f.o.b. sales, particularly on the Continent of Europe and in North and South America. All such negotiations must be confirmed by the Board in New Zealand before definite contracts are entered upon.

The Board does not permit of individual growers under its jurisdiction negotiating c.i.f. or f.o.b. sales. All such sales must be effected through the Board and must be made available to all growers under the Board's control. The procedure is as follows: All such forward sale contracts call for specific varieties and sizes of fruit. The particulars are made known to growers who are invited to nominate the number of cases, if any, they wish to supply, it being clearly understood that if the number of cases supplied exceeds that of the contract the surplus will be disposed of by the Board to the best advantage, and the proceeds pooled with the proceeds of the contract. Payout will be made accordingly. This means that if the surplus fruit realizes a lesser price the contract price level will be slightly reduced. Conversely, if it sells at a higher price the general level will be slightly

higher than that represented by the contract. The fruit from the Province of Otago, which is not under the control of the Fruit Board, is disposed of in much the same way as that of the Board except that additional brokers to those who sell for the Board are utilized, and that individual growers are free to negotiate forward sales.

IV. FINANCE OF MARKETING

This problem does not arise to any serious extent with respect to the local market. The facilities for marketing are convenient and simple. A grower who has the finance necessary to cover the purchases of cases and packing material has usually little difficulty in carrying on. The freight on packed fruit despatched to market is invariably made payable forward and is paid, together with other marketing expenses, by the selling agent out of the proceeds of the sale, and the net realizations returned to the grower. However, should the need of finance for this purpose arise, as it does on rare occasions, the grower has little difficulty in getting temporary assistance from the firm of auctioneers who attend to the disposal of his produce.

The position, however, is somewhat different in connection with the export of fruit. The matter of marketing finance plays an extremely important part covering as it does such items as the supplies of case timber, nails, packing materials, the labour of picking, grading and packing, carriage, local freight, insurance and overseas freights. Landing charges, commission, etc., incurred in receiving and selling fruit after arrival in an overseas country, are charged against sales, and are itemized in the account sales of the selling agent.

The financing of the former set of items is therefore the fruit grower's immediate concern, but in this he is no doubt in an extremely fortunate position. In the first place he has a very sound trading organization in his Federation, which, in view of the favourable position the latter's account occupies in the opinion of its bankers, is in a position to finance growers, either directly or by arrangement with the bank, in the purchase of case timber and all other packing materials.

By mutual agreement all such advances are charged to the individual grower's fruit export account and are recoverable from the proceeds of sales. In this the Federation is well safeguarded, for as it handles all export accounts on behalf of the Board, it is in a position to see that all such advances are duly met before final settlement with the grower is effected.

In the second place the grower has the assistance of the Fruit Board and the arrangements made by that body for financing the grading, packing and export of fruit.

The usual practice of financing the export of primary produce by

means of brokers' credits does not obtain in the fruit industry. The Fruit Board has an existing arrangement with the Bank of New Zealand under which advances are made on a case basis against fruit intended for export. The amount of such advances is sufficient to cover local and overseas freights and other export costs, and at the same time provide a cash payment to the growers.

The advantages claimed for this system are that not only is it slightly less costly than the alternative method, but under it the shipper, who as far as the major portion of the fruit exported is concerned is virtually the Board, remains independent of the broker from the point of view of monetary obligations, and is therefore free to demand service or transfer his patronage elsewhere without compensation in the event of his being of the opinion that such service is not being adequately rendered.

Although not under the jurisdiction of the Fruit Board, a similar system of finance has been developed in connection with fruit exported from the Province of Otago.

Chapter XXXIV

CO-OPERATION IN NEW ZEALAND[1]

By F. B. Stephens

I. Introductory—A. Aims and Objects of Co-operation—B. Types of Co-operation —C. Development of Co-operation. II. Co-operative Processing—A. Frozen Meat— B. Fruit and Eggs—C. Dairy Produce: 1. Reasons for Prominence; 2. Dairy Act 1908 and Amendments; 3. Provision of Capital; 4. Basis of Shareholding; 5. Differential Payments to Shareholders; 6. Non-supplying Shareholders; 7. The Directorate; 8. The Management; 9. The Secretariat; 10. Dangers in Present Administration; 11. Shareholders' Voting Power; 12. Inter-factory Competition; 13. General Evaluation. III. Co-operative Marketing—A. Relation to Control Boards—B. Dairying— C. Other Products: 1. Pig Marketing Association; 2. Wheat; 3. Fruit. IV. Co-operative Purchase—A. Purchase of Factory Requisites—B. Purchase of Farm Requisites. V. Co-operative Distribution. VI. New Zealand Co-operative Dairy Co. Ltd.—A. Size—B. History and Policy—C. Administration—D. Subsidiary Organizations—E. General Evaluation.

I. INTRODUCTORY

A. Aims and Objects of Co-operation

CO-OPERATION has been defined as a form of association either permanent or temporary, established for the purpose of furthering an economic aim (such as marketing, financing or purchasing economic goods) organized on such conditions that all who assume the duties of membership share in its rewards in proportion to the degree to which they make use of the association. In this the co-operative association is contrasted with the joint stock company in which shareholders benefit in proportion to capital investment. A great deal is made in certain quarters of the altruistic nature of much co-operation. As far as New Zealand is concerned, too much weight cannot be given to this claim, as the primary urge to co-operation has, in nearly every case, been economic. It has been prompted by the realization of relatively weak bargaining power of the individual farmer when confronting the more integrated marketing firms, and the desire to overcome this by eliminating the middleman. Rightly or wrongly, the farmer has thought that middlemen are making excessive profits and that some form of co-operative organization will increase the returns to the producer by reducing marketing costs, or transferring the profits of marketing from the middlemen to him.

B. Types of Co-operation

Some degree of co-operation applies in practically all primary industries except in the production and marketing of meat and wool. There is little if any co-operation in the *retail* marketing of primary products. Co-operation is most evident in the dairy industry where over 80 per cent.[2] of the value of the produce is processed co-operatively.

1. The Co-operative Provision of Credit is discussed in chapter IX.
2. 'The part played by co-operative organization in the international trade in wheat, dairy produce and some other agricultural products.' League of Nations memorandum from Int. Econ. Conf., 1927.

In this study co-operation will be discussed under the headings: *Processing, Marketing, Purchase, Distribution* and *Other.*

Processing, for the purposes of this section, may be taken to include all necessary operations from the time the raw material leaves the farm to the time it is in condition to be put into the wholesale markets. It thus includes assembling, grading, the conversion of raw materials into finished products and packaging. The reason for including these different services under the heading of Processing is that the operations outlined above are usually under the control of one administrative unit.

Marketing refers to the disposal of the finished product. Co-operative purchase can be discussed under two headings: (a) The co-operative purchase of farm requisites either directly or through a co-operative dairy company; or (b) co-operation between factories for the purchase of factory requirements. Co-operative distribution refers to the co-operation among farmers for the distribution of consumers' goods. As this is practically non-existent in New Zealand, not simply among farmers, but also among other sections of the community, little comment will be made under this heading.

C. Development of Co-operation

There is practically no evidence of co-operation in New Zealand prior to the eighties of last century. Thereafter the co-operative movement developed very rapidly in the dairying industry in Taranaki, the Waikato and, later, in Southland. By the opening of the present century co-operation was the dominant form of organization in dairying. Co-operation in other primary industries was of later and slower growth.

The recession of prices in the eighties and early nineties of last century provided a strong urge to co-operation among dairy farmers; but this, in itself, would have been insufficient had not two other factors operated. The development of a factory system in the early 'eighties made possible a high degree of efficiency and uniformity in manufacture, and the rapidly expanding export trade permitted the product to be marketed through well-defined export channels. These two conditions account for the more rapid growth of co-operation in dairying than in other primary industries.[3]

The steady development of the dairying industry from the 'nineties is marked by a corresponding steady development of co-operative dairy manufacture by the conversion of existing proprietary to co-operative factories; by the creation of new co-operative factories in new areas; or by the 'hiving off' of suppliers from existing institutions.

The serious price fall in immediate post-war years synchronizes with a remarkable development of dairying by a new type of farmer. The returned soldier, frequently city-bred and trained in commercial pursuits, became very prominent in agitation for better farming conditions. One

3. After Belshaw: 'The Dairying Industry of New Zealand,' unpublished M.A. Thesis.

phase of this movement was a further urge to co-operation. There was no great increase in the number of new factories, but there was a strong desire to push co-operation to further lengths by amalgamation of existing co-operative institutions, and by carrying co-operative operations into new fields, such as co-operative marketing and co-operative purchase. The failure of these excursions to produce any considerable financial return to the individual farmer, soon caused a cooling of enthusiasm and the middle of the past decade resulted in some disintegration of existing co-operative societies by the hiving off of disgruntled suppliers. The experiments in co-operative marketing on the whole proved unsuccessful and most concerns soon returned to their original field of manufacture, leaving the marketing to the previously existing concerns. There was a remarkable development for a time in co-operative purchase through dairy factories, but some serious mistakes were made and the antipathy of shopkeepers was very strong. Hence, by the middle of the decade, most concerns had retreated from this field although some still supply milk cans, separators and such like. The only development of any magnitude in this field since that date has been the co-operative distribution of fertilizers which has assumed large proportions in the last five years.[4]

From about 1923 to 1929 the main feature of the co-operative movement was the intense inter-factory rivalry. The fall in the price level after 1929 has stimulated a further desire to 'pull together.' This has taken the form of a movement towards inter-factory co-operation in fields of general interest, such as internal marketing.

Post-war years have seen considerable development in co-operation among poultry keepers, bee keepers, and fruit growers, but the relative importance of these movements is much less than that in the dairy industry, and is largely educative in character.

It is rather significant that in practically every field in which co-operation is prominent to-day the pioneer work was done by proprietary institutions. In fact the history of co-operative enterprises in New Zealand suggests that farmers' co-operative concerns are not suited for breaking new ground.

II. CO-OPERATIVE PROCESSING

A. Frozen Meat

By the very nature of the product, there is practically no processing required for wool prior to its marketing, and hence there is no co-operative organization in this field.

In regard to frozen meat there is no co-operative processing in New Zealand at the present time. The reasons for the absence of co-operation in this field are broadly as follow:—

4. The New Zealand Co-operative Dairy Co. Ltd. is a concern apart and as such will be dealt with later.

(a) Owing to the nature of the operations, a very large initial capital is required for plant and machinery.

(b) A large output results in definite reduction in overhead per unit of output.

(c) A large output enables considerable profit to be made from by-industries.

(d) A plant, once established, can, with comparatively little additional expense, maintain a capacity to handle all the produce of its district.

For the above reasons an established manufactory has practically the powers of a monopolist and competition is practically impossible. The very strength of the existing unit and the economies of a large output are such that even if it were possible to organize opposition the costs per unit of output for all factories would be increased. There are technical difficulties, too, in the way of running the industry co-operatively. In the first place there is the difficulty of providing the large fixed capital required; secondly, the peculiar nature of the supply of raw materials is such that finance by the issue of shares to co-operators on any equitable principle would be most difficult. A further fact strengthening the position of the existing proprietary concerns is the very efficient system of assembling raw materials by means of the railways.

The desire to give the farmer some control of the frozen meat industry has resulted, however, in the development of the quasi-co-operative concern in which shares are held chiefly by farmers. The concern operates as any proprietary concern and pays dividends on capital. Since farmers are invited to hold the capital and hence to control the directorate, some of the profit finds its way to the primary producer. But the profit is distributed on the basis of shareholding, and not of the raw material supplied, while the person receiving the profit may make no use of the institution at all. Hence such concerns are not truly co-operative. Rather, they are joint stock companies having some farmers as shareholders.

B. Fruit and Eggs

Grading of fruit and eggs is, to some small extent, carried out by co-operative institutions of producers, but its importance is small as the field is covered fairly effectively by proprietary institutions.

C. Dairy Produce

1. *Reasons for Prominence*

Co-operative processing of raw materials in New Zealand is practically confined to the dairying industry. The perishability of the raw material

places the farmer in a disadvantageous position competitively as he is quite unable to hold his produce for a rise in price. The fact that manufacturing is necessarily divorced from the farm life renders continuous connection with the business world necessary, with a consequent stimulus to interest in the affairs of marketing. The fact that dairy farms are small relatively to some other types of farming makes contact between farmers more frequent. Contact with fellow-farmers resulting in the recognition and expression of common interests is also encouraged when farmers cart their milk to the factory daily; finally the fact that all farmers are similarly affected by the manufacturing policy provides a very definite urge to common action.

As in most forms of co-operation, co-operation in dairying emerged because it was felt that the farmer would gain financially; or, in other words, that the expenses of processing and marketing through proprietary channels were too heavy. At the present time over 80 per cent. of the ultimate product is marketed from co-operative factories.

2. The Dairy Act 1908 and Amendments

Co-operative concerns are organized under Part III of the Dairy Act 1908 and Amendments. They are registered under the Companies Acts and are granted the privilege of limited liability. A very interesting feature indicative of the trend of public opinion was the Dairy Amendment Act 1926, which provided, *inter alia,* that no company operating in milk, butter, cheese or milk products was entitled to register under the Companies Act a name including 'co-operative' unless it was really a co-operative concern. Thus, as far as the dairy industry is concerned, the word 'co-operative' is protected. On the other hand, many truly co-operative concerns do not include the word 'co-operative' in their name. This applies particularly to the older associations.

To all intents and purposes, a co-operative dairy company registered under the Companies Act is a limited liability company, the liability of which is limited by shares. The Dairy Industry Act 1908 and Amendments relax some of the provisions of the Companies Act relating to co-operative dairy companies. These include the prohibition of the right to surrender shares to the company or the right of the company to pay for such surrender. Both these operations are permitted to co-operative concerns. The share qualifications, the signification of willingness to act and the requirements re attendance at meetings are relaxed in the case of co-operative dairy companies. This is interesting as it gives non-shareholders a seat on the directorate. That such a provision is wise will be evident if it is remembered that shareholders are farmers while the processing and marketing of dairy produce is largely a business proposition.

3. *Provision of Capital*

One of the problems of co-operative manufacture in any sphere is the provision of capital for plant and buildings. Such capital could be subscribed—on whatever basis decided—by the co-operators by a lump sum payment, but such a method would seriously tax the farmer's available cash resources, and very seriously reduce the number of co-operators. In all countries, cash resources available for such an investment by small farmers are very limited. Since New Zealand farmers are mostly small-scale and their farms are still largely in the developmental stage any available cash is almost immediately reinvested in the farm. Hence, shares have usually been allotted subject to being paid up over a number of years. Application and allotment moneys are seldom demanded. As a consequence, initial capital must be sought in other directions. In the earlier stages of the industry, co-operative companies arose through the buying out of proprietary concerns, and in these cases there was frequently a provision for the capital to be paid off over a number of years subject to a mortgage in the interim. But later expansion of the industry has necessitated the formation of co-operative concerns *ab initio*. Hence, it has been necessary to tap the credit resources of the community by other means.

The usual method of raising the necessary capital is by bank overdraft. In order to provide the necessary security, original members of new companies are usually required to sign a collateral joint and several guarantee to the bank. In addition the overdraft is secured against the assets and uncalled capital. Such a liability is usually sufficient to bind the suppliers to supply the factory until sufficient capital has been paid up to cover the capital liabilities. In addition, however, some form of supply agreement may sometimes be adopted. This is designed mainly to ensure adequate and regular supplies of raw material, but at the same time it strengthens the security against loans. In the case of the New Zealand Co-operative Dairy Company when a demand for a new cheese factory exists, it is usual, before erecting the factory, to take a specific supply contract for five years. In some other cases year-to-year contracts are made. In all cases when finance is provided to the individual farmer, it is the custom to take a supply contract which is operative till the advance is repaid. Again, where any specific payment for product, or any payment in addition to current prices is guaranteed, it is usual to demand a supply agreement. Since there was some doubt as to the validity of supply agreements, the Dairy Industries Amendment Act of 1924 was passed to make such agreements binding and obviate the defence of restraint of trade. There is still some doubt as to whether such agreements are legally binding.

Where stocks are sold f.o.b. or in advance, working capital is almost invariably provided by banks; buyers in such cases pay a large proportion

of the purchase price, if not all, on delivery or even in advance. In the case of consignments for sale abroad, banks advance a proportion of the value and are repaid on sale of the product in London.

4. *Basis of Shareholding*

Broadly, the basis of capital interest in a co-operative concern is determined by the use which the co-operator makes of the organization. Hence it is usual to demand that shares held should have some relation to the amount of the product supplied. Several methods are adopted. The older method was to require the holding of shares in proportion to the cows carried, the relationship being from one £1 share per cow to five £1 shares per cow. However, such a system legislates against the man with the low producing herd and consequently the present-day method has been to require share holdings to be proportionate to raw material supplied. As 'payout' is in terms of butterfat, shares are allotted on this basis. The precise relation varies in different companies, the range being from one share to 50 lbs. of butterfat per annum to one share for 300 lbs. of butterfat. The average would be about one £1 share for 80-150 lbs. of butterfat.[5] On the average the shareholding requirements in cheese factories are higher than in butter factories on account of the higher capital cost per unit of supply of cheese factories.

The amount of shareholding for any year is determined by the produce supplied during the previous year. Allotments are automatically made on an increased supply in any year. The directors usually have power to allot without reference to the shareholder. However, if he objects to increased shares he is treated as a non-shareholder for the supply over that warranted by his shareholding. Shares are paid up either by a deduction of between ¼d. and ½d. per lb. of butterfat supplied, the amount being deducted every month till the shares are fully paid; or by an annual deduction of a similar amount per lb. of butterfat supplied during the year, the deduction being made from the payout made after the product has been finally realized.

5. *Differential Payments to Shareholders*

Shareholding suppliers usually receive a slight differential payment over non-shareholders for produce supplied, but the excessive competition between co-operative companies themselves, and between co-operative and proprietary companies has led in districts other than the Auckland Province to the payment of all suppliers at the same rate.[6] This is possible because the companies are now not in need of further capital for fixed assets, and increased supply means lower unit working costs.

5. In the Waikato the average is about £1 share to 80 lbs. of butterfat.
6. It is usual for approximately 90 per cent. of the estimated net realization of the product to be paid out on the 20th of the month following supply, the balance being paid at the end of the year after the actual results of the realization are obtained.

6. *The Problem of the Non-supplying Shareholder*

In co-operative concerns the directorate is, in general, elected by the shareholders, although in a very large number of dairy companies non-supplying shareholders have no voting rights. The rights of non-supplying shareholders to dividend and control of the company is a hotly-debated point. Non-supplying shareholders are either shareholders who have retired from farming or are supplying other factories. The co-operative spirit would suggest that direction of the policy of the company should be in the hands of actual suppliers, although, on the other hand, the capital interest of non-supplying shareholders seems to demand either repayment of capital[7] or fixed interest on capital involved or some say in the company's affairs. A fixed interest on paid-up capital has been good 'sales talk' in obtaining suppliers, but there seems to be a move in the direction of no such interest payment, as this eats into the sum payable for butterfat and so reduces competitive power in obtaining supply.

7. *The Directorate*

Although minimum share requirements are not demanded from dairy company directors in terms of the Dairy Industries Act 1908, yet the Articles of Association usually provide some such interest. It is also usual to demand that a director shall be a supplying shareholder. Since the usual company is a one-factory concern, directors are elected irrespective of place of residence, at the annual meeting. The New Zealand Co-operative Dairy Company, which covers a very wide area, has a ward system of election of directors so that the directorate is representative of the whole area. In addition, the Company has local committees of suppliers who voice the opinions and grievances of their own localities. Such a system is necessary in order to preserve the personal interest of shareholders, which a company of such wide ramifications as the New Zealand Co-operative Dairy Company might otherwise lose.

The farmer directorate is a potential danger in the dairy industry to-day, as the normal farmer has not the time to spend on his company's affairs and may therefore become merely the mouthpiece of the manager or secretary of the company. He is further frequently unable to spare the time for an adequate study of market conditions and consequently there is a strong tendency for him to be influenced by propaganda, particularly where the output is small and competition keen. As a consequence there arose the demand for some co-ordination of marketing, particularly as it was felt that the smaller interests were being exploited by buying agents.

7. Most companies retain the right to pay off non-supplying shareholders. This is seldom done unless a person has retired from farming or has moved out of the area of the company's operations. The full face value, however, is seldom paid. Of course, a shareholder has the right to sell shares if he can.

8. *The Management*

Processing is in the hands of efficient managers who have normally risen from the ranks as a result of proved efficiency in butter or cheese making. The stimulus to increased efficiency is maintained by competitions at agricultural and pastoral shows. If a factory has a good manager, a farmer directorate can usually administer the processing side fairly satisfactorily although the smaller factories, by their inability to pay adequate remuneration, are at a disadvantage.

9. *The Secretariat*

In the matter of secretarial work the position is not quite so satisfactory. The larger companies maintain their own staffs whose whole energies are given to the work. The smaller companies usually engage a professional secretary to look after their affairs. It is common for such a public secretary to work with a large number of companies, and the division of effort and interest almost necessarily results in the work being done in a purely routine manner. Of course, such secretaries, in time, are able to acquire a very broad knowledge of the industry, but with certain notable exceptions, they are not prominent as leaders in that sphere where the industry needs leadership, namely, in the managerial field.

10. *Dangers in Present Administration*

There is a good deal to be said for the infusion of a business element into the directorate, especially on the marketing side. An efficient manager and secretary can usually prevent serious errors in either processing or accounting, but neither has the training to enable him to guide the directorate in the commercial side of the business. The advice of a mere commercial manager on the other hand could be overridden by directors unless he himself occupied a place on the directorate. While few but the largest concerns could so employ a full time managing director specially qualified to direct the commercial affairs of the concern, there seems to be a case for federations for marketing purposes employing such officers.

11. *Shareholder's Voting Power*

The usual procedure at meetings of shareholder suppliers is that in a show of hands each man has one vote while in a ballot he has votes in proportion to the shares he holds which is, of course, the same thing as in proportion to his butterfat supply. Frequently non-supplying shareholders have no vote except in cases where their interests are directly involved.

12. *Competition Between Co-operative Factories*

The very keen competition between rural co-operative factories is one of the most noticeable features of co-operation in New Zealand. The

various services offered, the fractional differences in 'payout,' and the differences in share basis are all quoted in order to attract and keep suppliers. Numerous cases could be quoted of two or more factories belonging to rural companies serving one district. Not only does this add considerably to the manufacturing costs, but also it leads to very doubtful practices. One direct outcome of this is that farmers change from company to company for the slightest reason.[8] This fluctuation in supply results in a definite increase in cost. So far has this movement gone in some areas, e.g., Manawatu, that the co-operative basis of joint financial interest in the processing plant is not now a prominent feature. Suppliers are under no obligation to have a financial interest in the capital of the concern. The logical outcome of this is, of course, that ultimately the companies will be merely joint stock companies where the interests of shareholders and suppliers do not necessarily coincide.

Not only is there competition for supply of raw materials, but competition extends to the marketing field, especially in the local market. Different prices are quoted for no reason other than a desire to get the market. This competition is very severe but is productive of enormous financial losses to farmers. The possibility of buying agents for London houses playing off factory against factory was a compelling cause leading to the Dairy Control Board of 1925. In some quarters, noticeably in Taranaki, the dangers are still not fully recognized. Small factories of very weak bargaining power marketing individually are, of course, no match for the strong buying houses. While the advantages of joint marketing have been discussed from time to time, there has been no widespread popular demand, so that joint marketing is not common.[9]

This inter-factory competition not only results in financial loss but is a very potent cause of social friction. The writer knows of several instances where Farmers' Union, school committee, and social committee elections have been fought out on party lines, the parties ranging themselves according to the factory they supply. The personal bitterness engendered, coupled with the loss of status to officials and directors of small companies, have proved effective barriers to any scheme for federation or amalgamation.

13. *General Evaluation*

Speaking broadly, the co-operative spirit, although very much talked about to-day, is not very evident in fact. Not that co-operative dairy companies are on the decline, rather the reverse, but the altruistic spirit, or as co-operators say, the 'unselfish' spirit, is not very prominent. The whole

8. This problem among others was discussed at a Dairy Conference early in 1933. Later, Regulations were issued which, *inter alia*, aimed at preventing farmers changing from one factory to another during the season.

9. Under the new Marketing Regulations of the Dairy Board, whereby the Board makes the allocations to agents, this danger is now obviated.

movement possesses rather the spirit of the ordinary joint stock company and of ordinary capitalist and destructive competition. There is an enormous need for a thoroughgoing self-examination within the ranks of existing co-operation in dairying, and an attempt in some way to overcome the perpetual suspicion and friction which exist.

III. CO-OPERATIVE MARKETING

A. Relation to the Control Board Movement

Co-operation in processing is important only in the dairying industry; but in marketing co-operation, either voluntary or compulsory, is to be found in most important products. The financial stress of immediate post-war years, due to the fall in prices, naturally directed attention to the question of marketing costs, and, rightly or wrongly, it was believed that such costs were excessive and could be reduced by some form of co-operative effort. Hence the past decade has seen a demand from all the major industries for some form of interference with the then existing marketing agencies. The plight of frozen meat producers and dairy farmers, and the fact that they represented by far the largest groups of primary producers caused them to be the first to make their wants known. The Government was persuaded in 1922 to institute a Meat Control Board. This was followed by the Dairy Control Board, the Kauri Gum Control Board,[10] the Fruit Control Board, and the Honey Control Board. However, the activities of these Boards are confined to a very small range of functions and do not normally extend to price control or distribution of the product. Their primary functions are the arrangement of freight, insurance and advertising, as well as, in some cases, the setting of standards of quality. The Boards have representatives of producers, merchants and the Government, and aim to fairly represent the industry as a whole.[11]

The actual selling is still, in most cases, in the hands of the producers through their companies and consequently the competition of New Zealand products with each other and the playing off of New Zealand products against New Zealand products is still very evident. Hence there is scope for some co-ordination of the actual selling. The need for such co-operation is generally recognized, but local or personal jealousies are frequently effective barriers to efficient co-ordination.[12]

B. Dairying

In the sense that most of the dairy factories are co-operative in principle, the marketing of dairy produce is also largely co-operative. But such a statement hides the fact that the inter-factory competition for

10. This went out of existence in 1932.
11. See chapter XXXV.
12. Legislation of 1934 greatly widened the powers of the Dairy Board to include internal administration as well as export marketing; and the setting up of the Executive Commission of Agriculture provided for the closer co-ordination of the various Produce Boards.

markets is frequently more severe than proprietary competition would be. With certain exceptions to be mentioned later the usual methods of the sale prior to 1930 were:—

(1) Sale f.o.b. either for a particular shipment or for a whole season, to English buying houses who bore the risks and enjoyed the profits from price movements. Such a method was, perhaps, the most satisfactory to the smaller factories who had neither the ability to finance consignments to England nor the knowledge of market prospects.

(2) Consignment to London to be sold on arrival. The New Zealand Co-operative Dairy Company, the largest company, has always consigned its produce and has maintained selling agents abroad.

The distance of New Zealand from the market, the consequent lack of first-hand knowledge of market conditions, and the fact that the majority of the companies operate on such a small scale that it is impossible for them to maintain a private selling officer in London, all make it very difficult for the average New Zealand dairy company to compete effectively on the London market. Further, the small financial status of most companies and the practice of large advance payments prior to marketing are such that the smaller companies are, in general, unable to take the risk of market changes during the period of transportation.

In Chapter XXX the marketing operations of the New Zealand Producers' Co-operative Marketing Association and of the Amalgamated Dairies Limited, with relation to the industry in general, are discussed. Since the latter concern is not now operating for the industry in general the former concern is now practically the sole co-operative marketing institution in New Zealand. The former concern was floated in the immediate post-war years as the New Zealand link between the New Zealand Co-operative Dairy Factories and the English Co-operative Wholesale Society. Shares were offered to New Zealand co-operative factories, the basis of shareholding to be the tonnage output of the factory. The English link in the chain was the New Zealand Producers' Association in which half interests were held by the New Zealand Producers' Association and the Co-operative Wholesale Society. The New Zealand concern then offered to market dairy produce for its suppliers and others through the New Zealand Producers' Association in London from which the Co-operative Wholesale Society had the right to purchase its butter, but at purely competitive prices. On its part the New Zealand Producers' Association was under no obligation to sell to the Co-operative Wholesale Society but could sell in the best market. Profits were divided between the New Zealand Producers' Co-operative Marketing Association and the Co-operative Wholesale Society. The profits of the former were distributed

as a rebate to those who sold through the Association, but non-shareholders receive only half the rebate that shareholders receive. Although the concern has not received a very large support from the co-operative factories as a whole, it is an interesting example of co-operative principles extending from producer to consumer.

The Co-operative Wholesale Society has made several efforts to make direct contacts with New Zealand co-operative dairy factories but these efforts have been repulsed by interested parties who have suggested on the one hand that the Co-operative Wholesale Society is a socialist concern and hence is representative of political interests subversive of order, and on the other hand is a consumers' concern and hence aims at price reduction.

The very strength of existing marketing connections in New Zealand and the extensive difficulty and expensiveness of establishing a connection in England are very serious obstacles to the extension of co-operative marketing on any large scale of New Zealand dairy produce. An interesting recent development has been the formation of a concern by the various factories supplying the Wellington provincial internal market. The aim of this is to prevent the considerable price-cutting and pirating of the market which has been a feature of internal market conditions in the past year or two.

C. Other Products

1. *Co-operative Pig Marketing Association*

While in the major items of frozen meat there is no co-operative marketing to-day, there is a very interesting experiment in the co-operative marketing of frozen pork. In the Waikato, the Co-operative Pig Marketing Association has been in operation for some time. In the immediate post-war years an ambitious project for pork marketing was attempted. The failure of this attempt resulted in considerable dampening of enthusiasm and for some years little was done. However, the Co-operative Pig Marketing Association was formed to meet the requirements of dairy farmers who desired an avenue for marketing their pig products. The concern makes use of existing proprietary slaughtering and freezing works, but markets on its own account. Until recently no shareholdings were required. Pork was marketed for dairy farmers and after expenses were met the balance was remitted to farmers. Finance was provided by banks on a floating overdraft. Recently, however, a basis of shareholding by dairy farmers has been attempted. The Association maintains that it markets the largest quantity of pork in the Waikato district. So far, however, the experiment has not been copied in any other centre.

2. *Wheat Marketing*

The marketing of wheat and other arable products is discussed in Chapter XXXII.

3. *Fruit*

Fruit growers also co-operate to some extent in the marketing of their produce. In several areas there have been co-operative marketing agencies for the internal market. They have not been entirely successful, due largely to lack of experience and lack of efficient management. The Fruit Growers' Federation, to which are affiliated Fruit Growers' Associations in the various areas, is hardly a co-operative institution in the commercial sense of the term but is interested rather in the broader educational aspects of the industry. The Fruit Control Board, which is really an offshoot of the Federation, attends to the grading and marketing overseas of all fruit from New Zealand except that from Otago. This is a most interesting example of compulsory co-operation which has been very successful in its operations.[13]

IV. CO-OPERATIVE PURCHASE

Co-operative purchase is of two kinds: A. Co-operative purchase of factory requisites, and B. Co-operative purchase of farm requisites.

A. Purchase of Factory Requisites

With regard to the co-operative purchase of factory requisites, the National Dairy Association in the North Island and the South Island Dairy Association in the South Island are the most important operators. The former of these concerns is an ordinary share company of limited liability, while the latter is a company limited by guarantee. In each case the liabilities are assumed by various dairy factories throughout the area roughly in proportion to their output.

Originally these concerns performed, for a large proportion of the industry, those functions relating to shipping space and shipping formalities which are now carried on for the whole industry by the Dairy Control Board. With the inauguration of the Control Board these functions were relinquished and the companies confined themselves to the other main function, namely, that of purchasing factory requisites for the industry. In other words, they acted more or less as a co-operative wholesale society.[14] No profit is distributed to members but the aim is to sell as near cost as is consistent with sound business. Any profit which has accumulated in the past is carried to a capital accumulation fund to be used for extension purposes. However, profits may be distributed if and when the above fund is sufficient to make the concerns independent.

At the annual gathering of these institutions general matters affecting the dairy industry as a whole are discussed; in fact the National Dairy

13. See chapters XXXIII and XXXV.

14. The South Island Dairy Association also acts as buying agents for the New Zealand Producers' Co-operative Association Ltd., and also distributes for a small commission some of the butter for the local market. However, these are subsidiary and not primary functions.

Conference which is held immediately after the annual meeting of the National Dairy Association, and under the aegis of that body, and to which are invited representatives of the whole of the dairy manufacturing industry in all its phases, is really the deliberative assembly of the New Zealand dairy industry.

B. Purchase of Farm Requisites

The co-operative purchase of farm requisites is an interesting development out of co-operation in processing. Shortly after the war this movement assumed large proportions and the dairy farmer was able to purchase practically all his farm requisites and machinery through his factory. However, lack of experience in this work and the strong opposition of general traders have caused most factories to recede from the position of general providers. Some factories still maintain a general store, but, in the main, they confine their trading activities to a narrow range of products. Thus most factories will supply cream cans and such tinware, while some factories are agents for separators and milking machines. A recent development has been the supply of petrol to shareholders. In the past year or two, practically all concerns have acted as agents for the purchase of fertilizers for their shareholder-suppliers, and the majority of fertilizers for the dairy industry to-day are purchased through the co-operative factories. The general advantage of purchasing through the co-operative factory is that payment can be spread over a period by means of deduction from monthly cheques or can be postponed until the annual bonus payment is due and deducted therefrom. This provision of credit by dairy factories is a definite aid to the dairy farmer.

Apart from the two dairy Associations mentioned above the experience of the industry in the field of co-operative purchase is not encouraging. Serious mistakes have been made and large losses incurred. The general attitude to-day is that co-operative factories have the definite function of the manufacture of dairy produce and in the main should confine themselves to this. For this purpose their constitution and administration fit them. When excursions into the realm of competitive trading are made, the 'farmer' control is a serious danger, as farmers are not fitted by training to compete with men trained in business dealings. It is unlikely that there will be any extension in this field at least for a long period.[15]

V. CO-OPERATIVE DISTRIBUTION

Apart from the few co-operative factories which maintain general stores there is practically no true co-operative distribution in New Zealand of general consumptive requirements. On the other hand, there has been a very considerable development of the quasi-co-operative concern in the

15. This attitude is particularly marked in Taranaki where a return to dairy manufacture pure and simple is definitely in progress.

form of an ordinary joint stock company in which the majority of the shares are held by farmers. Practically every area in New Zealand has one or more of such concerns, which usually describe themselves as 'co-operative.' Although at first there was some attempt at a rebate to shareholders on their purchases, no such provision is in operation to-day and the ordinary method of dividend on shares is pursued. These concerns are usually very large general providers, some having as many as forty or fifty branches in various rural centres. In addition, most operate as stock auctioneers. However, apart from the farmer shareholding, which to-day is becoming less and less pronounced, the concerns differ but little from ordinary competitive concerns either as to prices or conditions of sale. Many of these concerns were among the first to feel the pressure of falling prices after the war, largely as the result of over-expansion during the post-war boom.

VI. THE NEW ZEALAND CO-OPERATIVE DAIRY COMPANY LIMITED[16]

A. Size

While much of the discussion regarding co-operation in the dairy industry would apply with equal force to the New Zealand Co-operative Dairy Company Limited, yet, because of its size and of some interesting features of its own, this concern is worthy of special mention. It is claimed that this institution is the largest of its kind in the world. It has 8,000 members, maintains 16 butter factories, 18 cheese factories, 3 dried milk factories, 1 casein factory, together with 14 casein precipitating stations, 9 bulking stations, and 1 condensed milk factory, has a paid-up capital of well over £1 million, exports over 30 per cent. of the butter exported from New Zealand and has an annual turnover of between £6 million and £8 million.

B. History and Policy

From the very first the Waikato area, in which the New Zealand Co-operative Dairy Company operates, has concentrated almost wholly on butter production. As noted in the section on Dairy Marketing, this is conducive to greater concentration of administration and greater concentration of manufacturing. Consequently, even in the days before home separation when the creamery system was in operation, the field was covered by very few institutions. From about 1900, the New Zealand Dairy Association (a co-operative concern) practically monopolized the area in the basin of the Waikato River, while the Thames Valley Co-operative Dairy Company monopolized the north-eastern portion of the area. About 1909, the Waikato Co-operative Butter Company commenced operations in the area covered by the New Zealand Dairy Association on the basis of the home

16. The writer is indebted to Heward: 'The New Zealand Co-operative Dairy Company,' unpublished M.A. Thesis, for certain information in this section.

separation of cream. For a decade after this the New Zealand Dairy Association maintained the creamery system and severe and sustained competition raged between the two concerns. The triumph of the home separation system was only a matter of time, and by the end of the war negotiations for amalgamation were in train.

In 1919 these two concerns amalgamated, the Waikato Co-operative Cheese Company, which was under the same management as the Waikato Co-operative Butter Company, joining in the amalgamation. The new concern, the New Zealand Co-operative Dairy Company Limited, commenced to operate. It was mainly concerned with butter production from home separated cream. In 1920 the Thames Valley Co-operative Dairy Company got into serious financial difficulties consequent on the erection of a dried milk factory, and in that year was absorbed by the New Zealand Co-operative Dairy Company Limited.

By 1920 the New Zealand Co-operative Dairy Company had practically a monopoly of the area in butter and cheese making; in butter making it pursued a policy of centralized butter factories in three or four convenient locations. The personal interest of the farmer in 'his' factory thus became lost. This and the conjunction of falling prices, some mistakes in policy and a management that was, though efficient, somewhat autocratic, caused considerable discontent which became active by 1923. In several areas disgruntled suppliers left the 'big' company and formed local co-operative factories. Thus by 1929 there were upwards of a dozen autonomous single factory co-operatives in operation in the district as well as two or three proprietary factories. One of these proprietary factories claimed to have the largest output for a single factory in the world.[17]

C. Administration

The administrative organization of the concern is in Hamilton, the economic centre of the area. All office work is performed at this place and the heads of the various departments make it their headquarters. The general control of the organization is vested in a body of directors who are elected by the shareholder-suppliers on the ward system. The whole area of the company's operations is divided into wards, each of which elects one or more directors. In order to maintain some local interest in the working of the local factory, each factory has a local factory committee elected by suppliers to that particular factory. The duties of these committees are nominal and their institution is rather in the nature of a 'sop' to local patriotism and in some measure blinds them to the fact that the actual control is vested in an absentee body to whom local interests must be subservient to the wider interests of the organization.

17. It must not be supposed that the aggregate output of the 'big' company diminished. The general development of the district which was shown in increased carrying capacity and increased output per cow enabled it to increase its total output throughout the whole period under review.

Towards the end of each year the general manager, assisted by one or more of the directors, tours the district holding suppliers' meetings at each factory, when the general policy of the company is discussed. In August of each year the annual meetings are held. First there is a general meeting of committeemen from the whole area, who discuss the broader problems facing the industry in general and the company in particular. Next day there is the annual meeting of the company when the financial affairs of the concern are discussed. Because of the very size of the institution, democratic control by the co-operators is very remote and the strong central control adopted by the administration has been the cause of considerable friction. However, it would seem that such control is absolutely necessary if an institution of such a size is to function at all effectively.

The institution is one of the highly centralized types of co-operatives. There is no membership of the local factory and no real control of the affairs of the local factory by the suppliers of that factory. This statement is wholly true of the butter group which is by far the largest part of the company's operations. However, with respect to the cheese factories, the casein and dried milk factories, each factory stands alone as an accounting unit although for administrative purposes it is part of the big organization. The products are marketed not as those of a particular factory but as products of the company. Since this organization markets its own produce through a subsidiary, Amalgamated Dairies Limited, the whole of the operations from collecting the raw material to placing it on the London market are co-operative.

D. Subsidiary Organizations

Probably the most interesting phase of the operations of this concern is the extent of the subsidiary work which it undertakes. It owns its own coal mine, the shares for which are held by the shareholders. It also owns a subsidiary company for the supply of short-term and intermediate finance to shareholder-suppliers the shares being held by the company as such and not by the shareholders. A box- and tin-making factory are part of the equipment of the major concern. It holds 50,000 £1 shares in the largest fertilizer company operating in the province as well as the right to two seats on the directorate of that company. It undertakes the distribution of fertilizers to its suppliers at normal prices, but the profits from the shares held are pooled with the annual profits. It maintains an efficient insurance staff who operate the agency of a leading insurance company. It maintains a well-equipped laboratory for the investigation of the problems of dairy manufacture. It maintains a large outside staff whose duties, though mainly directed to the maintenance and increase of supply, are also concerned with the maintenance of efficient conditions on the farm and

in the sheds. It holds shares in a leading finance company operating in the district and has the right to two seats on the directorate. At one stage it held shares in one of the pioneer radio broadcasting companies, the aim being to aid a service which would make the lot of the farmer more pleasant. Until twelve months ago it held a controlling interest in a monthly journal devoted to the dissemination of dairy farm and dairy marketing information. Every shareholder of the company was supplied with a copy of this journal free.

In many instances the moral support which this organization has given to other co-operative institutions has been a major factor in their successful operation. Among such institutions are the Waikato Co-operative Herd Testing Association and the Co-operative Pig Marketing Association. As has been indicated, the produce is marketed by the Amalgamated Dairies Limited in which the 'big' company owns a half interest. The other half interest is owned in equal shares by two persons who were originally employees of the big company. This seems to be a movement away from the true spirit of co-operation.

For two seasons the Amalgamated Dairies marketed the produce of such other co-operative factories as were prepared to consign their produce through them. However, in 1931 it receded from this position and now confines itself to the produce of the New Zealand Co-operative Dairy Company as previously.

E. General Evaluation of the Company

The New Zealand Dairy Company, because of the progressive attitude which it has always taken up, has been a very definite factor in the development of dairying in the Waikato area, and has been very prominent in all matters connected with the general progress of dairying and dairy manufacture and marketing in New Zealand. There seems little doubt, although such statements are always difficult to prove, that the liberal attitude which this concern has usually taken up has, by the very magnitude of its competition, forced other concerns in the Waikato to adopt a similar policy. Still, there is a potential danger in the fact that the management and control of policy have been strongly concentrated. The success of the company has been largely dependent on the efficiency of the management and its continued success seems likely to depend, to a very considerable degree, on the possibility of procuring the services of an equally competent management in the future. By virtue of the wide area and the range of operations covered, men of unusual ability will be required, and the importance of management personnel will always be paramount.[18]

18. In the reconstituted Dairy Board (Act of 1934) the New Zealand Co-operative Dairy Company has been recognized as a separate ward, and elects one of the four elected members of the Board.

CHAPTER XXXV

CONTROL BOARDS

BY F. B. STEPHENS

I. Pre-war Uncontrolled Marketing—A. Introductory—B. Public Opinion—C. Effects of Rising Prices—D. Condition of Primary Industries. II. War-time Control. III. Post-war Reaction against Control. IV. The New Urge to Control—A. Market Conditions, 1921-22—B. Criticisms of Existing Marketing—C. Meat Producers' Board, 1922—D. Dairy Control Board, 1923—E. Fruit Control Board, 1924—F. Honey Control Board—G. Wheat Board—H. Poultry Board. V. Organization of Control Boards—A. Appointment of Boards: 1. Introductory; 2. Meat Producers' Board; 3. Dairy Control Board; 4. Fruit Export Control Board; 5. Honey Control Board; 6. Wheat Purchase Board; 7. Poultry Board—B. Inauguration of Control—C. Revenue of Boards. VI. Functions and Objectives—A. Absolute Control: 1. Definition; 2. Absolute Control of Dairy Produce, 1926-27; 3. Absolute Control of Fruit; 4. Absolute Control of Honey; 5. Wheat Control—B. Limited Control: 1. Definition; 2. Functions of Boards in New Zealand; 3. Functions of Boards in England. VII. Public Opinion in Regard to Control—A. Farming Opinion—B. Mercantile Opinion—C. Summary. VIII. Co-ordination of Control—A. The Executive Commission of Agriculture—B. Functions of Commission—C. Status of Commission.

I. PRE-WAR UNCONTROLLED MARKETING

A. INTRODUCTORY

PRACTICALLY no attempt was made in pre-war years in New Zealand to organize any phase of the marketing of our primary produce for the country as a whole. Probably in no sphere of economic activity has the post-war change of attitude been more marked than in the now almost general agreement, that some form of co-ordination of effort is necessary in the marketing of most of our primary products. One possible exception to the above statement in regard to the pre-war years was the dairy industry where the twin organizations of The National Dairy Association and The South Island Dairy Association[1] undertook to arrange the transport of the product of such companies as desired to utilize their services. However, while this was a gesture in the direction of co-operative marketing, it was not in pre-war days suffciently important to negative the general statement that marketing was in the hands of individual merchants. Except in those circles which advocated some form of social control of all production and distribution, no effective demand was heard for a change in the system then operating.

B. STATE OF PUBLIC OPINION

It appears necessary then to examine the reasons why the pre-war marketing policy seemed to the producers to give satisfaction.[2] Probably

1. The former operates in the North Island and the latter in the South Island. Membership of these organizations, which are companies registered under The Companies Act 1908, are open to dairy companies operating within their areas.

2. In the following discussion, attention will be paid to New Zealand conditions although some of the arguments may be of general application.

the most important reason for non-interference with the business of marketing was the general political opinion on this subject. It was not that the public opinion of New Zealand was antagonistic to State interference to help the weak; for various Acts providing old age pensions, arbitration courts, and such like, had been passed in the 'nineties, and on the whole this interference with the distribution of the national dividend had been acquiesced in by the public of New Zealand. To interfere with the competition of merchants was, however, another matter. In this sphere the attitude was still that of the Benthamite Liberals of the previous century.

C. Effects of Rising Prices

Further, except in the case of wool, New Zealand had been important as an exporter of primary products only since the 'nineties. Although dairy produce and frozen meat had been exported since the introduction of refrigerated transport in 1882, yet in no case did they become really significant till the 'nineties. Reference to other parts of this work will show that the development of these exports involved a reorganization of New Zealand farming. Since the general trend of export prices from the middle 'nineties till 1914 was upwards, and since this upward trend coincided with an increased output in New Zealand and an increased consumptive capacity in our main market, Great Britain, the farmer tended to be fairly prosperous. Any defects in the system of marketing were obscured by the increase in prices and profits.

D. Condition of Primary Industries

Finally, until 1914, the dairy and frozen meat industries might be said to have been in their infancy. Rural transport facilities were not particularly good and the possibility of any adequate development or expression of rural opinion was thus limited. It is true that from 1900 there had been a steady development of co-operative dairy manufacture, but in general, not only did co-operative concerns serve a small, defined area, but also they confined their attention solely to manufacturing and did not enter the selling field. Available evidence shows a lack of knowledge of marketing conditions and requirements overseas, and consequently an incapacity to discuss or criticize these conditions.

In summary, the state of public opinion, the fact that prices and, hence, profits were rising, and the fact that farming opinion was not organized, all led to a sort of passive acquiescence in the then state of affairs.

II. WAR CONTROL

War conditions soon demanded control of the various products necessary for the maintenance of the fighting forces and of the civilian

population of the United Kingdom. Hence was instituted the Imperial Government commandeer of practically all New Zealand's exported produce. Transport, price levels, insurance, and the ultimate distribution of the products were all organized by the State. In order to preserve as far as possible the existing structure of commercial society the various agents and merchants were utilized more or less as passive agents. The fact that prices rose considerably during the period and that the community, in general, was intent on 'winning the war,' were sufficient to prevent any adequate realization that a very drastic change had been made in the structure of marketing organization.

III. POST-WAR REACTION AGAINST CONTROL

That Governmental control was not only necessary but also very efficient in these circumstances cannot be denied; that it would be acquiesced in during a period of sharply rising prices was only to be expected. Hence, control lasted approximately till the middle of 1921; that is, during the war and the early reconstruction period after the war. However, during 1920, when general prices and profits were rising very fast, the merchants and agents began to suggest that control was no longer necessary as it was hampering a return to what they suggested was the normal state of economic activity, preventing a rise in the prices of controlled products commensurate with the rise in the general price level and preventing, rather than aiding, reconstruction. It was further argued that unnecessary costs were incurred. The drastic fall of prices in 1921 coincided with, and probably hastened, de-control. Farming interests generally were strongly in favour of a return to pre-war conditions, or rather to a condition of free markets. Much criticism was heard in commercial and farming circles against the 'inefficiency of Government in business,' and against the high cost of Government and the weight of taxation. Further, it was felt that the 'forces of supply and demand' unfettered by Government interference, would provide a higher profit.

It is not suggested that the Imperial Government intended to maintain its control either permanently or for any long period. Rather the general policy at that time was a return as speedily as possible to pre-war conditions. However, there is no doubt that when the most urgent need for the mobilization of national resources for war purposes had passed a return to pre-war methods of marketing seemed desirable. In this, as in many other spheres, conditions in 1914 when compared with subsequent conditions seemed much brighter than in fact they were. On every hand there was a failure to recognize that a mere return to marketing methods of an earlier time would not restore the *status quo ante bellum* of the markets themselves. By the middle of 1921, pre-war marketing methods were in force in a post-war world, which was to prove materially different.

IV. THE NEW URGE TO CONTROL

A. Market Conditions in 1921-22

The year 1921 was a period of deep depression with the usual features of sharply falling prices and surplus stocks. In addition to this there was a very great increase in the volume of practically every item of New Zealand's exports. These factors, coupled with the fact that Great Britain was now practically the only available outlet for the world's surplus agricultural produce, accentuated the depression in New Zealand. Hence the old form of marketing was scarcely introduced before it met with severe criticism from farming interests. War-time control was associated with high prices, and post-war *laissez-faire* marketing operated in a period of low prices. It is not surprising, then, that control and high prices were associated as cause and effect.

It was now recognized that control had been efficient during the war and it was argued that if superior control was efficient in war-time, there was no reason why it could not be efficient in peace-time. A remarkable change in attitude had taken place. The old methods had proved ineffective under post-war conditions. This reaction was fairly widespread, not only in New Zealand, but also in Australia and America.

B. Criticism of Existing Marketing Organizations

In New Zealand the serious financial plight of the farmers made the matter a political one and the issue was joined betwen the farmer and the merchant. In the ensuing discussions, two major problems ultimately became clear. The first was the costs incurred in collection and transport to England, and the second the distribution of the products in England. There was much talk, particularly in the meat industry, of 'Trusts' operating to the detriment of the New Zealand producer, and in general practically all the established marketing agencies became suspect. The farming community in particular had come to look to the Government as its sole source of help in every difficulty. This attitude persists to the present day and is in marked contrast with the pre-war attitude.

C. The Meat Producers' Board, 1922

Various meetings of meat and dairy farming interests were held, practically all of which suggested a frontal attack on the existing marketing systems. Late in 1921 the Government conferred with representatives of 'persons whose business is the production of meat for export,' and that conference urged the setting up of a Board of Control. The preamble to the Act which set up the Control Board in 1922 is of considerable interest:

'WHEREAS the economic welfare of New Zealand has lately been adversely affected by reason of a reduction in the net returns receivable by persons engaged in the business of the production of meat for export,

such reduction being due in part to falling prices and in part to the charges payable in respect of freight and other services: AND WHEREAS conferences have lately been held of representatives of the Government and of persons whose business is the production of meat for export, and it has been resolved that the public economic welfare will be promoted by the establishment of a Board of Control, with power to act as the agent of the producers in respect of the preparation, storage, and shipment of meat, and in respect of the disposal of such meat beyond New Zealand: AND WHEREAS it is desired to give effect to the resolutions aforesaid, and to provide by law accordingly: AND WHEREAS it is further deemed necessary and desirable that the expenditure of the Board of Control should be subject to audit as if it were public expenditure, and that the expenditure of the Board should be guaranteed by the Government of New Zealand.'[3]

It will be noted above that differentiation is made between the effects of falling prices and the effects of 'charges payable in respect of freight and other services.' Further, it will be seen that the conference recognized the two problems mentioned earlier: (a) the preparation, storage and shipment of meat; and (b) the disposal of such meat beyond New Zealand. The Act itself is epoch making in that it recognizes that the 'public economic welfare will be promoted' by interference in marketing. As noted above, interference with the distribution of the national dividend was not new but this marks an entirely new movement in Governmental activities in peace time.

This Act became law on February 11, 1922, and the first meeting of the Board took place on March 14 following.

D. The Dairy Control Board, 1923

Almost immediately after the passing of this Act, a movement towards some Dominion organization of dairy marketing was commenced. On March 29, 1922, a representative meeting of dairy manufacturing interests[4] was held at Wanganui. At this meeting it was suggested that a Limited Liability Company with a capital of £1,000,000 should be formed to organize a compulsory pool. Meetings were held throughout the territory covered by the North Island Dairy Association and the principle was unanimously approved of almost everywhere. On May 18 following, at another representative meeting in Wellington, it was agreed to form a Company called the New Zealand Dairies with a capital of £250,000. The Company was to have a London Board as well as a New Zealand Board and was to have power to control supplies and prices. It was decided to ask the Government to make marketing through the Company compul-

3. Preamble to the 'Meat Export Control Act' 1921-22, passed 11/2/22.
4. The meeting represented the co-operative side of the industry.

sory and to give the Company power to make levies not exceeding ¼d. per lb. on butter and ⅛d. per lb. on cheese on the gross returns. The Director-General of Agriculture, however, informed the representatives that the Government would not give such power to a private Company. Further, the South Island Dairy Association did not approve of the scheme.

Hence, in July the representatives decided to work for a Board similar to the Meat Board and to that end a general meeting of factories was called in Wellington in September, 1922, at which meeting the proposal to ask the Government to institute a Dairy Control Board was carried by a very large majority. It is interesting to notice that at this meeting the dissentients were chiefly the proprietary interests. The Government acceded to the request and a Bill was almost immediately introduced into the House. However, the opposing interests, chiefly proprietary factories and the selling agents, strenuously fought the Bill and the committee stage was so prolonged that it was not proceeded with in 1922. It was, however, one of the first Bills brought forward in the 1923 session of the House and passed into law on August 28, 1923. Although there had been a spirited opposition by vested interests to the Meat Control Bill, the 'fight' over the Dairy Control Bill was one of the most spirited in the annals of New Zealand rural interests. The Board met for the first time on January 31, 1924.

E. Fruit Control Board, 1924

The operations of the various 'Orchards' Acts,'[5] and of the Fruit Growers' Federation[6] had resulted in the existence of Fruit Growers' Associations in the various provinces and a Dominion Fruit Growers' Conference was held annually.

In the immediate post-war years a fairly considerable export trade in apples and pears had developed. The main market was England. To stimulate this trade the Government guaranteed a minimum return of 1d. per lb. on all apples and pears exported. The New Zealand Fruit Growers' Federation, working in conjunction with the Department of Horticulture, had been enabled, because of the existence of this guarantee, to institute 'many improvements in the get-up and marketing of New Zealand fruit.'[7] However, the continuance of this work depended on the continuance of the guarantee and as the guarantee was likely at any time to be discontinued it was felt that '. . . some Board with wider powers was necessary.'[8]

The first proposal for a Control Board came in the shape of a remit from the Nelson Fruit Growers' Association to the Dominion Conference in June, 1923. To enable the other provinces to discuss the matter, the proposal was deferred till the next Conference. At the 1924 Conference

5. See chapter XXXIII.
6. Ibid.
7. First Annual Report of the Fruit Export Control Board.
8. Ibid.

it was the outstanding business. The proposal to set up a Fruit Export Control Board was carried unanimously with the Otago delegates refraining from voting. There seems little doubt that the setting up of the Meat and Dairy Boards had been the prime cause of this movement among the fruit growers.[9] The delegation which waited on the Minister of Agriculture asked for '. . . a Bill on the lines of the Dairy and Meat Control Acts.'[10] The main opposition in the committee stage of the Bill was, however, directed not to the provisions regarding export, but to provisions regarding internal marketing. The Act passed into law on November 6, 1924, and the Board met for the first time on March 12, 1925.

F. The Honey Control Board

Shortly afterwards a New Zealand Honey Export Control Board Act was passed, to carry out functions similar to those of the other Export Control Boards.

G. The Wheat Board

All the above Boards have been set up by Act of Parliament, but on January 6, 1933, regulations were issued under Section 26 of the Board of Trade Act, 1919, setting up a Wheat Purchase Board. The 'bumper' harvest which was in prospect made it necessary that some action should be taken for preventing a heavy fall in prices. The Minister, in a public statement on the issue of the regulations, frankly stated that the object of the Board was to maintain internal prices and to dump any surplus overseas. As a necessary corollary to this, of course, the existing prohibitive tariff on the import of wheat is maintained. The institution of this Board has been very strenuously criticized by all sections of the community with the exception of the 'Wheat' interest at whose instigation it was created. The major grounds of criticism are the inequity of further protection to the wheat grower at the expense of the rest of the community, although some criticism of 'Order in Council' Government has been heard.

H. The Poultry Board

An Act of 1933 provides for the registration of all commercial poultry-runs where more than 25 head of poultry are kept and for the constitution of an elective Board whose general function is to organize and develop the poultry industry.

9. The following sentence appears in the First Annual Report of the Board: 'During the discussion it was pointed out by supporters of the proposed Bill that it was becoming more necessary every day that the Fruit Industry should have a Producers' Board empowered to make decisions and generally further the interests of the export of fruit.'

10. First Annual Report, p. 3.

V. THE ORGANIZATION OF CONTROL BOARDS

A. The Appointment of the Boards

1. *Introductory*

The Meat Export Control Board Act, 1921-22, was the first of the series of Acts instituting Control Boards and the subsequent Acts, with minor differences, due to the different structures of the various industries, are identical with the Meat Export Control Board Act, 1921-22. Hence it will suffice if the general nature of the Act is indicated and any differences in other Acts noted.

The Acts set up a Board consisting of Government nominees and representatives of the industry. The Meat and Dairy Acts provide for the representation of the two phases of the industry—namely, the producers and manufacturers on the one hand, and the selling agents and proprietary interests on the other.

2. *The Meat Producers' Board*

The Meat Producers' Board consists of eight members, two of whom are appointed by the Governor-General on the advice of the Minister of Agriculture; five are appointed by the producers of frozen meat, and one is appointed by the stock and station agents as representing the selling side of the industry. For the purpose of the Act, producers are taken to be all those on the sheep return published in April of each year. The method of the election of the producers' representatives is an indirect one. From each of the ten districts into which New Zealand is divided for the purposes of the election, representatives are sent to an electoral committee which meets in Wellington in August each year.[11] The main duty of this electoral committee is the election of the Meat Producers' Board.[12] Members of this Board hold office for two years and retire by rotation.

3. *The Dairy Control Board*

The Dairy Produce Control Board originally consisted of twelve members, two of whom were appointed by the Governor-General on the advice of his Ministers, nine elected by votes of producers, and one person representative of the proprietary manufacturers and sellers' interests. Producers in this case were the suppliers of the various dairy factories through the Dominion. For the purpose of the election of producers' representatives, New Zealand was divided into nine wards, the wards being defined in terms of factories and their suppliers. After 1926, a direct

11. The number of representatives from the various districts varies roughly in proportion to the importance of these districts as producers of meat. There are five districts in each island. There were originally only six districts but it was felt that the districts were too large and that a smaller size would stimulate interest in the election.

12. In adidtion to this the Electoral Committee also considers the annual report and balance sheet.

voting system was adopted. Each producer voted for one of the candidates nominated for his ward. The votes of each factory's suppliers were then counted separately and the candidate who obtained a majority of votes in that factory got that factory's votes. Votes were allotted to each factory on a tonnage basis. Producers' representatives held office for three years, one-third of these members retired annually.[13]

Under Part II of the Agriculture (Emergency Powers) Act, 1934, which followed upon recommendations made by the Dairy Industry Commission, the New Zealand Dairy Board is given powers additional to those conferred upon it by the Act of 1923. The outstanding change has been to empower the Board to regulate the production of dairy produce and to exercise control over dairy produce intended for local consumption. The Board has been reconstituted and now consists of three 'appointed' members (appointed by the Governor-General in Council) and four 'elective' members (two elected from the newly-defined North Island wards, one from the new South Island ward and one from the New Zealand Co-operative Dairy Co. Ltd.). The method of election of the 'elective' members has been simplified. Each Company votes through its directors and the vote of each company is weighted by the tonnage of its output, cheese and other processed commodities being converted into tonnage votes on a prescribed scale, viz., one ton of butter equals one tonnage vote, two tons of cheese equals one ton of butter, and two thousand pounds of butterfat comprised in other dairy products equals one ton of butter.

4. *The Fruit Export Control Board*

The Fruit Export Control Board contains six members, two of whom are appointed by the Governor-General and four by producers of fruit for export.[14] Two of the producers' representatives are appointed by Nelson fruit growers, and one each by Auckland and Hawke's Bay fruit growers. The franchise in the election for producers' representatives is limited to those fruit growers who have in the previous year exported 100 cases of fruit. Members hold office for two years, some members retiring each year.

5. *The Honey Export Control Board*

The Honey Export Control Act provides for a Board of three members, one appointed by the Governor-General and two by producers of honey. The franchise is the export of at least two hundredweight of honey in any one of the three preceding years.

13. A very interesting provision of the Dairy Produce Export Control Board Act was that a Government nominee could not be a person defeated as a representative of producers.

14. There is provision for a seventh member, that is, a fifth producers' representative, in the Act. However, Otago and Southland, having voted against the institution of the Control Board (see infra), no representative from Otago sits on the Board.

6. *Wheat Purchase Board*

The Wheat Purchase Board consists of eight members, all of whom are nominated by the Wheat Marketing Agency Co. Ltd.[15] and appointed by the Minister in Charge of the Department of Industries and Commerce. Four of the members represent wheat growers and four represent the flour millers. The chairman is appointed by the Minister and every member holds office at the Minister's pleasure.

7. *The Poultry Board*

The Poultry Board consists of six members, two of whom are appointed by the Governor-General on the recommendation of the Minister of Agriculture. The other four members are appointed by the Governor-General on the recommendation of the New Zealand Poultry Association.

B. Inauguration of Control

The Meat Export Control Act was put into operation by statute. The statute was mandatory. In the case of the Dairy, Fruit and Honey Export Control Acts, the statutes were enabling only. The Acts were to be put into force if and when producers as defined in the Act had voted in favour of putting the Act into operation.[16] In each case a postal ballot was held and a majority voted in favour of the Act.

Otago and Southland were strongly opposed to the local control proposed in the Fruit Export Control Act. To meet this provincial feeling the Act was divided into two parts—Part I, dealing with exported fruit, and Part II with control of local fruit marketing. With regard to Part I, a majority vote of the producers could bring the Act into force but it was provided that if 70 per cent. of the producers in a district so desired that district could be exempted from the operation of the Act. Under this provision the Canterbury-Otago district voted for complete separation from the control movement.[17]

As noted above, provision was included in the Fruit Export Control Act for the institution of control of local marketing of fruit. If a 60 per centum majority of the fruit growers[18] voted in favour of the institution of local control in any district a local board of three elected members was to be set up. This board was to have fairly wide powers to control in the local marketing of fruit. This portion of the Act has not been operated on up to the present.

The Wheat Purchase Board was set up by regulations without an official referendum of wheat growers being taken. However, as the purpose

15. The Wheat Marketing Agency Co. Ltd. is an institution representing all phases of the wheat industry and includes representatives of growers and millers.
16. The franchise for this vote was similar to the franchise for the election of Board members.
17. The provincial feeling on the Fruit Control Act ran so high that the districts were defined in the enabling Act. In the case of the other Boards this was left to regulations.
18. The franchise was given to persons who had at least 120 fruit trees. The Act applied only to apples and pears. (This refers to both Parts I and II.)

of the Board is to guarantee prices and as the Company nominating the members of the Board represents all phases of the wheat industry it can be taken that wheat growers as a whole have acquiesced in the Board.

C. Revenue of the Boards

The Boards controlling the export of frozen meat, dairy produce and honey, are financed by an export levy on the produce which comes under their jurisdiction. The levies are collected by the Customs Department on the export of the produce. For its services the Department receives 1 per cent. of the gross value of the amount collected.

No export levy is collected on fruit exported. Fruit is marketed on behalf of the Fruit Control Board by the Fruit Growers' Federation, which pools given quantities in a given consignment and remits the net proceeds, after expenses are met, to the growers.

VI. FUNCTIONS AND OBJECTIVES

A. Absolute Control

1. *Definition*

As noted above, the Acts instituting the Dairy, Fruit and Honey Control Boards were modelled on the Meat Export Control Board Act and prior to the reconstitution of the Dairy Board, the functions and powers of all the Boards were almost identical. They were empowered to exercise 'absolute' or 'limited' control over the produce in which they are interested. 'Absolute control' means that the Board assumes the responsibility for the whole of the marketing of the produce so that competition amongst exporters is eliminated. The Board takes over the produce as soon as it is ready for export and grades, handles, pools, stores, insures, ships and sells the meat under such conditions as it deems fit and remits the net proceed to the original owners of the produce. Thus the Meat Export Control Act states: 'all meat of which the Board has assumed absolute control shall be graded and shipped as the Board directs and shall be sold and disposed of only by the Board and by direction of the Board at such times and in such manner and on such terms as the Board in its discretion determines.'

2. *Absolute Control of Dairy Produce—1926-27*

The Meat Control Board has never exercised absolute control. For the one dairy season 1926-27 the Dairy Control Board exercised absolute control over exported butter and cheese. Shortly after the institution of this Board a deputation of three members of the Board visited England and America to study market conditions. It recommended that the Board should '. . . *undertake the responsibility of all sales and establish a London office.*'[19]

19. Report of the delegation.

The Board accepted the report and decided to institute absolute control on August 1, 1925. It was later decided to alter the date to September 1, 1926. The New Zealand Dairy Co. Ltd., whose chairman of directors was one of the deputation and whose managing director was also a member of the Board, were very prominent in the agitation for absolute control and the support of this huge concern, which was absolutely essential to the success of the scheme, was guaranteed by the attitude of the two aforementioned gentlemen. In fact, the London selling agency of the Board was modelled on the New Zealand Co-operative Dairy Company's marketing scheme. However, there is little doubt that the ardent support of the scheme by this company 'prejudiced it in the eyes of some who were opposed to the company.' In any case the proprietary manufacturers and the selling interests were strongly opposed to absolute control.

All produce of New Zealand factories was pooled grade for grade. Price fixation by a joint committee of the Board and a committee of three elected by the London allottees of butter and cheese was the method of sale in England. The scheme aimed to utilize the English agents as distributors of the produce. Sales were to be made at fixed prices and at such times as the Board's London Board should dictate, and to ensure that the Board's instructions were carried out an audit of account sales by a firm of chartered accountants was to be periodically carried out. This absolute control covered not only sales in England but also sales in the United States and Canada in each of which places the Board had agents. The agents were guaranteed a 2 per cent. commission on sales at minimum prices and if any should show sales of three shillings or more per hundredweight over minimum prices, an additional commission of 1 per cent. or 3 per cent. in all was allowed.

Two of the agents had direct contacts with the retailers while the others worked through brokers, wholesalers or multiple shops. The above-mentioned arrangement as to commission in effect limited the wholesalers' margin to three shillings per hundredweight, for if they charged a higher price the two agents mentioned above could undersell them to the retailers. The wholesale interests asked that the margin be placed at five shillings per cwt. The Board, in refusing definitely, antagonized the wholesale interests in England and in some quarters it is felt that this was a prime factor in the ultimate failure of the absolute control.

Absolute control was strenuously opposed by proprietary and selling interests in New Zealand and the English merchants made no secret of their opposition. In New Zealand a Free Marketing League sprang up and put up candidates at the elections in August, 1926, for two of the seats on the Board as producers' representatives. Both these candidates were elected, this unseating two members more or less favourable to absolute control.

An impossible situation also arose on the London Board where two members were opposed to absolute control and two in favour of control. Thus, on questions of moment, an impasse was always the outcome there.

The Free Marketing Association carried out propaganda in the press and elsewhere, and opposition in New Zealand grew. The London Board was hopelessly divided and contradictory cables were received from each section of that Board, one urging cessation of price fixation, the other urging a continuance. By March, 1927, the unsold stocks in London were heavy, although the stocks in the hands of buyers were very low. The New Zealand Board in March decided to abolish price fixation. Their new scheme provided that a given quantity was to be released each week and prices were to be allowed to find their own level. For a time market conditions were chaotic and the lack of a consistent policy considerably weakened the Board's position. Opposition increased and further 'anti-control' members were elected to the Board, and in June the Board decided to terminate absolute control.

Very little has ever been revealed as to the real facts of the opposition to absolute control. On the purely commercial side the Board showed itself quite capable of handling the huge business with which it was entrusted. As to the Board's policy of price fixation, there seems little doubt that it was a mistake to attempt to fix prices in a market where New Zealand supplied only 25 per cent. of the produce and in a market where other supplies were constantly increasing the adoption of such a policy was to court disaster. In any case buyers who sought to capitalize their knowledge of market conditions were bound to oppose a scheme which deprived them of a potential source of profit. Both in England and New Zealand the Board's scheme really amounted to a frontal attack on the proprietary interests. In addition, certain of the co-operative interests in New Zealand opposed absolute control. While there is no doubt that in some cases the selling agents, through which the co-operative interests had previously marketed their produce, represented that absolute control was resulting in lower prices, there was a strong feeling in certain quarters that the whole scheme, modelled as it undoubtedly was on the New Zealand Co-operative Dairy Company's scheme, and strongly supported as it was by that Company of which two of its directors had seats as producers' representatives on the Board, was really an attempt by certain members of that Company to dominate the industry. This personal antagonism was unquestionably a factor in the elections which resulted in the return of four anti-control Board members in 1926 and 1927. However, the fundamental factor in the opposition was the fear by proprietary selling interests that if the scheme were successful it would imperil their profits.

It is possible that the above opposition might have been overcome but

for two factors: (a) The scheme was launched just after the 1926 strike in England as a result of which it is estimated that 6,000,000 boxes of New Zealand butter had been carried over from the 1925-26 season. This carry-over, which was not subject to control, enabled selling interests in England to carry on without buying new season's controlled butter. The proprietary selling interests were thus able to boycott controlled butter; (b) There is little doubt that the Board were at that time lacking in experience of the actual facts of the market and of the strength of the existing marketing interests. The Board attempted to advance before it had consolidated its own position. It was a potent fact that the producers were far from unanimous and it was known that the Board itself was not unanimous. The scheme was imposed from above without any attempt to educate the producer up to the position. Finally, the scheme as instituted was too exhaustive at that time. It is conceivable that the Board could have instituted a scheme which aimed at a gradual advance into the realms of absolute control. This would have had the double merit of educating the producer in the value of the scheme and of giving the Board experience in the new field. But the Board, having adopted the all-embracing scheme it did, found that it could not maintain its advanced position and had so consolidated the opposition that it could do no other than surrender its whole position and acknowledge defeat.

In conclusion there is no doubt that the sponsors of absolute control were actuated by the highest of motives. The idea of eliminating the scores of New Zealand representatives of London import houses who tour New Zealand for business, was undoubtedly a good one as was also the aim to avoid speculation in New Zealand dairy produce. The scheme did unquestionably bring the selling agents 'up to scratch,' and has resulted in a much more efficient service to factories in subsequent years.

3. *Absolute Control of Fruit*

As noted above the Fruit Control Board arose out of an expressed desire of the Fruit Growers' Federation for an Export Control Board. These two institutions are very closely connected. All fruit must be exported through the Federation as agents of the Board.[20] The produce is pooled and payment is made to the producer through the Federation after deduction of the levy. The trade is relatively small at present, the total value of the fruit exported being about £500,000. Fruit export is relatively new and no large vested interests have been set up. The Fruit Growers' Federation has already pioneered the market. Then again, the Fruit Growers' Federation was strongly entrenched as the mouthpiece of orchardists long before absolute control was instituted. Consequently,

20. Note, however, the Canterbury-Otago position. This district is not subject to the Control Board, but provides only about 10 per cent. of the total exportations.

little criticism of the operations of absolute control of fruit export has been heard. In fact, it would seem as if absolute control was merely legalizing the position already occupied by the Fruit Growers' Federation.

4. *Absolute Control of Honey*

The honey industry has been organized for a considerable number of years. The National Beekeepers' Association is the general mouthpiece of the industry while the Honey Producers' Association Ltd. was a co-operative institution for blending and marketing honey. These institutions were prominent in the demand for an Export Control Board in 1924, and when the Board was set up it made the Honey Producers' Association its agent in practically all business matters. The latter two institutions were very closely connected. The General Manager of the Honey Producers' Association was the Chairman of the Control Board.

In the case of all the Control Boards, export of produce except under licence of the Board was prohibited, but except where absolute control was operative, licences were practically always given and in no case was any restriction made as to the person to whom the produce was consigned. The Honey Control Board decided not to institute absolute control but regulations were issued that *all* export honey had to be sent to a certain named consignee in England. This consignee was the agent of the Honey Producers' Association.[21]

In 1933 the Honey Producers' Association was forced into voluntary liquidation and in March the Board announced that it was instituting 'absolute' control. The Chairman of the Board, who was Manager of the Honey Producers' Association, resigned his position on the Board and was appointed Manager of the Board.

There has been some opposition to the operations of this Board. In the first place, it is maintained that in prescribing that the only consignees in England should be agents of the Honey Producers' Association, the Board was using its statutory powers to aid a private, albeit co-operative institution. The Board's answer to this is that 98 per cent. of the producers for export are members of and exporters through the Honey Producers' Association and hence the provision, to all intents and purposes, merely recognized the *status quo*. Secondly, it is said that prices received through the prescribed consignees were lower than could be obtained under free marketing. This charge, however, would be extremely difficult to prove or disprove, but in rebuttal the Board have submitted evidence to the Chamber of Commerce that in each of the years from 1927 to 1932 the return to New Zealand honey was always higher than to that of any other country supplying the English market. A third charge has been

21. The Chairman of the Honey Control Board states that the amount exported by consignors other than the Honey Producers' Association was about 8 to 10 tons annually.

that honey shipped through the prescribed consignee and not sold under the 'Imperial Bee' brand has been debited with an advertising charge of 1d. per lb. and that this sum has been spent on advertising 'Imperial Bee' honey. The Chairman of the Board states that as there were only 8 or 10 tons per annum of honey other than 'Imperial Bee' honey the amount involved is negligible and further that if the charge were objected to the Honey Producers' Association were prepared to refund it. The charge that the Honey Producers' Association spent too much on advertising is not a charge against the Board *qua* Board although it may be a charge against those members of the Board who were directors of the Honey Producers' Association. The serious fall in honey export in the past year or two is alleged to be due to the operations of the Board. The Board's reply is that there has not been any honey to export, and that although the actual number of hives in New Zealand has increased, the climatic conditions have militated against a crop sufficiently large to provide for internal requirements and leave a surplus for export. Finally, it is stated that the Board, in purchasing in 1933 the 'Imperial Bee' brand for £6,000 from the liquidators of the Honey Producers' Association, paid more than the brand was worth. The Board's reply is that, seeing that the Honey Producers' Association had, in the course of five or six years, spent £45,000 (approximately) on advertising, which had built up a goodwill for 'Imperial Bee' brand and had enabled it to get the premiums over other honey mentioned above, it was essential that the brand be purchased and that the price paid was less than the real commercial value.[22]

5. *Wheat Control*

The Wheat Purchase Board was set up to assume absolute control of all the wheat produced in the Dominion. The Regulations provide for the formation and operation of a '. . . compulsory pool' of all wheat, the object being maintenance of the internal price level at a value of 4s. 3d. to 4s. 6d. per bushel. The immediate cause of the formation of the Board was the very heavy production in the 1932-33 season. If the wheat had been released through ordinary trade channels prices would have fallen heavily. The object of the Board is to 'dump' the surplus abroad at whatever price it will bring and so maintain internal prices. The Minister, in a press interview at the time of the issue of the Regulations, stated that the objects of the Board were that 'the growers might receive the average value of their produce based upon: (1) a New Zealand home consumption value of approximately 4s. 3d. to 4s. 6d. a bushel, and (2) an export value of probably not more than 2s. 6d. a bushel.[23]

22. It is stated that offers of considerably more than was paid by the Board were made for the brand.

23. New Zealand *Herald*, 9/1/33.

The general technique of the Board's operations is fairly simple:—

(i) Wheat growers must declare the amount of wheat harvested;
(ii) No person may sell or buy wheat except through the Wheat Purchase Board;
(iii) The Board operates through the ordinary channels of trade so that the merchant brokers previously operating in wheat are now the licensed agents of the Board. These agents receive no remuneration except the normal agency commission payable by the Board;
(iv) The Board is to purchase all the wheat;
(v) Persons desirous of purchasing wheat must purchase from the Board;
(vi) All wheat is pooled grade for grade and payment is made by the Board to the producer in proportion to his contribution to the pool.

The Board exported considerable quantities of wheat during 1933 and has maintained the internal price level at between 4s. 3d. and 4s. 6d. These provisions together with the sliding scale duties are opposed to the interests of New Zealand as a whole although they certainly do benefit the wheat growers. The added cost to the consumer must far outweigh the added benefit to the producer. It would seem that a direct subsidy to the industry would be a more satisfactory method of dealing with the situation.[24]

B. Limited Control

1. *Definition*

As previously noted the Meat, Dairy, Fruit and Honey Control Boards may assume 'limited' control of the produce in which they are interested. Since the Fruit and Honey Control Boards have assumed 'absolute' control, it is necessary to discuss the operations of limited control only in the cases of the Meat and Dairy Control Boards. The Meat Export Control Act states: 'Where the Board has assumed limited control the extent of its control shall be defined by notice as aforesaid (i.e., to the persons concerned as in the newspapers), or by agreement between the Board and the owners of meat. . . .'

2. *Functions of the Boards in New Zealand*

Probably the most important function of both Boards has been the regulation of shipping. The Boards have represented their respective industries in negotiations with the shipping companies. Throughout the period of their operations both Boards claim to have secured considerable freight reductions, and there is little doubt that though freights would have

24. For fuller details see Chapter XXXII.

fallen ultimately, the united front which the Boards present to the shipowners has enabled these reductions to be secured earlier than otherwise. The Boards' inspection of the refrigerated storage on all vessels taking their produce has also been of very great importance to the Meat and Dairy industries. The conditions of refrigerated transport have been materially bettered of recent years and new vessels are being designed after consultation with the Boards.

The Meat Board makes a general contract as to freight rates with the shipping companies for a period of years and allots the space on each vessel among the various exporters. The actual taking out of the Bills of Lading, paying the freight and shipping the meat is left to the individual shippers. The Dairy Board takes out Bills of Lading and pays the freight for the whole shipment, and is reimbursed by the actual shippers.

Both Boards have also acted for their respective industries in negotiating insurance rates and conditions; but while the Meat Board leaves the insurance to the shipper, the Dairy Board has insured for the whole shipment and collected from the shippers.

The Meat Control Board has set up a grading standard throughout New Zealand. The actual grading is done by the freezing works, although the Board maintains supervisory graders. In the dairy industry an official grading system is maintained by the Department of Agriculture and hence the Board is not active in this regard. The Fruit Board has instituted a grading system in connection with exported fruit.

All the Boards have been very active in research into the various problems of their respective industries. Thus the Dairy Board has made annual grants to the Dairy Research Institute, which is interested chiefly in research into problems of manufacture. The meat industry is in close touch with the Cambridge Low Temperature Research Station in England. The Fruit Control Board has made grants for research into various problems of orchardists.

The Boards also aim at improving the quality of the produce by offering awards for good quality. Thus there are prizes for the producers of the best mutton and lamb exported to England and for the factories producing the butter and cheese of the highest average grade throughout the season. One of the most interesting ways in which the Dairy Board has shown its interest in the dairy industry has been by its subsidizing the Herd Testing movement in New Zealand.

3. *Functions in England*

The Boards all maintain active London representatives. Much has been done to improve the method of unloading and storage in London and qualitative deterioration through faulty handling has been lessened.

In addition, cold storage rates have been reduced, largely owing to the Boards' efforts.

Perhaps the most important part of the work of all Boards is the advertising of New Zealand produce in England and elsewhere. Displays are made in shops and exhibitions; films are exhibited showing conditions of production in New Zealand; special shops are opened with expert demonstrators, and in the case of butter and cheese, sample cartons are sold at a reduced price. This advertising campaign has done much to further the consumptive demand for New Zealand products and has undoubtedly been a factor in enabling the increased export from New Zealand for consumption in England. Mention should also be made of the activity of the various Boards in the search for new markets, and although no very definite results are evident, this must be attributed mainly to the general world conditions which are such that advance in this direction has been impossible.

Considerable space could be devoted describing in detail the operations of the Boards but the above will suffice to give an indication of the work which they are doing. In conclusion, it remains to indicate two factors of importance in the Boards' activities. First, they have become in effect the parliaments of their respective industries. All matters of moment are discussed by the various Boards and their opinions are usually accepted by the Government. In the second place, they have developed valuable statistical services. The Meat and Dairy Boards send out weekly summaries of market conditions and prices, and general information likely to be of interest to the industries as a whole. The annual reports of these industries are excellent examples of the manner in which the Boards are educating their public. The annual reports discuss all phases of the industry and are a very fine survey of the conditions of the year under review.

It can thus be seen that in the sphere of limited control the Boards have more than justified their existence. They have provided some degree of co-operation in the marketing of produce and have enabled the industry to present a united front on most questions of moment. Such activities as advertising, which are probably of the most importance to the industry, would most likely not have been carried out at all apart from the institution of the Control Boards, and even the most bitter opponents of this new movement have had to acknowledge the fine work that the Boards are doing.

VII. PUBLIC OPINION IN REGARD TO CONTROL

A. Farming Opinion

It has been shown that at the original institution of the Meat and Dairy Produce Control Boards, farming opinion was by no means unani-

mously in its favour. However, as the years have gone by there has been a gradual recognition of the value of the various Boards as instruments for limited control; but the general attitude to absolute control is less favourable to-day than it was at the inauguration of the Boards.[25] Probably the reason for this is the failure of the experiment of the Dairy Control Board in 1927.

There has been some criticism of the rather heavy expenses of the various Boards. In 1931-32 the Meat Board's expenses were £38,860 and the Dairy Board's £26,699. Although absolutely these amounts are large, yet relative to the volume of output they are small, especially when account is taken of the importance of the work which is done.

B. Mercantile Opinion

Mercantile opinion is, as might be expected, solidly opposed to absolute control and the Chambers of Commerce, as representatives of that opinion, are continually passing resolutions calling attention to the growing encroachment of public control in the field of business. While the experience of the Dairy Control Board in 1926-27 seems to give ground for this opposition, their general condemnation of the functions of limited control seems rather forced. Opposition to any attempt at orderly marketing in the sense of controlling the flow to the English markets is based on the difficulty of the problem. However, the fact that there are seasonal fluctuations in price and in the quantity demanded seems to suggest that some means should be taken to secure any advantage therefrom for the producer and it is not to be expected that a large number of merchants operating in competition with each other will consider possible benefits to the farmer as their prime motive. That there have been mistakes is admitted, but such are inevitable in any new field and it is to be expected that these will diminish as more and more information as to market conditions is collected. Further, the almost complete absence of New Zealand commercial houses on the London market makes it all the more necessary in the interests of the New Zealand farmer that there should be some institution capable of maintaining his interests in the market itself.

It is contended that, in making freight contracts for three years in advance as the Meat and Dairy Boards do, the industry is tying itself in such a way as to preclude it from getting immediate advantage of a fall in general freight rates. This is, of course, valid in times of falling freight rates; but against this must be set the contention of the various Boards that they have, by collective bargaining, secured better rates than would have otherwise been possible under competitive conditions. Another factor not disconnected with this problem is, of course, the acknowledged improvement in the refrigeration conditions in transport.

25. The case of fruit and wheat, where absolute control is acquiesced in by the industry has been discussed above.

Merchants also complain that because of the wide powers of the Boards they fear that if they develop new markets the Boards will deprive them of any advantage due to them as pioneers in a new field. The uncertainty as to the policy of the various Boards particularly in the first five or six years of their operations was a definite disincentive to exploratory work by commercial firms. However, against this contention can be raised the fact that the Boards' policies are to-day more or less fixed and well known, and they do not unnecessarily encroach on the legitimate domain of private business. On the other hand, the work of the Boards in advertising their products and in exploring potential outlets for New Zealand produce has probably more than outweighed loss to the merchants arising from fear of the Boards' interference.

Finally, it must be recognized that the attack from mercantile quarters is motivated largely by a desire to defend vested interests and there is a general recognition that the Boards are directed towards nullifying the unfair advantage which some of those interests have had over the primary producers. The term 'Control Board' seems to imply a general restriction of private enterprise and there seems little doubt that in popular discussion 'control' connotes much more than the limited control as carried out by the Boards. It is interesting to note that probably in recognition of this fact, the Meat Control Board styles itself the 'Meat Producers' Board,' and the Dairy Control Board tends to drop the term 'control' from its title.

C. Summary

The Control Board movement is now a permanent feature of the New Zealand economy. There have been mistakes, some due to lack of experience in the tasks undertaken, some due to over-enthusiasm of supporters of the Boards. These mistakes have been exploited by interested parties, particularly by proprietary interests who see in the Board an end to some of their profits. The public reaction has, however, been surprisingly favourable, in view of the revolutionary character of the movement; and it is not too much to say that so long as New Zealand's primary producers occupy the place that they do in the national economy the Control Boards will continue to operate in some form or other.

VIII. CO-ORDINATION OF CONTROL BOARDS

A. The Executive Commission of Agriculture

In its Report the Dairy Industry Commission, 1934 (pars. 295 to 302), strongly urged the need for the co-operation and co-ordination of the various Produce Boards. 'Independent Boards, each concerned with the marketing of one group of commodities, are no longer able, as isolated units, to cope effectively with the problems confronting them. The

investigation and opening of new markets for the disposal of surplus production can best and most economically be undertaken by a single central body acting in the national interest and having due regard to the requirements of all branches of production.'

The Agricultural (Emergency Powers) Act of 1934, Part I, gave effect to this recommendation and set up an Executive Commission of Agriculture consisting of the Minister of Agriculture as Chairman and three other members to be appointed by the Governor-General in Council for a period of five years, subject to reappointment.

B. Functions of the Commission

The Commission's functions are:

(a) To co-ordinate the work of the several Boards and other authorities exercising powers with respect to any of the primary products of New Zealand.

(b) To exercise any powers that may, by Order in Council, be transferred to it from any of the Boards.

(c) To make recommendations to the Government for the framing of regulations to give effect to the Dairy Industry Commission's recommendations and to secure the effective conduct of any of the industries over which it has powers.

(d) To exercise such other powers as may from time to time be conferred on it.

It is provided that no powers should be transferred from any Board to the Executive Commission except after consultation between the Commission and the Board in which such powers are vested.

C. Status of Executive Commission

The Dairy Industry Commission was careful to define the status of the Executive Commission. The problem was to set up a body which, though appointed by the Government, would be free from political bias or influence and which would also be distinct from the ordinary Public Service. For this reason it was recommended that the Commission 'shall be constituted and act as a permanent Executive Commission of Agriculture, and have all the powers of a Commission appointed under the Commissions of Inquiry Act, 1908.' The Act would appear to have secured the desired objectives by stipulating the qualifications required of appointees and by providing that the members shall not be deemed to be permanent officers of the Public Service.

CHAPTER XXXVI

FARMING INDUSTRIES DURING THE WORLD CRISIS

EDITORIAL

I. The Course of the Crisis. II. Measures towards Rehabilitation—A. Reduction in Cost: 1. Interest Reductions; 2. Mortgagors and Tenants Relief Act; 3. The Rural Mortgagors Final Adjustment Act, 1934-35; 4. Wage and Salary Cuts.—B. Subsidies—C. Taxation—D. Assistance from Unemployment Funds—E. Exchange Depreciation—F. Rural Finance. III. Ottawa and After—A. Great Britain's New Agrarian Policy—B. The Ottawa Agreements—C. Trade Agreements after Ottawa—D. United Kingdom Policy in Regard to Dairy Produce—E. The Problem Confronting New Zealand—F. The 1935 Meat Agreement.

I. THE COURSE OF THE CRISIS

FARMING industries as a whole were enjoying conditions of reasonable prosperity during the years immediately prior to the world crisis. Export prices were not so high as in the years 1920, 1924, and 1925, and the ratio, index number of export prices: index number of farm expenditure was also less favourable than in those years; but the volume of production had expanded rapidly, and was higher than in any previous year. For the calendar years 1928 and 1929 the value of exports reached the record totals of £56·2 millions and £55·8 millions respectively. For the season 1928-9 the value of farm production also reached a record of £82 millions. As a result of expanding production and the transfer of land at more economic prices, the overcapitalization of farming enterprises consequent on the post-war boom was being steadily liquidated.

Although, at the time, farming opinion in New Zealand would not have been prepared to admit that the position was satisfactory, yet, viewed in retrospect, it would seem that conditions were, on the whole, as favourable to farming industries as during any other post-war years. The seasons 1928 and 1929 have tended to be regarded as the norm to which reconstruction efforts should be largely directed.

As in other countries, the crisis in farming industries in New Zealand presented itself in the form of heavy reductions in selling prices but intractable costs, and the crux of the problem was to bridge the gap between the two so that farming profits might re-emerge. Some attempt was made, particularly in the dairying industry, to meet the position by the continuance of the expansion of production which was characteristic of the pre-crisis years; but it has become apparent that recovery is unlikely to be found along this road for New Zealand was not the only country to expand her exports, and the glut on the British market, particularly in dairying and meat products, forced a policy of import restriction and control which left

the New Zealand producer embarrassed and bewildered. The change in British policy closed the door to recovery through expanding production and threw the burden of readjustment on internal policy. The problem occasioned by the changed marketing situation will be the most important for many years to come; for the Dominion will be forced to adjust an economy based on the theory of a continuously expanding market for a few important staple exports, whose value represents about a third of the national income, to a situation in which these exports are limited and controlled. At worst this may mean that the sacrifices and hazardous experiments of the crisis have been made in vain. At best, it raises problems of reorganization and the redirection of enterprise which present great difficulties.

The new situation will be fraught with such important consequences as to warrant a more exhaustive treatment than has been possible in this work. All that can be attempted is the summary narrative of the quota negotiations which forms the concluding section to the book. It will be clear that Ottawa marked the beginning of a new and uncertain epoch in the economic history of the Dominion.

It is proposed in this chapter to describe in outline the measures which have been taken within New Zealand to effect readjustment. These have been directed mainly to bringing about a revival of profits through the reduction of costs and the increase in receipts by means of exchange depreciation. Before describing the measures taken, it is desirable to recapitulate briefly the major effects of the crisis on farming industries.[1]

The average of export prices in 1929 was only slightly less than in 1928. Thereafter they fell rapidly till 1933 when there was some improvement, especially in wool and meat. The following table shows changes in the index numbers of export prices since 1929:—

TABLE CXCVII

Index Number of Export Prices

(Base, Average of Prices for 1929 =100)

Year	Dairy Produce (1)	Meat (2)	Wool (3)	Other Pastoral (4)	All 1–4	Agricultural	All Exports*
1929	100	100	100	100	100	100	100
1930	83	94	59	73	78	89	79
1931	68	71	40	45	59	81	61
1932	64	60	37	37	53	78	55
1933	57	64	39	44	53	81	55
1934	53	83	74	52	67	85	68

*Inclusive of non-farming products such as timber and minerals, which comprised 5.2 per cent. of the total value in 1933.

1. For a fuller account, see 'Report of the Economic Committee,' February, 1932 (Prof. J. Hight, Chairman, Professors H. Belshaw, D. B. Copland, A. H. Tocker, and Mr. A. D. Park, Secretary to the Treasury); 'The Crisis in New Zealand' (Prof. H. Belshaw, L. Holt, H. R. Rodwell, F. B. Stephens and D. O. Williams), and 'Crisis and Readjustment in New Zealand,' by Prof. H. Belshaw, *Journal of Political Economy*, November, 1933.

The above prices are in New Zealand currency, and so allow for a 10 per cent. depreciation in exchange on sterling in 1930, 1931, and 1932, and a 25 per cent. depreciation in 1933 and subsequent years. Expressed in New Zealand currency, export prices of pastoral products, which comprise about 94 per cent. of the value of total exports, were about 47 per cent. lower in 1933 than in 1929. Expressed in sterling they were about 58 per cent. lower.

As has been indicated, the domestic prices of exportable farm products move in close sympathy with export prices. Except for products which are not normally exported, such as market garden products and wheat (the latter is protected by a sliding scale tariff), there is only a small proportion of the total product of farms not affected directly by changes in export prices. Hence, despite an increase in the volume produced, there has been a considerable fall in the value of farm products. This is indicated by the following:—

TABLE CXCVIII

Gross Value of Farm Products, 1928-29 to 1932-33

(£ Millions)

Year	Agricultural Products	Pastoral Products	Dairying, Poultry, and Bees	Total
1928–9	9·9	43·1	29·3	82·3
1929–30	9·1	36·1	28·4	73·6
1930–1	8·8	24·6	22·2	55·6
1931–2	8·0	19·3	21·9	49·2
1932–3	8·9	20·4	21·2	50·5

It is not possible to obtain an accurate measure of costs in farming, but a comparison of export prices with various internal prices, more especially with the index number of farm expenditure, gives a reasonably good indication of the relative movements between costs and selling prices. The following index numbers compare the position in 1928 and 1931:—

TABLE CXCIX

(Base, Average 1914 = 1,000)

	1928	1931	Per Cent. Fall
Export Prices	1,553	881	43
Farm Expenditure	1,642	1,490	9
Wholesale Prices, All Groups ..	1,417	1,278	10
Retail Prices	1,602	1,447	10
Nominal Wages	1,656	1,542	7

The above figures are sufficient to reveal the general disharmony in the price structure of New Zealand which resulted from the fall in world prices, and emphasize the exceptionally severe strain on farming industries.

Having regard to this disharmony, it should be abundantly clear that the fall in the gross income of farmers is not a full measure of the burden of depression in farming industries, for the intractability in costs has meant a much greater proportionate fall in net income. The Dairy Industry Commission which reported in 1934,[2] estimated that 50 per cent. of dairy farmers were insolvent, and while the position is less serious in other primary industries it seems doubtful whether, balancing losses against profits, farming industries as a whole showed any net profit at all in the depth of the depression.

II. MEASURES TOWARDS REHABILITATION

The rehabilitation policy of the Government has consisted partly of general reconstruction measures which affected farming industries either directly or indirectly, and partly of special measures directed to farming industries. The Government's policy has been based in the main on the Report of the Economic Committee presented in 1932, and more recently on the Report of the Commission into the Dairy Industry, presented in 1934.

A. Reductions in Costs

1. *Interest Reductions*

A general reduction in interest and rents was effected under Part III of the National Expenditure Adjustment Act, 1932. The purpose of this Act was 'to effect reductions in rates of interest payable by mortgagors in rents and other fixed charges, commensurate with the reductions in salaries and wages' made under the Finance Act, 1931, and Part I of the National Expenditure Adjustment Act, 1932. 'The standard reduction in interest and rents is to be 20 per cent. in the case of contracts entered into on January 1, 1930, or during the previous five years; or 20 per cent. of the rate which would have been paid on January 1, 1930, in the case of contracts entered into before or after these dates.' This hypothetical rate is to be determined:—

(a) By agreement between the parties;
(b) By arbitration if they agree to arbitrate;
(c) By the Court in other cases.

Under this Act, interest was not to be reduced below 6½ per cent. in the case of chattel mortgages, 5 per cent. in the case of other mortgages, and 4½ per cent. in the case of debentures free of income tax. A limit of 5 per cent. of Government valuation was also fixed in the case of ground rents.

A later measure gave some relief to farmers and others, by providing

2. Mr. Justice (now Sir Francis) Frazer (Chairman), Mr. G. A. Duncan, Mr. J. Gilkison and Mr. D. O. Williams.

for the conversion of Local Body Debts to lower rates, while some relief has been given to ratepayers by means of Government subsidy on rates.

2. *Mortgagors and Tenants Relief Act*

The Mortgagors and Tenants Relief Act was introduced in 1931. By that Act a mortgagee was restrained from enforcing his rights against a mortgagor until the mortgagor had had an opportunity of applying to the Supreme Court for relief. The Court was required to consider, *inter alia*, the effect of the continuance of the mortgage upon the position of the mortgagee, the inability of the mortgagor to redeem the property, the conduct of the mortgagor in respect of breaches of mortgage covenants, the relative hardship inflicted on the mortgagor by permitting enforcement of the rights of the mortgagee, or on the mortgagee by relieving against enforcement of his rights, and the extent to which the default of the mortgagor had been caused by the economic conditions brought about by depression. If the Court decided that relief should be granted to the mortgagor, it was empowered to make an order, subject to such terms and conditions as it thought fit, prohibiting the mortgagee from exercising his powers under the mortgage for a period of not more than twelve months. Power was given to extend the period on the application of the mortgagor, subject to such further terms and conditions as the Court might think proper.

By an amending Act passed during the same session of Parliament, the Court was empowered, in determining any application for relief in respect of mortgages of farm lands, to postpone for not more than two years the due date of principal and interest payments, to reduce the rate of interest payable, and to remit arrears of interest wholly or in part. The same amending Act made provision for the setting-up of Adjustment Commissions, to which were entrusted the duties of investigating and reporting upon applications made to the Court for relief. The Commissions were also empowered to assist mortgagors and mortgagees to make voluntary arrangements for the modification of their respective rights and obligations.

Three further amending Acts were passed in the session of 1932-33. These Amendments enabled a mortgagor to apply for relief, even though the mortgagee had not taken any steps to enforce his rights under the mortgage. The Court was empowered to extend the term of a table mortgage for a period not exceeding two years and to postpone the due dates of payment of instalments of principal and interest, and to relieve, for such period as it deemed proper against the enforcement by action in any Court of the personal covenant expressed or implied in any mortgage. The special provision contained in the 1931 Amendment Act relative to mortgages of farm lands was extended to cover all mortgages of land.

The first Amendment Act of 1932-33 empowered the Court, on the application of a lessee, to reduce rent for a period not exceeding two years, and to remit arrears of rent, and further to restrain a lessor from exercising his rights of distraint and re-entry without the leave of the Court. The second Amendment Act of 1932-33 extended the application of the principal Act to mortgages that had been varied by the parties before or after the passing of the Amendment Act and to replacement mortgages, and gave further protection to guarantors of mortgagors and lessees. It also enabled the Court to join a stock mortgagee as a party to an application for relief made by a mortgagor of farm lands, in order that inquiry might be made as to whether the stock mortgagee had exercised his powers in a harsh or unconscionable manner to the disadvantage of the mortgagor or mortgagee of the land. The third Amending Act of 1932-33 debarred mortgagors and lessees from contracting out of the benefits of the relief legislation, and restrained lessors from enforcing payment of rent by means of judicial process without the leave of the Court.

The Mortgagors and Tenants Relief Act, 1933, consolidated and amended the existing legislation. The most important of the new provisions brought mortgages of stock fully within the scope of the Act, and enabled the Court, on notice being served on a stock mortgagee by any person having an interest in land in respect of which an application for relief was made by a mortgagor or lessee, to treat the application as being an application for relief of the stock mortgage as well as in respect of the mortgage or lease of the land. In such cases the Court was empowered to 'budget' the farmer and make an equitable allocation on the income derived from the land among the persons entitled to a share thereon. Another provision enlarged the protection already given to applicants for relief under the Act against the ordinary processes of law for the recovery of debts, by extending it so as to cover claims by creditors other than lessors and mortgagees of land and stock.

3. *The Rural Mortgagors Final Adjustment Act, 1934-35*

This Act arose largely out of the findings of the Commission into the Dairying Industry. In his second reading speech, the Rt. Hon. Mr. J. G. Coates, Minister of Finance, who was responsible for the measure, commented as follows:—

'As long as there was reasonable hope of any substantial recovery in overseas prices, it was regarded as unfair to creditors for the Government to suggest the writing down of excessive liabilities. The mortgagor relief legislation now in force was designed as a temporary measure to meet the position by enabling capital charges to be reduced and arrears to be remitted and postponing proceedings that would dispossess their property.

'This legislation has worked well. It has prevented the chaos and

social friction which would have been inevitable if creditors had been permitted to exercise their contractual rights to the full. But it offers no permanent solution—in fact, in some cases it tends to hinder refinancing arrangements—and the time has now arrived when something must be done to bring about a readjustment of capital indebtedness. While the future course of prices cannot be forecasted with complete certainty, there seems little prospect of a rise substantial enough to make the writing down of excessive capital obligations unnecessary. In these circumstances, it is useless continuing on the basis of temporary relief and postponement, and some general scheme of permanent reconstruction seems wise.'

The legislation was motivated by the belief that recovery could not reasonably be hoped for from any substantial rise in overseas prices within a reasonable period, and the view that the reduction in excessive liabilities was necessary in the interests of the farmer and of the community at large.

The Act, which came into force on May 1, 1935, is to apply to farmer mortgagors whose normal income is derived wholly or principally from farming operations. It covers mortgages executed prior to April 17, 1931, or mortgages in substitution thereof. If any one mortgage is thus covered, all the liabilities of the farmer are covered.

The Act is to be administered by a Court of Review consisting of a Judge and two other members, who act judicially, and not as representatives of mortgagor and mortgagee. The Adjustment Commissions set up under the Mortgagors and Tenants Relief Act, continue to function, and are more or less in the position of a Court of first instance.

It is the intention of the Act to promote voluntary settlements, and the door is left open for voluntary adjustments at every stage in the operation of the Act. The mortgagor who desires to have his liabilities adjusted, gives notice in the prescribed form, and at the same time files a list of all his creditors and debtors, and a statement of his assets and liabilities. A mortgagee may also give notice, in which case the mortgagor is required to file similar statements. On filing notice, the mortgagor is removed from the protection of the Mortgagors and Tenants Relief Act and comes under the protection of the Rural Mortgagors Final Adjustment Act.

The Adjustment Commission in the mortgagor's district then calls a meeting of his creditors and endeavours to bring about a voluntary settlement. If not less than three-quarters in value of the creditors agree to an adjustment, this becomes binding, provided that the agreement meets with the approval of the Adjustment Commission. Any aggrieved creditor has the right of appeal to the Court of Review. A similar right exists against practically all the decisions of an Adjustment Commission. If an agreement is arrived at, the excess liabilities are written off and the creditors are then free to exercise their ordinary rights in respect of the liabilities as reduced.

If no adjustment is arrived at, the Adjustment Commission has then to decide whether or not a stay order is to be issued. If a stay order is not issued, the mortgagor is removed from the protection of the Act and of the Mortgagors and Tenants Relief Act, and his creditors may then exercise their ordinary rights, except that the payment of interest and principal may be postponed for a period not exceeding twelve months.

If a stay order is granted, the remaining provisions of the Act apply. The effect of a stay order is to protect the mortgagor from proceedings by his creditors to enforce their rights. A trustee is to be appointed, who acts as the agent of the mortgagor, receives payments and makes disbursements. The Adjustment Commission may dispense with the appointment of a trustee, in which case the mortgagor is deemed to be trustee on behalf of his creditors.

A budget is then prepared under which the income is to be disbursed under such general or special directions as the Adjustment Commission may determine. Living expenses and working expenses are a first charge on income, the remainder being disbursed on the direction of the Commission, which is given discretionary powers, but expected normally to observe the ordinary priorities.

The stay order is to operate for a period of five years, but where a farmer has already been working under a budget consistent with an agreement or order under Section II of the principal Act,[3] the stay order may relate back for a period not exceeding two years. If the mortgagor and all the mortgagees agree, an adjustment may be made at any time during the operation of a stay order, or a voluntary agreement may be made under the conditions mentioned above.

At the end of the period of the stay order, the Adjustment Commission proceeds to assess the productive value of the property, which is deemed to be the annual average net income capitalized at a basic rate of interest to be determined by the Court. The Court then proceeds to assess the provisional basic value, by taking into account other factors which may be relevant apart from the productive value as determined above. If this is accepted by the mortgagor and all the mortgagees, it becomes the basic value, to which the liabilities of the farmer are reduced. If any mortgagee appeals against this value, an assessor representing mortgagor and one representing the mortgagees sit with the Court, and the Court as then constituted determines the basic value.

Having regard to the relative hardship on the mortgagor and mortgagee and other relevant factors, the Court then decides whether or not the mortgagor is to remain in possession. If the Court so decides, the mortgagor's liabilities are to be reduced to the basic value, and the mortgagor is freed from his excess liabilities, except insofar as he possesses

3. I.e., the Mortgagors and Tenants Relief Act.

other assets which are used to satisfy his creditors. If the Court decides that the mortgagor is not to remain in possession, he is to receive compensation of an amount to be determined by the Court. In assessing this compensation, the Court is directed to take into account, *inter alia*, the relative financial positions of mortgagor and mortgagee and the extent to which the living expenses of the mortgagor during the operation of the stay order fell short of a reasonable remuneration for his work in managing the farm. If the mortgagor elects not to remain on the property he is entitled to the same compensation.

When the liabilities have been adjusted, the mortgagor ceases to be liable under any personal covenant for the liabilities which have been written off, but creditors may exercise their ordinary rights in respect of the remaining liabilities, except that they cannot demand repayment of principal for a period of five years. If the mortgagor sells the property within five years, his mortgages may become due, and one half of any excess in value goes to his creditors up to the amount required to meet their unsatisfied liabilities.

Under the same Act the Mortgagors and Tenants Relief Act is indefinitely extended.

4. *Wage and Salary Cuts*

In pursuance of its policy of adjusting internal costs to the new external price situation, and of reducing Government expenditure the Government initiated a 10 per cent. cut in the salaries of civil servants in April, 1931, and empowered the Arbitration Court to reduce award wages. Accordingly, by a general order dated May, 1931, the Court reduced all allowances and rates of pay prescribed by industrial awards and agreements by 10 per cent., except in the case of apprentices, or where substantial reductions had already been made.

The National Expenditure Adjustment Act of May, 1932, imposed further cuts on civil servants on a graduated scale of from 5 per cent. to 12½ per cent. The Government also passed an amendment to the Industrial Conciliation and Arbitration Act which aimed at replacing voluntary conciliation and compulsory arbitration with compulsory conciliation and voluntary arbitration. The results were further reductions in wages.

The Government reinstated a portion of the cuts in civil servants salaries as from April, 1934, by an all-round increase of 5 per cent. in salaries, and there has been some tendency to increase wages in private employment.

In general, the effect of wage reductions on farming industries has been felt through the price of goods and services rather than through direct reductions in costs, though farm wages have also fallen.

B. Subsidies

The device of the subsidy as a means of reducing costs or increasing returns has not been used to any very great extent in New Zealand, in the latter case, no doubt, mainly because the cost of subsidies on the major farm products would be very heavy in proportion to the national income. Nevertheless, subsidies to encourage the use of fertilizers and lime, and to reduce the cost of transport are a minor, but established feature of policy.

Encouragement in the use of lime and fertilizers has been given for many years through the remission of freight costs on railway haulage. It is doubtful whether this has been of any considerable assistance to farmers, partly because such cost reductions appear to have been largely absorbed in the form of higher selling prices for the commodities assisted, or because the remissions have tended to be capitalized in higher land values.

With the advancement of the crisis, however, the use of fertilizers fell, and the maintenance of fertility came to be regarded as a national problem. In October, 1931, a system of payments by way of subsidy was introduced, under which manufacturers were paid 11s. per ton on superphosphate sold,[4] this payment being made from the consolidated fund on condition that the price of superphosphate to farmers was reduced accordingly. This system has been maintained up to the present time, but the rate of subsidy has fluctuated and now stands at 2s. 6d. per ton.

In February, 1933, freight concessions amounting to 15 per cent. of schedule charges were made on a prescribed list of primary products carried on railways. This concession was reduced to 12½ per cent. as from April 1, 1934, and the list of goods has been revised to exclude certain commodities originally included. This subsidy is still in operation.

C. Taxation

Prior to April, 1931, land tax was levied on a graduated scale. Under the Land and Income Tax Act, 1931, the graduated tax was replaced by a flat tax of one penny in the pound unimproved value, but the minimum valuation taxable was reduced to bring a greater percentage of farmers within the scope of land tax. Farmers also became liable for income tax,[5] but farm implements and requisites were exempt from the sales tax imposed early in 1933.

D. Assistance from Unemployment Funds

During the course of the depression, the Unemployment Board has, from time to time, introduced schemes to assist in the absorption of unemployed men through their employment on farms. These schemes have

4. The normal price was somewhat over £4 per ton.
5. For a fuller discussion see chapter XII.

been based on a wage subsidy to farmers, and in some instances allowances have also been made for a part of the cost of food supplied to men so employed. The Unemployment Board stipulates that the work on which subsidized labour is used is of a developmental nature. In certain instances, farmers themselves have been directly helped from the Unemployment Fund, where it has been shown that without such assistance the farm would be abandoned, and the occupier would then come on the Unemployment Register.

The assistance given to farmers from this fund has essentially been in the direction of land improvement, but much of the work performed can be broadly classified as maintenance, and in this way has been of immediate benefit to land-owners.

E. Exchange Depreciation

In February, 1932, a committee consisting of four economists and the Secretary to the Treasury was appointed to report on the 'Economic and Budgetary Situation.' The general tenor of the Report was in favour of a depreciation of the exchange on London, though no particular rate was specified. The Secretary to the Treasury dissented from those sections of the Report which were favourable to exchange depreciation.

Both before and after the presentation of the Report exchange depreciation was a subject of acute political controversy. From early in 1930 the rates on London for telegraphic transfer were steadily depreciated until they reached £110 N.Z. = £100 sterling in January, 1931, at which rate they were pegged. No action was take on the Economic Report in relation to exchange until January, 1933, when the Banks Indemnity (Exchange) Act was passed and the rate was depreciated to £125 N.Z. = £100 sterling. In August, 1934, the Reserve Bank of New Zealand was established, and an announcement was made shortly after that it was unlikely that the rate would be altered for some considerable time.[6]

F. Rural Finance

The problem of rural finance in New Zealand is dealt with in Chapter IX. No substantial changes were made in the organization thus described until 1935, though obviously enough, the crisis and the rehabilitation measures adopted had important effects on the provision of credit to farming industries.

In April, 1935, the Mortgage Corporation of New Zealand Act, 1934-35, was passed—a measure which may be expected to make profound changes in the financial organization of New Zealand. The main objectives of this Act are three: (a) to reduce mortgage interest to the lowest level

6. For a fuller account of the exchange problem, see Economic Report, 1932, *Crisis and Readjustment in New Zealand*, paras. 306-338 of *Report of Monetary Committee, 1934*, and evidence of Professor Belshaw, Professor Tocker and Mr. D. O. Williams in Minutes of Evidence of Monetary Committee, 1934.

consistent with sound finance; (b) 'to provide an alternative to the present unorganized market for private mortgage finance in the shape of a system which is less risky, more elastic and more closely in conformity with the needs of rural industries;'[7] and (c) to establish an organization to take over and manage the mortgages held by various State lending departments, including the State Advances Office.

In its main principles, the Act follows the lines of mortgage banks in other countries, and it will be sufficient to indicate briefly the main characteristics of the Corporation.

The share capital consists of one million shares of one pound each, of which one half are subscribed for by the Minister of Finance at par, the remainder by the public. Dividends are to be paid out of profits at the rate of 4½ per cent. per annum cumulative.

The Corporation is managed by a Board of eight directors, of whom three are elected by shareholders, the rest by the Governor-General in Council. Of the State directors, one is Chairman of Directors, two are joint Managing Directors, and one is an officer of the Treasury, acting *ex officio*.

The main business of the Corporation is to make advances on the security of land, except that the Corporation may make advances on the security of stock or chattels in order to safeguard a security over land. Advances are not to exceed two-thirds of the valuation of the security, which is to be based on the 'earning capacity' in the case of farming property. There is a provision that loans may be made up to four-fifths of the valuation of *farming* properties in the case of mortgages in existence at the time of the passing of the Act, the difference between this and the normal lending margin being guaranteed by the State to the Corporation. This provision is designed to assist in the refinancing of mortgages during the present difficult period, but applies at present to rural mortgages only.

Loans are to be made on table mortgage for a period not exceeding fifty years, except that the Corporation may advance on flat mortgage for five years, which may be extended for a further period of five years.

The necessary funds are to be obtained by the issue of bonds or other securities, which are to be eligible as Trustee securities.

The rate of interest to be charged on advances is not to exceed 1 per cent. above the rate on the issue of securities immediately prior to the granting of the advance. The capital of loans is to be repaid by instalments, but borrowers may repay in advance on any instalment day in the securities of the last issue prior to the taking up of the loan from the Corporation.

The Board may, at its discretion, accept repayment in cash.

7. Second reading speech of Rt. Hon. Mr. J. G. Coates, Minister of Finance, in Rural Mortgagors Final Adjustment Bill.

The amount of securities issued by the Corporation is limited to fifteen times its subscribed capital plus reserve fund. The reserve fund is to be made up of certain securities transferred to it by the Government, together with profits transferred to reserve and an amount subscribed by each borrower equal to 2 per cent. of the amount of his loan from the Corporation. This amount may be paid in cash or added to the mortgage when the advance is made.

The Corporation is to take over from certain State lending departments certain classes of securities now held by them. In respect of these securities, the Corporation is to be indemnified against loss.

On a date to be fixed by Order in Council, the Rural Intermediate Credit Board established under the Rural Intermediate Credit Act of 1927 is to go out of office and its functions are to be taken over by the Board of the Corporation. This is unlikely to affect the organization of the Rural Credit System or to limit its activities.

III. OTTAWA AND AFTER

A. Great Britain's New Agrarian Policy

New and interesting problems for New Zealand arise from changes in Great Britain's agricultural policy as evidenced at the Ottawa Conference (1932) and subsequently. For the time being, at any rate, Great Britain is far from content with a policy of *laissez-faire* in relation to her own agriculture; instead, she is protecting, planning and developing agriculture in a manner that contrasts sharply with her previous ninety years' unconcern. Whether this represents a relatively permanent change is a question of first importance to New Zealand and to all countries that supply the United Kingdom market. If it does, we are faced with some difficult problems of adjustment.

The Agricultural Marketing Acts of 1931 and 1933—the first promoted by a Labour Government and the other by the National, or Conservative, Government—the Trade Agreements made with foreign countries in 1933 and later, and indeed the whole trend of activity in the recent past, strongly support the view that the United Kingdom has entered upon a radically different era from that with which we have been familiar. It seems altogether likely that, for better or for worse, the Ottawa Conference, or perhaps we should say the 'Depression,' will be long regarded as a turning-point in imperial economic relationships.

B. The Ottawa Agreements

The main features of the five-year agreements made at Ottawa between the United Kingdom and the Dominions may be summarized:—

(1) The United Kingdom undertook that the Dominions' products then exempt from duties under the Import Duties Act, 1932, should remain exempt after November 15, 1932.

(2) The United Kingdom undertook to apply duties to imported foreign goods, including wheat (2s. per quarter), butter (15s. per cwt.), cheese (15 per cent. *ad valorem*), apples and pears (4s. 6d. per cwt.) and dried fruits, eggs, milk products, honey.

(3) In respect of dairy produce and eggs, the United Kingdom reserved the right, after three years, either to impose a duty on Empire products—while maintaining their preferential margins—or to bring such products under a general scheme of quantitative regulation.

(4) The Dominions on their part agreed to reduce specified tariff items in favour of the United Kingdom (the Canadian and Australian agreements set out extensive lists compared with only four items in the New Zealand schedule; but New Zealand's tariff was already relatively very low).

(5) The Dominions agreed to maintain margins of preference in favour of the United Kingdom; New Zealand's undertaking was that existing margins of preference would not be reduced to less than 20 per cent. *ad valorem* except with the consent of the United Kingdom.

(6) The Dominions also agreed to hold inquiries into their protective tariffs on United Kingdom goods, giving United Kingdom manufacturers a right to be heard; they undertook that 'protection by tariffs should be afforded against United Kingdom products only to those industries which are reasonably assured of sound opportunities for success'; and, after inquiry, they were 'where necessary, to reduce protective duties as speedily as possible to such a level as will place the United Kingdom producer in the position of a domestic competitor, that is, that the protection afforded to the (Dominion) producer shall be on a level which will give the United Kingdom producer full opportunity of reasonable competition on the basis of the relative cost of economical and efficient production.' Canada and Australia agreed to act in accordance with the recommendations of their Tariff Boards.

(7) For meat, the United Kingdom proposed a plan of quantitative regulation, and this in modified form was agreed to. Her imports of South American mutton, lamb, and frozen beef were to be reduced, by progressive quarterly cuts, to a volume 35 per cent. below the volume for the year ended June 30, 1932; and

foreign chilled beef was to be held at the figure for that year. Australia and New Zealand agreed that their mutton and lamb shipments to the United Kingdom in the calendar year, 1933, would not exceed the volume shipped in the year ended June 30, 1932. The United Kingdom undertook that no further restrictions would be placed on the Dominions' meat prior to July, 1934.

(8) The United Kingdom gave a formal statement to Australia and to New Zealand to the effect that 'a policy will be adopted that will have for its definite objective the two-fold purpose of raising the price of meat to a remunerative level and of progressively increasing the share of the Dominions in the United Kingdom market.'

(9) By a clause in her agreement with Canada, the United Kingdom agreed that, if the supplies of bacon and hams were regulated, provision would be made for free entry of Canadian bacon and hams up to a maximum of 2,500,000 cwts. per annum. (In this concession, it is to be commented, the United Kingdom departed from her announced policy of extending equal treatment to all Dominions.)

(10) The agreements are to continue in force, after their five-year period, until a date six months after notice of denunciation has been given by either party.

During the Conference, New Zealand and Australia had asked that tariffs and quantitative regulation—from both of which their own products should be exempt—should be imposed by the United Kingdom on her imports of foreign dairy produce, meat, and fresh fruit. The substance of the agreements in this respect was that (a) the principle of quantitative regulation of imports from all sources, the Dominions included, was applied to meat, which was to remain duty-free; and (b) dairy produce and fruit were dealt with by preferential tariff and not by quantitative regulation, but with the important reservation that after three years (meaning in August, 1935), dairy produce might be subjected either to a duty on Dominion produce (maintaining the agreed margins of preference) or to quantitative regulation. It was thus possible in the period immediately following the Ottawa Conference, to view the concurrent operation of quotas on meat and of tariff preferences on dairy produce; and it is significant that the former gave by far the greater satisfaction.

C. Trade Agreements after Ottawa

In 1933, the United Kingdom made trade agreements with Denmark, the Argentine and Sweden; these operate for three years and facilitate the entry of United Kingdom goods into the three countries in return

for the United Kingdom's undertaking that certain of their farm produce will not be restricted, in its import into the United Kingdom, below stated levels. Butter, meat, and bacon are thus affected; and it is agreed by the United Kingdom that Argentine meat will not be taxed on its entry into the United Kingdom. Because of their bearing on the privileges sought for Empire produce in United Kingdom markets, these three trade agreements have been labelled by critics 'The Three Black Pacts.'

D. United Kingdom Policy in Regard to Dairy Produce

The failure of the preferential tariff on dairy produce to give satisfaction to producers, and notably to New Zealand producers, led to renewed moves towards the regulation of supplies. In January, 1933, the London Manager of the New Zealand Dairy Produce Board took the initiative in urging the restriction of competing foreign supplies, the request (as at Ottawa) being that Dominion produce should be left free from all restriction. But in the ensuing discussions the United Kingdom Government made it clear that they would regulate supplies if, and only if, Dominion produce were also included. They were prepared immediately to reduce foreign supplies by double the percentage of reduction imposed on Dominion supplies; and it developed that, in the interests of their own producers, the United Kingdom wished to apply a general scheme of quantitative regulation to dairy produce. This was made clear in mid-1933 when Dominion Ministers were in London for the World Economic Conference; it led to the visit to New Zealand of Mr. Thomas Baxter, representative of the National Farmers' Union of England and Wales; but prolonged negotiations were fruitless.

A change in United Kingdom policy in relation to dairy produce early in 1934, has greater significance than was appreciated at the time, or since. The Government adopted the expedient of directly assisting United Kingdom farmers by means of a guaranteed return on milk used for manufacture—particularly for cheese-production. In short, the new policy was one of making low market prices tolerable to their own farmers rather than of raising prices by concerted action for the benefit of all suppliers to the market. One result of this policy is that some types of English cheese are now selling at a lower price than that of New Zealand cheese.

E. The Problem Confronting New Zealand

In relation to meat, a similar possibility presents itself. Which is (a) the more likely, and (b) from the Dominion producers' viewpoint, the more desirable; a quota on all supplies, or the imposition of a levy, the proceeds whereof will be used for assisting United Kingdom farmers? If given the choice in August, 1935, and thereafter, would New Zealand

and other overseas farmers prefer the taxation of their products entering the United Kingdom (the proceeds being used to subsidize their competitors in the United Kingdom) or the quota? If the United Kingdom markets for agricultural products are to be controlled on a basis of quantitative regulation, what then? This is a main theme demanding attention by countries of supply. What internal and external re-arrangements in regard to production and trade are they obliged to make?

If nothing is done in the country of supply to cope with the new situation created by a quota in the importing country, a condition can well arise in which, while prices are artificially raised in the latter country, by limitation of supply, they are artificially reduced to producers in the exporting country subject to the quota. For in this exporting country there may then be an exportable surplus cut off from its former market, and it is a 'buyers' market.'

This condition, in fact, is reported to have arisen in Argentina as a result of the United Kingdom's meat restrictions of November, 1932. Complaint was made in the House of Commons (March 13) that, within three weeks of the meat restriction, prices in the Argentine fell by 25 per cent., while prices on the Smithfield Market increased by 25 to 60 per cent. The increased profits to meat importers (according to Lord Beaverbrook) were at the rate of £8,000,000 a year.

A like result, it may be commented, could less easily arise in connection with New Zealand's dairy exports, which to a substantial extent are co-operatively marketed than with meat exports. The Argentine experience is, however, sufficient to show that the possibility of simply widening the margins of profits to middlemen is not a mere theoretical imagining.

For a new and developing country like New Zealand, one outstanding danger that lurks in the quota requires to be constantly emphasized and guarded against—the danger that production may be stereotyped in its present form, or on existing farms, either in the quantities now produced or with some flat-rate or proportionate adjustment of present production. This would be to deny the advantages of change and progress. It is a danger that is far more real in a new country than in one such as Holland or Denmark; and the devices that have been adopted by these countries to meet Great Britain's quota policy, while interesting and worth close study, cannot be directly applicable to our conditions. A prime need here is to ensure efficiency in production. The danger of anything in the nature of standstill, or of maintaining present producing units with some general percentage variation, can be illustrated by supposing that the quota principle had been applied to New Zealand, say twenty years ago; clearly it would have been absurd thus to block the changes and development that have taken place since then, and it is equally unsound to stand still

now. This danger is indeed a principal and potent objection to the quota. Prices and supply and demand can act as an instrument of progress, as a ruthless eliminator of incompetent producers; and any quota method or system of planning must be at least as effective in ensuring productive efficiency though it will operate in other ways.

The alternative prospects facing New Zealand are, then, quantitative restrictions in the form of quotas, or levies on imports into Great Britain, the proceeds to be used to subsidize British producers. The problem has already been posed, to New Zealand, in the case of meat.

On February 13, 1935, the British Government cabled[8] their long-term meat policy for consideration by the Dominions and the Argentine Governments. The British attitude was summed up in the third paragraph of the cable. 'It is clearly impossible for the United Kingdom Government to acquiesce in a situation which threatens ruin to the United Kingdom live-stock industry.' The British proposal was that a levy should be collected on meat imports (with preference to the Dominions) and the proceeds applied to the assistance of the home industry according to the needs of the market, overseas producers being thus left free to regulate their exports to the United Kingdom market themselves.

The United Kingdom Government claimed that with the Ottawa and Argentine Agreements still current, the only practicable means of safeguarding the British live-stock industry was a 'drastic reduction of the import of meat into the United Kingdom from all sources.' Hence, the levy proposal was put forward for the consideration of the Governments concerned as an alternative to such restriction.

The official New Zealand Government reply showed a clear grip of the realities of the situation. In a closely-reasoned statement it was pointed out that the imposition of a levy would 'destroy the mutually beneficial results arising from the Ottawa Agreement which New Zealand has made strenuous efforts to observe,' and would heavily penalize mutton and lamb producers 'to assist in the solution of what is essentially a beef problem.' It would react on the Dominion's tariff policy, and would be discriminatory in its effects. It would involve New Zealand in serious economic loss and would negative all the adjustments made in New Zealand to reduce farming costs.

It was further emphasized that the economic development of New Zealand and our ability to service the charges on British capital investments were contingent on adequate returns to our export industries. The view was expressed that there was slender hope of meat-supplying countries agreeing among themselves to restrict supplies to suit the needs of the market and that any agreement to regulate supplies must also embrace

8. This cable was later published as a White Paper on March 6, 1935.

home producers. Hence it was concluded that the meat market would be heavily over-supplied, thus involving a collapse in the price, not only of beef, but of mutton and lamb.

The New Zealand statement is noteworthy, not only because it shows the economic basis of imperial relations, but because it is perhaps the first occasion definitely known to the public in which this Dominion has firmly (but politely) taken a stand against the proposals of the Mother Country. The following quotation from the cabled reply to the British White Paper well expresses the New Zealand point of view: 'New Zealand regrets that it cannot voluntarily support the principle of a levy; and in the form proposed it is especially repugnant to meat producers and to the people of this Dominion. New Zealand, with a population of one and a half millions, with the highest per capita external trade in the world, with meat exports amounting to a quarter of our total export values—a proportion which is enormously greater than that of any other Dominion—would be called upon to carry a levy which is demonstrably a far greater burden to New Zealand than to any other British Dominion. We urge that the proposal is inequitable and discriminatory.'

From the point of view of New Zealand, the levy proposals are objectionable for two reasons; first because the proportion of meat to total exports is higher than from any other Dominion, so that the burden of a levy on all meat exports is proportionately greater; second because the scope for expansion of meat output is not great by comparison with New Zealand's main competitors. Hence, New Zealand is likely to suffer from any fall in prices resulting from the expansion of meat exports without being able to obtain any substantial compensation in the form of increased exports of her own.

The different position in the dairying industry leads to a point of view among producers, which is more unfavourable to quotas than to the levy. The obvious effect of a quota is to limit the effectiveness of competition. To industries which have been long-established and which have reached or approached their maximum output, the quota acts as a form of protection against the competitive encroachment of younger and perhaps more efficient producers. The mature, or the inefficient industry, has therefore less to fear from a quota than from a price war operating under a system of levies. To younger expanding industries the quota acts as a barrier against development and such industries prefer the levy as the lesser of two evils.

It is largely because the scope for expanding production is less in the case of meat than of dairy produce that quantitative restriction is regarded as less damaging by meat interests in New Zealand than a levy on British imports to be used as a subsidy to British producers, while dairy farmers in general would prefer a levy.

Both the quota and the levy have dangers from the national viewpoint. Provided that a quota on meat exports involved no restriction on normal output it would raise no serious national problems. In dairying, however, quantitative restriction would close an avenue for the application of labour and capital which is traditionally regarded as the most economic means of national expansion. There is little hope for escape through the exploitation of other markets. New Zealand would be faced with the transfer of resources to less economic secondary industries. The practical difficulties of diverting labour and capital to other industries exploiting national resources, or to manufacturing industries, would be serious, and the net result might well be prejudical to the standard of living.

The imposition of a levy would face the dairying industry with some immediate loss, more especially in the form of inability to meet fixed charges. On the other hand, working expenses are low, and would be further reduced by expanding production, more especially on the more fertile areas. In the long run, the dairying industry could probably survive a price-war unsupported by subsidies more efficiently than its overseas rivals. In meat the position is otherwise; for in the competitive struggle, the New Zealand industry is less favourably placed than Australia or the Argentine to offset lower prices by expanding production.

Any action by Great Britain which had the effect of substantially reducing the returns from farming would raise the question of subsidy in one form or another into the forefront of political controversy. In fact, there is no escape by this means, for the export trade is so great in proportion to population or national income that any subsidy large enough to be effective would throw too great a burden on tax revenue. Moreover, the domestic market is too small to raise any substantial subsidy by taxing the domestic consumer. This is one important point of contrast between the dairying industry in New Zealand and Australia.

It may indeed prove that either levy or quota, if pressed far enough, may impose so great a strain on our national resources that we may find no escape from the unpleasant necessity of asking our creditors to share in our distress.

Gradually, and reluctantly, New Zealand is becoming aware of the changes of a far-reaching character that are occurring in the United Kingdom. We are faced with unsolved and almost unstated problems. Rightly, we feel that these developments in the United Kingdom go to the very heart of our economic life—they are a challenge to our whole conception of free competitive private enterprise.

F. The 1935 Meat Agreement

Since the above was written a Meat Conference between the United Kingdom and the Dominions has been concluded. As far as mutton and

lamb are concerned the results are a recognition of the Australian and New Zealand position; the Meat Agreement as cabled by the Right Hon. J. G. Coates covers quantities for the 1935 July-December period (for New Zealand), viz.: Mutton and lamb, 1,578,800 cwt.; beef and veal, 478,000 cwt. (the same as for the similar period, 1934), plus 70,000 cwt. carry-over from June. This involves the continuance of the restrictions on certain categories and cuts of beef and veal. The global beef total includes 66,000 cwt. of chilled beef, which is quite satisfactory, having regard to present developments. Frozen pork was tentatively settled at 140,000 cwt.

A beef and veal agreement was not concluded for 1936 mainly because any changes affecting Argentine chilled beef or levies on Argentine meat must, first of all, require the agreement of that country.

The most satisfactory arrangement was the mutton and lamb agreement recorded by the United Kingdom, Australia and New Zealand, which included an explicit statement that there would be *no duty or levy on mutton and lamb* in 1936, while the quantities allowed for the full year 1936 are: New Zealand, 3,900,000 cwt., and Australia 1,750,000 cwt., with the right in each case to carry over a further 50,000 cwt. if the quotas already accepted for the current six months were short to that extent. The new Zealand figure is the peak of the Ottawa year and above it if the carry-over is included. It should be mentioned that the actual arrivals from New Zealand in the year 1934 were 3,554,000 cwt.

APPENDIX

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