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AGRICULTURE

AND

ANIMAL HUSBANDRY

IN INDIA

1937-38

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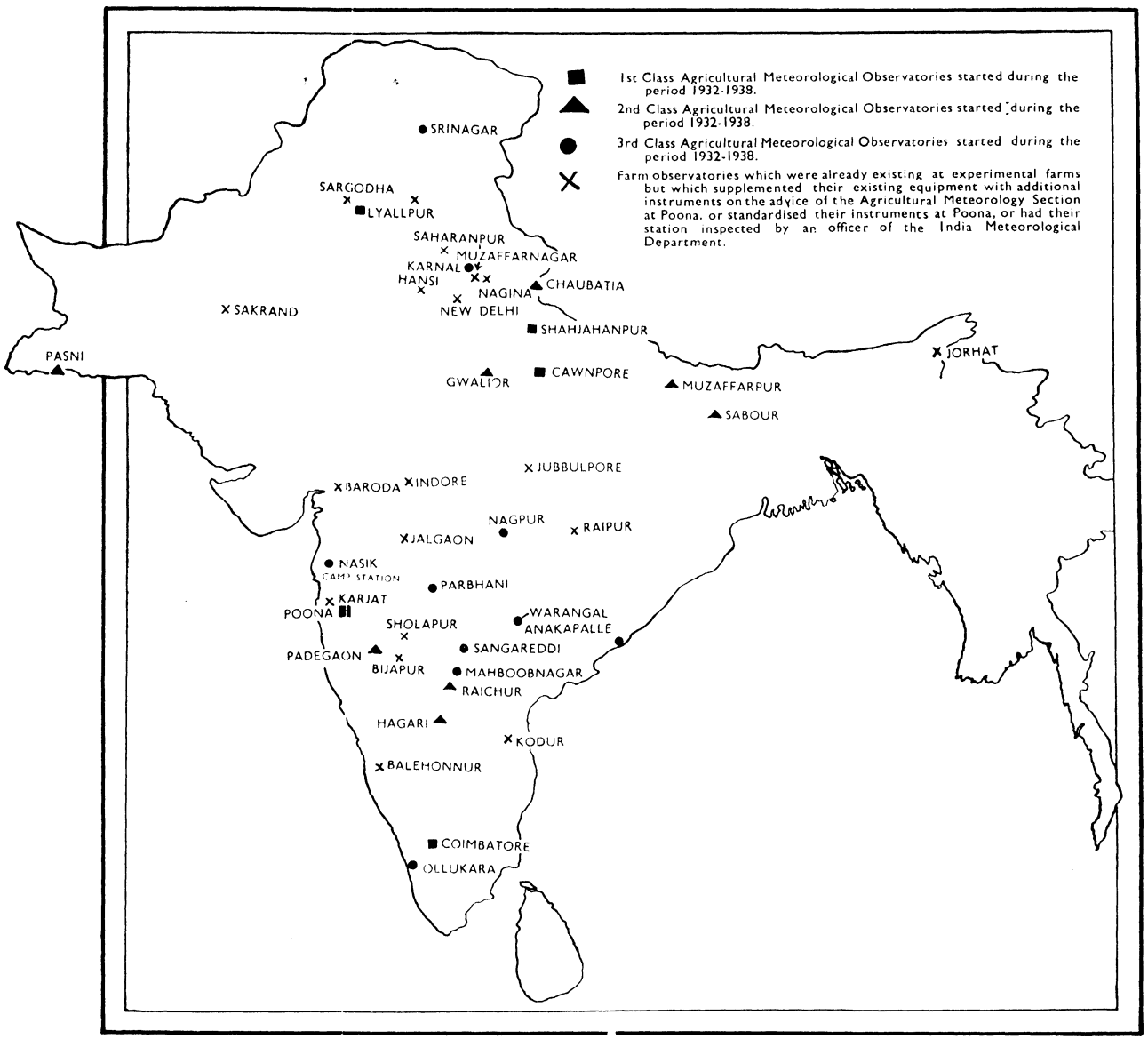
MAP OF INDIA SHOWING EXPERIMENTAL FARMS WITH METEOROLOGICAL OBSERVATORIES OF DIFFERENT ORDERS IN 1938



CHAPTER I

AGRICULTURAL CONDITIONS

1. Agriculture and climate

THE monsoon of 1937 was marked on the one hand by spells of heavy rains causing floods in parts of Northern India, and on the other by a prolonged break during August resulting in drought in North-West India and the Deccan. Averaged over the plains of India, the total rainfall during the monsoon period was in defect of the normal by one per cent only. During the retreating period, the rainfall was scanty in Orissa, the United Provinces and West Gujarat, but generally in excess of the normal elsewhere. Taking the year as a whole, the rainfall was within 20 per cent of the normal except in Sind, Berar, Gujarat and the West Central Provinces, where it was excessive.

Areas under important crops showed some fluctuations during the year. The Indian cotton crop of 1937-38 was not so good as in the previous year. In 1936-37 the out-turn of raw cotton in India amounted to the record figure of 6·2 million bales of 400 lb. each. In the year under review the yield was estimated at 5·7 million bales only. The yield was 8 per cent less than in the previous year and the area under the crop was 3 per cent more than in 1936-37. The all-India average yield per acre in the year under review was only 89 lb. as compared with 100 lb. in the previous year. The total area under wheat in 1937-38 was reported to be 35,618,000 acres, which was greater than the area of the preceding year by 7 per cent. The crop was reported to have been affected in places by rust and smut attacks, hail storms and wind, but its condition was, on the whole, good. The total estimated yield was 10,950,000 tons, which was 11 per cent greater than the yield of 1936-37. The total area under rice during 1937-38 was reported to be 72,277,000 acres as compared with 72,295,000 acres in the preceding year. The condition of the crop was reported to be good on the whole. The total yield was estimated at 27,787,000 tons, as against 27,828,000 tons in 1936-37. The production of sugar has been increasing consistently for some years and exceeded a million and a quarter tons in the season 1936-37. This was the highest figure attained and was due mainly to the very large crop of cane during that year. The cane-grower suffered from this over-production as he could not dispose of his crop at remunerative prices. As a result, the area under sugarcane decreased by 14 per cent in 1937-38. The estimated yield amounted to 5,485,000 tons of raw sugar (*gur*) which was less than the production of the preceding year by about 18 per cent. In spite of deficient rainfall during the growing period, the condition of the crop was, on the whole, fairly good. Among oil-seeds, the condition of the linseed crop was, on the whole, good. The total area under linseed in 1937-38 was 3,839,000 acres as against 3,677,000 acres in the preceding year. The condition of rape, mustard and sesamum was also fairly good. The total area under rape and mustard in 1937-38 was 5,733,000 acres as against 5,889,000 acres in the preceding year, while in the area under sesamum there was an increase of about 999,000 acres. The out-turn of groundnuts in India in 1937-38 has been estimated at the record figure of 3·3 million tons as compared with 2·7 million tons in the preceding year.

This crop increased in 1937-38 by about 31 per cent over that of the preceding year. The out-turn of raw jute in India for the season 1937-38 was estimated at 8·6 million bales (of 400 lb. each) as compared with 9·6 million bales in the preceding season. Conditions were generally favourable for sowing and germination. The propaganda for the restriction of sowing had limited success and the total area during the year under review was 2,889,000 acres as compared with 2,886,000 acres in the preceding year. The crop forecast announced in September 1937 fell much below market expectations and it was thought that the total out-turn was considerably underestimated. To arrive at a correct estimate of the yield of jute, the Indian Central Jute Committee, in collaboration with the Government of Bengal, had started a scheme of area determination by random sampling checked by a total enumeration in a limited number of *thanas* (revenue sub-divisions). The production of tea, though controlled, increased during the year under review to 430 million lb. as compared with 395 million lb. in the preceding year. This large production was readily absorbed as the export demand as well as the internal demand for tea was very brisk during the year.

In MADRAS the monsoon broke late. Although the rainfall was heavy in June on the West Coast, it was less than normal in other parts of the province. The monsoon was active in July on the West Coast and the Deccan. The rainfall in this month was bordering on or above normal except in South Arcot, the central districts and the south (Tinnevelly excepted). In August the monsoon weakened and the rainfall was below normal except in parts of the Circars, the central districts and the south. Towards the end of September there were heavy falls at a few stations but the rainfall in this month was generally below the normal except in Trichinopoly, the south (Tanjore excepted) and South Kanara.

The south-west monsoon was, on the whole, defective, except in Chingleput, Chittoor, Trichinopoly, Madura, Ramnad and South Kanara and the sowings of crops were generally below the average.

The north-east monsoon set in over the Bay of Bengal by the middle of the third week of October and became established by the 20th of the month. The rainfall during October was generally above normal except in Bellary, Salem, Coimbatore, Ramnad and Tinnevelly.

The uneven distribution of rainfall during both the monsoons had an adverse effect on paddy at Anakapalle and the paddy breeding stations at Coimbatore, Aduturai and Ambasamudram; on sugarcane and plantains at Samalkota; on groundnut at Tindivanam and Guntur; on pulses and coriander at Koilpatti; and on the dry and garden crops at Palur, Central Farm Coimbatore, and Pattukottai; cotton and *jonna* (*Andropogon Sorghum*) gave, however, normal yields at Nandyal. At Hagari *mungari* (early) crops had to be sown late by two months along with *hingari* (late) cotton. Nanjanad was the only research station which had an even distribution of rainfall, and potatoes and *sanai* (*Crotalaria juncea*) fared satisfactorily. Fairly good crops were also obtained on the millets breeding stations at Coimbatore, Buchireddipalayam, Gudiyattam and Maruteru. The dry weather, though it affected the yield of cotton and Bengal gram in the Cotton Breeding Station, Coimbatore, was helpful to some extent in checking the multiplication of the cotton stem weevil (*Pempheres affinis*). At the Fruit Research Station, Kodur, the north-east

monsoon was specially favourable and was responsible for producing a good second crop of oranges. The season was a failure for *hingari* crops in the Bellary district but it provided an opportunity to study the effects of irrigation on the crops raised in the *hingari* season at the newly opened agricultural research station at Siruguppa in the Tungabhadra Project area.

In BOMBAY there were ample rains over most of the province during the season under review but their distribution was uneven as regards periodicity and area. The rainfall was continuous and heavy towards the end of June, in July and September, but there was a prolonged break of about five weeks in August and the first week of September. The *kharif* (rainy season) was thus characterized by irregular rainfall which had the effect of reducing the yield of crops. A large block of the country in the south of the Deccan and almost the whole of the Karnatak had deficient and very badly distributed rainfall almost throughout the season and both the *kharif* and *rabi* (winter or spring) crops in these areas were poor. Taking all crops together, there was little alteration in the total area sown. The area under food-grains and cotton showed a little improvement over the last year, while the area under groundnut exhibited a considerable increase and reached the record figure of 1,344,000 acres during the year under report, which exceeded the highest figure of 1933-34 (1,292,000 acres).

In BENGAL the season at the sowing time was not generally favourable either for *kharif* or *rabi* crops. Rainfall was deficient and unevenly distributed in all the districts. Want of proper rainfall in the beginning of the *kharif* season delayed sowing of *aus* (autumn) paddy and *bhadoi* (grown and harvested in August to September) crops. Later, heavy rains and flood water damaged *kharif* crops and delayed *rabi* sowing in many places. For want of rain in the *rabi* season, cold weather crops generally and specially English vegetables and tobacco suffered. The yield of winter paddy during the year was below normal due to late transplantation and subsequent damage by floods at the end of September. On the whole, the weather was favourable for sugarcane, fodder crops and some *rabi* crops.

In the UNITED PROVINCES the monsoon on the whole was found sufficient for rice, *jowar* (*Sorghum*) and *bajra* (*Pennisetum typhoideum*), but not enough for sugarcane the growth of which was retarded by insufficient rain throughout the year and more particularly during September. This crop also suffered severely from attack by the sugarcane leaf-hopper in some localities, particularly in the Upper Doab and Rohilkhand tracts. There was also serious local damage to the sugarcane crop from white fly and red-rot in the *Terai* districts. Sowings of cotton were adversely affected by scanty rain in the west and excessive and continuous rains elsewhere which affected the germination. The latter part of the season was, however, favourable to the cotton crop, resulting in production of good quality lint and a higher yield than in the previous year.

The area under *kharif* crops other than cotton exceeded that of the previous year by 461,000 acres, i.e. approximately by 2 per cent; and of the accepted normal by 429,000 acres; the major increases being in rice, *jowar* and smaller millets. The out-turn of the *kharif* crops was fair, showing improvement in all the important crops excepting *jowar*, *bajra* and sugarcane.

Rabi sowing was delayed either by absence of late September rains or excessive rains and floods during October, more particularly in the Eastern division. There was a reduction of about 4 per cent in the area under *rabi* crops as compared with that of the previous year. The wheat area was 4·3 per cent above that of the previous year, and nearly 14 per cent above the normal 30 years' average. The linseed crop showed further recovery of area of over 3 per cent but was still some 33,000 acres below the normal average. The main crops which contributed to the decrease in the *rabi* area were rape-seed, gram and barley which were lower by 25, 11 and 8 per cent respectively in comparison to the 1936-37 *rabi* season. Notwithstanding the difficulties at the commencement of the *rabi* season, the out-turn generally showed an improvement in all crops except gram, and the *rabi* harvest may be said to have been satisfactory.

In the PUNJAB the monsoon started earlier than usual, but did not continue long enough and the rainfall was inadequate during August and September. Prolonged drought and hot and dry winds towards the end of September and in the beginning of October were largely responsible for shedding of flowers and bolls of cotton. In the Canal Colonies the cotton crop also suffered from the attack of white fly. Excessive dry cold coupled with frost in November caused defective opening of the bolls, particularly in the case of American cotton sown in mid-season. The adverse effect of the season was reflected in the yield of cotton which was 1,232,700 bales of 400 lb. each from 3,135,500 acres as against 1,468,000 bales from 2,909,000 acres in the previous year. Sugarcane was very badly attacked by Pyrilla in the Rohtak district, so much so that even *gur* could not be made out of the juice obtained from the diseased cane. The weather was continually wet and cloudy during the latter half of December, and during January and February. Considerable damage was caused to the crops in some districts by hail-storms about the middle of February. In the beginning of April there was again rain accompanied by a severe hail-storm in some districts. Owing to mild conditions in March, the grain was well developed, resulting in a high yield of wheat—almost equal to the record yield of 1929-30. The total yield of wheat was 3,724,000 tons from 9,944,700 acres as against 3,392,000 tons from 9,385,000 acres in the previous year. April and May were favourable for harvesting and threshing. The attack of gram blight was more widespread this year. The gram crop all over the province suffered, but in the Attock and Mianwali districts it was almost completely wiped out.

In the CENTRAL PROVINCES the monsoon commenced late and followed a somewhat abnormal course throughout. *Kharif* sowings were started only towards the end of June. Germination of *kharif* crops, though generally satisfactory, was defective in crops other than rice in Chhattisgarh and in a few places in Berar where some re-sowing was necessary. Precipitation was heavy throughout July in all districts and gave no opportunity for inter-cultivation with the result that weeds flourished and crops made slow growth. A long break in August improved the position considerably and conditions throughout September remained favourable. Prospects in the cotton tract fell off again in October when the monsoon ceased and intense heat supervened. Of the *kharif* crops, cotton fared worst, groundnut somewhat better and *jowar* still better. Paddy was a considerably smaller crop than the average of past years.

Preparation for *rabi* sowing was given a good start by the August break. Sowings were done at the normal time in most places and earlier than usual in some, and germination was generally satisfactory except in Chhattisgarh where October rain made some re-sowing necessary. Crops made good growth to begin with but lack of winter rain combined with abnormal heat prevented full development and this was followed later on by cold spells and hail-storms in some of the northern districts. Rust made a slight appearance but did not cause serious damage, and cut-worms did some harm to linseed in Chhattisgarh. The cumulative effect was that *rabi* crops in general were below normal.

In BIHAR the weather conditions were, on the whole, favourable for the winter rice *rabi* and sugarcane crops, while *bhadai* crops, particularly maize, suffered to some extent due to a shortage in the early stages and an excess of rain in the later periods of crop growth. Floods occurred in the months of June, July, August and September and standing crops, including sugarcane, suffered as a consequence in parts of Patna, Bhagalpur and Tirhut divisions.

There was a considerable shrinkage in the area under sugarcane due to the very low prices received by growers in the 1936-37 crushing season and also due to a large surplus crop left in the fields at the close of that season. The area under the crop fell from 490,000 acres in 1936-37 to 360,500 acres in the year under report.

A good *hathia* (October) rainfall helped the normal sowings of the *rabi* crops and cold weather rains, although late, resulted in a fairly good harvest.

The year under review must, on the whole, be considered fair as satisfactory out-turns were secured from *bhadai*, *aghani* (winter) and *rabi* crops.

In SIND, generally speaking, the condition of the crop throughout the province was below normal during the year. Hot winds during May and June adversely affected the germination of crops. Subsequently, the fall in the river level delayed sowings and transplanting operations in the non-Barrage areas. The heavy showers in July affected the germination of *jouar* and *bajri* in several places. There was considerable damage due to sterility in rice.

During the winter season, wheat on the Left Bank suffered on account of the canal closure and the cloudy weather just before maturity brought on the rust attack on the crop. In Upper Sind the yield of wheat decreased due to the absence of flooding in *katcha* lands during the *Abkalani* and lack of rain in the winter season. The *matar* (pea) crop was affected by *Mahlo*. Oil-seeds suffered from frost in Jacobabad district but flourished in Larkana and Dokri districts. The area under *toria* (*Brassica napus*) increased on the Left Bank and good yields were obtained. Linseed and safflower grew successfully. An effort is being made to overcome the difficulties in marketing these crops. Berseem fodder has now become popular in the Left Bank tract and was grown on a larger area.

There was a general fall in the prices of agricultural commodities during the year. This, combined with the diminished yields of crops, was responsible for the decline in the economic condition of the people in the Barrage area. In the non-Barrage areas, there was a little improvement, the crop being better than in the previous season.

In the NIZAM'S DOMINIONS, in the western districts, heavy rains at the time of maturity damaged the crops considerably, while in the eastern districts the rainfall continued to be low and was unfavourably distributed. Consequently, the crops could not grow satisfactorily and the out-turns were low. The *rabi* season received little rain, and the crop remained poor. In Marathwara the monsoon started well in the Aurangabad and Parbhani districts, but later on there was a long drought which affected the *kharif* crop unfavourably to a certain extent. The conditions were satisfactory for the *rabi* crop, but some damage to cotton and other crops was caused by severe cold in parts of Aurangabad district. In the Nanded and Bhir districts the monsoon started late, but the conditions were favourable in the end and the crops could make fair growth. On the whole, the season was satisfactory in this division. In the Karnatak area the rainfall was below the normal and was badly distributed. In the Raichur district the monsoon started late, but the *kharif* crop received some help from the late showers though those showers were not sufficient for the *rabi*. The Osmanabad district was comparatively more fortunate. The most unfortunate district during the year was Gulbarga district, where the *kharif* failed due to the late arrival of the monsoon followed by drought, and the *rabi* suffered on account of inadequate moisture. The conditions in the Bidar district were, on the whole, favourable and normal crops were harvested in both seasons.

In MYSORE the distribution of rainfall during the year was not satisfactory. In the Bangalore circle rains were untimely, there being no rains near maturity of the crops. In the Tumkur circle though there were good rains early in the year there was a long break afterwards due to which the crops suffered. In the Shimoga circle rainfall was not favourable and the crops suffered heavily. In the Chikmagalur circle the coffee blossom showers were somewhat early and insufficient. The long break in the rainfall also adversely affected the yields of coffee. On the whole the seasonal conditions were unsatisfactory and there was failure of crops and scarcity of water in several localities. The prices of agricultural produce continued to be more or less normal.

In BARODA, with the generally moderate rain in June, the rain sowings and the pre-monsoon ones in light and heavier soils tracts were quite successful. The July rains prevented proper cleaning and interculture in fields and checked vigorous growth of crops. The succeeding drought did not allow timely transplanting of paddy and tobacco and adversely affected the growth of *bajri*, millets and pulses. The heavy rains in September caused further damage to these crops and to sesamum, but helped cotton, tobacco and *kyari* paddy and ensured a good village water supply. The groundnut crop suffered heavily due to both heavy rains and drought. The season proved quite good for cotton and *kyari* paddy, particularly where it could be helped over the drought with some irrigation. The continuous rains and severe cold spells in winter caused thin stalk growth and low ginning in cotton.

In TRAVANCORE the total rainfall during the year under report was almost everywhere less than the normal and the total falls during the previous year. The rainfall was unevenly and unusually distributed. The month of *Makaram* (January-February) was exceptionally wet. This uneven and unusual distribution of rainfall had a bad effect on the growth of crops. Paddy in South Travancore failed to a large extent. Insufficiency of water towards the close

of the previous year hindered the cultivation of the *Kanni* (September-October) crop in many fields. Unexpected rains in *Makaram* damaged the *Kumbhom* (February-March) crop which was then just flowering. Again the lack of rains towards the close of the year left very gloomy prospects for the *Kanni* crop of the current year. The situation in Central Travancore was no better. The *Makaram* rains rendered it impossible to sow the inter-crop of sesamum in most of the fields in Onattukara. The water remained in the fields so long that they could not be tilled or prepared satisfactorily even for the second paddy crop which is generally sown in dry pulverised soil. These early rains were also very injurious for the paddy in *punja* fields. And still worse was the lot of pepper. The vines put forth their flush with the early rains but these dropped off in large numbers when the rains broke off, with the result that the harvests were very poor and irregular. In North Travancore, however, the distribution of rain was more even.

In COCHIN the south-west monsoon rains commenced earlier than usual with active and vigorous rainfall and were, on the whole, slightly in excess of the normal, but the weather towards the close of the year was disappointing, with only very little rainfall. The result was that the paddy crop sown early with the short duration types was uniformly good both in dry and wet lands, whereas the late sowings and long duration types of paddy suffered considerably. The north-east monsoon rains were almost normal with uniform distribution. The second crop of paddy did not therefore suffer much. There were some good showers during hot weather months also and the water scarcity was not so very severe as in previous years.

2. Economic conditions

Prices of most of the items of India's agricultural production attained their maximum in the first part of 1937 and thereafter declined sharply, the fall being about 25 per cent and more in most cases in a period of only a few months. Thus raw cotton declined from March 1937 to October 1937 by 33 per cent and raw jute fell off in value from May 1937 to March 1938 by 25 per cent. Wheat which reached its highest level in April 1937, dropped by 35 per cent in March 1938 and tea by 16 per cent in about the same period. Prices of groundnut were highest in August 1936 ; since then they declined almost continuously. The price of rice was fairly steady throughout 1937-38 and the preceding year and that of linseed was on the average higher in the year under review than during 1936-37.*

3. Imperial Council of Agricultural Research

The expansion of the Council's activities was maintained during the year under review. As usual the Advisory Board met twice and the Governing Body once during the year. The Annual General Meeting of the Council took place on the 12th March 1938 when the annual reports on the working of the Council and on the accounts were adopted. A Special General Meeting of the

* For details of area, export and prices of different crops reference may be made to:
1. *Estimates of Area and Yield of Principal Crops in India, 1937-38.*
2. *Review of the Trade of India in 1937-38* (pp. 12 to 53).

Council was also convened at which various formal amendments to the Rules and Regulations of the Council, which were rendered necessary by the constitutional and other changes and developments, were passed. The Council received from the Government of India a total grant of Rs. 12,25,000 to cover, among annual recurring grants, expenses on marketing schemes, researches on sugarcane and cold storage schemes. Five schemes were approved by the Governing Body during the year under review and the total fund allotted for research at the end of 1937-38 was Rs. 65,34,211. Of the total number of schemes financed by the Council, 112 are under local Departments of Agriculture, and 23 are carried out by university organizations or private bodies. A complete list of schemes financed by the Council is given in Appendix XV.

A notable event during the year was the holding of the second meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry at Lahore during December 1937. This was followed by a visit of members to Lyallpur to see the research work in progress at the Punjab Agricultural College and its surrounding farms. The deliberations of the Board were opened by H. E. the Governor of the Punjab. About 60 members from all over India participated in the discussions and a large number of useful papers were read. The Board made useful recommendations on several subjects.

Another step taken by the Council during the year was the constitution of a standing Central Fodder and Grazing Committee. This was in pursuance of the recommendation made by the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry and of a similar recommendation made by the Cattle Conference. The personnel of the Committee consists chiefly of representatives of provincial Forest and Agricultural Departments. The first meeting of the Committee was held in November 1937 and important questions pertaining to the improvement of grassland were discussed and future lines of action were laid down. As recommended by the Council, provincial Fodder and Grazing Committees have been constituted in most provinces and it is expected that with this type of organization having branches all over India the coordination of research on problems of fodder production in India will be greatly facilitated.

The second meeting of the standing Rice Committee preceded by a meeting of a Research Sub-committee was held in March 1938. Besides discussing the reports of research schemes of different stations, the Committee approved the extension of certain schemes and recommended that more funds should be provided for rice research.

A meeting of the Horticultural Research Workers Conference was held in September 1937. In addition to the progress reports of research schemes and technical programmes of work, the Conference considered a memorandum regarding the need for uniformity in the maintenance of cultural records and performance records of fruit trees in different stations of India, the questions of layout of horticultural experiments and the better coordination of horticultural experimental work now in progress.

A meeting of the Dry Farming Coordination Committee was held in September 1937. At this meeting practically all the scientific workers of the various dry farming research stations were present. It was preceded by a meeting of a small Drafting Sub-committee. The Committee considered the progress reports on current research schemes and the question of correlating

their results. Suitable arrangements were also made for an interchange of quarterly progress reports.

The Soil Science Committee met twice during the year in conjunction with the Advisory Board, i.e. in November 1937 and in March 1938. It examined a number of progress reports and technical programmes of work and considered applications for the renewal of certain existing schemes and applications for grants for new schemes. One of the principal items on the agenda at each meeting was the consideration of Sir John Russell's recommendations regarding soil research.

The Sugar Committee met twice during the year. In May 1937 the Committee considered the progress reports of 1935-36 and a few technical programmes of work on research schemes financed by the Council. The question of the desirability of extension or otherwise of sugarcane cultivation was discussed and it was agreed that in view of the increases which had taken place and of the increase in yield per acre, there was no scope for any general increase in the cane area but that the present distribution was imperfect. It was considered desirable to take stock of the performance of all the sugarcane varieties grown in India and the Imperial Sugarcane Expert was requested to prepare a list of them with a statement indicating their behaviour in different places and remarks as to their usefulness. The Committee reviewed the working of the Sugar Production Rules, 1935, and approved experiments on the ratooning of sugarcane at two agricultural stations, one in the United Provinces and the other in Bihar at a cost of Rs. 59,000, spread over a period of five years.

In March 1938 the Committee considered 13 progress reports and 10 proposals for the renewal of existing schemes. The Committee also recommended an expansion of the scheme of work on the insect pests of sugarcane in provinces other than the United Provinces, Bihar and Bombay which had already been sanctioned. Proposals for the continuation of the Sugar Marketing Survey conducted by the Agricultural Marketing Adviser to the Government of India were considered and approved. The Committee also approved a summary of some practical results of sugarcane research in India prepared by the Imperial Council of Agricultural Research and desired that a similar publication should be issued annually, giving a short account of the outstanding achievements recorded in the progress reports of each year.

The Council sanctioned a technical survey of the *gur* industry in India with special reference to *gur*-making outfits and the implements made under the direction of the Director, Imperial Institute of Sugar Technology. The work is in progress and it is hoped that a complete monograph in this connexion will be published for the benefit of the industry.

The second meeting of the Wheat Committee was held at Simla in September 1937. The Committee devoted considerable time to the discussion of the major conclusions contained in the report on the Wheat Marketing Survey. The progress made in the standardization of wheat ' futures ' contract for India was noted and discussed. Emphasis was laid on the desirability of encouraging better storage, special reference being made to the underground concrete *khattis* (bins) used in Muzaffarnagar. The Committee recommended that wheat market prices should be regularly broadcast and published in newspapers. This recommendation has since been accepted and acted upon. The Committee agreed that both from the point of view of marketing and from the

agricultural standpoint it was necessary that the number of improved types selected for distribution should be limited and that the policy of building up compact blocks of single varieties was the correct aim. Notes from several provincial Governments and provincial representatives on the economics of wheat production were discussed. The general view was that the principal requirement was an intensification of the organization for seed supply and better organized marketing. The Committee noted that discussions with the Liverpool Corn Trade Association were in progress with a view to ascertaining whether the Indian wheat could be made tenderable against the Liverpool wheat 'futures' contract. Since the Committee met it has been ascertained that there is no objection in principle to Indian wheats being made so tenderable, provided a regular export trade was established and wheats of satisfactory cleanliness, not liable to attacks of weevil in storage, could be shipped in commercial quantity.

At the instance of the Government of India, the Imperial Council of Agricultural Research undertook an enquiry into the possibility of clove production in India. Imports of cloves mainly from Zanzibar are valued at over Rs. 30 to 40 lakhs annually. The question whether cloves could be profitably produced in India has been raised from time to time but there was a lack of precise information. The Council appointed Dr. A. K. Yegna Narayana Iyer, retired Director of Agriculture, Mysore, as officer on special duty to make the enquiry in promising areas in South India. The enquiry lasted for about six months. He visited parts of Coorg, Mysore, the Nilgiris and Tinnevelly and submitted a report which has been published as a *Miscellaneous Bulletin* (No. 20) of the Imperial Council of Agricultural Research. This report records the special officer's observations on the scattered clove cultivation in India, deals with the soil and climatic conditions necessary for clove plantations and makes suggestions for the future.

As recommended by Sir John Russell, the results of manurial experiments on rice and sugarcane conducted so far in the provinces and states were collated by the Statistician to the Council with a view to replanning the whole system of manurial experiments on these crops and in particular to arrange for identical or similar experiments to be carried out simultaneously at all stations.

The Twelfth International Horticultural Congress was held in Berlin in 1938 to which an official invitation was received by the Government of India and the Council arranged for a delegation consisting of Dr. W. Burns, the Agricultural Commissioner with the Government of India, as leader and Dr. H. Chaudhri, Reader in Botany of the Punjab University and Mr. K. C. Naik, Horticulturist, Fruit Station, Madras, as members.

In marketing efforts were made from the commencement of the year under review to put into practical effect the preliminary results obtained in the course of the marketing surveys up-to-date. Much of the information collected by the central and local marketing staffs in regard to grains, oil-seeds and ghee was compiled for use in discussions with the producers and trade interests concerned. A full report on the marketing of wheat in India was published as also its abridged editions in English, Hindi and Urdu. A report on the marketing survey on cold storage and transport of perishable produce was also published. Other reports which were ready for the press were linseed, tobacco, eggs, grapes and coffee. Various statutory all-India central commodity committees such

as lac, jute and coffee decided to have their own marketing staff to carry out special surveys on the products concerned. The work of these special officers will, however, be supplemented by the enquiries instituted by the existing local marketing staffs and the central marketing staff. The Government of India placed a fund at the disposal of the Agricultural Marketing Adviser for expenditure in regard to the improvement of sugar marketing in India. For this purpose a Marketing Officer and two Assistant Marketing Officers with a nucleus staff were appointed temporarily with effect from the 1st December 1937. The survey was started from the same date.

With a view to better grading of agricultural produce and providing a common basis for trading on standard quality to the advantage of both producers and consumers, the Agricultural Produce (Grading and Marking) Act was passed by the Central Legislature in February 1937. To give a practical lead to all concerned the Central Marketing Staff initiated the grading and marking of different commodities at more than 30 centres. Although some of those grading stations were running for a short period towards the end of the year the total value of the graded produce put out under the 'Agmark' exceeded Rs. 10 lakhs. With a view to demonstrating suitable methods of grading at different stations and to showing producers the practical possibility of obtaining a premium on graded produce, a number of experimental grading and marking stations were established at different centres throughout India. These stations dealt with hides, eggs, fruits, tobacco and ghee. An important part of the headquarters work on grade standards consisted in the collection and examination of a large number of samples of the different commodities. Arrangements were made with various institutes throughout India to carry out the physical and chemical analyses of these products.

A Marketing Officers' Conference was held as usual in the course of the year. One of the main decisions arrived at was that greater emphasis should be laid in future on development work, particularly in the way of

(i) the establishment of more grading and packing stations under the Agricultural Produce (Grading and Marking) Act,
(ii) the regulation or registration of markets and market charges,
(iii) the standardization of weights and measures, and
(iv) an improved market news service for producers.

A representative conference of ghee producers and others was held in Simla in September when proposals were formulated for the standardization of ghee and the establishment of ghee grading and marking stations. In Bombay another informal conference was held to discuss with the trade representatives the results of a special investigation into the chemical quality of Kathiawar ghee.

CHAPTER II

ECONOMIC WORK ON CROPS*

THE ascertained area under improved varieties of crops in British India in 1937-38 was approximately 22·05 million acres as compared with 22·4 million acres in 1936-37. These figures by no means represent the whole extent to which improved strains have replaced old varieties as it is difficult to gauge the full extent of the natural spread of improved varieties. Tables I and II show the position so far as it can be ascertained.

*The assistance of the following officers in the preparation of this Chapter is gratefully acknowledged :

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(2) Dr. B. P. Pal, M.Sc., Ph.D. (Cantab.), F.L.S., Imperial Economic Botanist, Imperial Agricultural Research Institute, New Delhi	*Wheat, Tobacco and Potatoes.*
(3) Mr. D. N. Mahta, B.A. (Oxon.), Secretary, Indian Central Cotton Committee, Bombay	*Cotton.*
(4) Mr. N. L. Dutt, M.Sc., Imperial Sugarcane Breeding Station, Coimbatore	*Sugarcane.*
(5) Mr. A. P. Cliff, B.A., Dip. in Agri., I.A.S., Secretary, Indian Central Jute Committee, Calcutta . .	*Jute.*
(6) Dr. J. S. Patel, B.Sc. (Agri.), M.Sc. (Cornell), Ph.D. (Edin.), Jute Specialist, Indian Central Jute Committee, Ramna, Dacca	*Oil-seeds.*
(7) Mr. P. H. Carpenter, F.I.C., Director, Scientific Department, Indian Tea Association, Cinnamara, Assam .	*Tea.*
(8) Mr. M. J. Simon, Secretary, Indian Coffee Cess Committee, Bangalore	*Coffee.*
(9) Dr. G. S. Cheema, D.Sc., I.A.S., Horticulturist to Government, Bombay Province, Poona . . .	*Fruits.*
(10) Professor L. S. S. Kumar, M.Sc., A.R.C.S., D.I.C., Economic Botanist to the Government of Bombay, Poona	*Fodder Crops and Grasses.*
(11) Mr. B. S. Sawhney, B.A. (Cantab.), Botanist for Millets, Botanical Sub-station, Sirsa, Punjab . . .	*Millets, Beans and Pulses.*
(12) Rao Saheb Ram Dhan Singh, Cereal Specialist, Lyallpur	*Other Cereals.*

TABLE I

Areas under improved crops in India during 1937-38 (in acres) as far as information is available

Province or state	Rice	Cotton	Wheat	Jute	Sugarcane
			BRITISH INDIA		
Madras	1,771,186	677,702	..	..	61,414
Bombay	67,442	911,226	74,133	..	22,944
Bengal	486,068	..	..	1,763,747	286,202
United Provinces	226,233	37,224	494,215	..	1,405,308
Punjab	..	2,495,900	4,937,700	..	319,200
Bihar	38,517	..	64,751	2,700	657,640
C. P. & Berar	702,562	389,773	568,415	..	..
Assam	51,698	..	..	14,391	15,607
N.-W. F. P.	..	5,405	308,546	..	32,291
Orissa	25,032	102	440	258	33,000
Sind	328,068	784,472	384,851	..	..
Total for British India	3,696,806	5,301,904	6,833,051	1,781,096	2,833,606
			INDIAN STATES		
Hyderabad	2,622	247,981	1,558	..	5,436
Mysore	47,122	51,598	..	..	15,067
Baroda	7,466	61,454	23,459	..	156
Travancore	218	..	..	..	..
Cochin	4,697	8,542	..	..	214
Bhopal	16	80	72,000	..	..
Kashmir*	..	..	..	..	..
Total for Indian States	62,141	369,655	97,017	..	21,773
Grand Total for British India and Indian States	3,758,947	5,671,559	6,930,068	1,781,096	2,855,379

* Departmental seed 3,590 acres under different crops. Natural spread not known.

TABLE I—*contd.*

Province or state	Millets	Gram	Potatoes	Ground-nut	Other Crops
	BRITISH INDIA				
Madras	..	..	..	..	237,514
Bombay	20,442	..	2,550	56,092	31,283
Bengal	..	..	..	..	63,464
United Provinces	..	72,580	..	..	318,103
Punjab	..	..	..	..	..
Bihar	..	6,750	..	1,967	9,925
C. P. & Berar	166,302	..	..	151,466	52,578
Assam	..	..	12,304	..	..
N.-W. F. P.	15	425	3,086	..	197,110
Orissa	3	407	3,050	6,012	18,869
Sind	..	..	..	..	172,490
Total for British India	186,762	80,162	20,990	215,537	1,105,636
	INDIAN STATES				
Hyderabad	1,844	..	..	174,419	704
Mysore	158,235	..	..	26,809	1,117
Baroda	329	..	6	397	15
Travancore	..	..	..	..	..
Cochin	..	..	..	40	193
Bhopal	30	3,600	..	240	1,976
Kashmir*	..	..	..	..	..
Total for Indian States	160,438	3,600	6	201,905	4,005
Grand Total for British India and Indian States	347,200	83,762	20,996	417,442	1,109,641

* Departmental seed 3,590 acres under different crops. Natural spread not known.

TABLE II

Areas under improved crops in India (as far as information is available)

Crops	British India		Indian States		Grand Total for British India and Indian States	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
Rice	3,319,671	3,696,806	128,269	62,141	3,447,940	3,758,947
Cotton	4,864,206	5,301,904	210,307	369,655	5,074,513	5,671,559
Wheat	8,329,797	6,833,051	149,416	97,017	8,479,213	6,930,068
Jute	1,315,769	1,781,096	..	..	1,315,769	1,781,096
Sugarcane	3,196,556	2,833,606	46,419	21,773	3,242,975	2,855,379
Millets	234,956	186,762	318,802	160,438	553,758	347,200
Gram	338,892	80,162	5,909	3,600	344,801	83,762
Potatoes	12,117	20,990	603	6	12,720	20,996
Groundnut	194,271	215,537	147,258	201,905	341,529	417,442
Other Crops	624,141	1,105,636	105,644	4,005	729,785	1,109,641
TOTAL	22,430,376	22,055,550	1,112,627	920,540	23,543,003	22,976,090

1. Rice

The rice crop occupies, on an average, about 35 per cent of the total cultivated area in India. Table III shows the estimated area and production of rice during the year under review and the preceding four seasons :

TABLE III

Acreage and production of rice during the five years from 1933-34 to 1937-38

Year	Area in acres (thousands)	Yields in tons (thousands)	Average yield per acre in pounds
1933-34	70,340	25,733	830
1934-35	69,731	25,706	821
1935-36	70,998	23,213	737
1936-37	72,295	27,828	861
1937-38	72,277	26,737	826

It will be seen that though the area was practically the same as last year, yet production was in defect by 3·9 per cent.

With the separation of Burma, the position of India in the world rice market has undergone a change. Rice produced in India is mostly retained for local consumption, exports being not even one per cent of the total production. In spite of the very large acreage under rice, India is now one of the largest rice-importing countries of the world, and this is due to the fact that the production has not kept pace with the increase in population. The annual average imports of 726,000 tons from Burma during the quinquennium 1922-26 rose to 1,136,000 tons in the quinquennium 1927-31, and to 1,690,000 tons in 1933-37. In Table IV are shown the total out-turn of rice, exports from India and imports into India from Burma during the past five years.

TABLE IV

(In thousand tons)

Year	Production of clean rice in India proper	Exports		Imports	
		Rice	Paddy	Rice	Paddy
1933-34 . . .	25,773	216	1	1,877	*
1934-35 . . .	25,706	204	4	2,594	*
1935-36 . . .	23,213	189	4	1,391	254
1936-37 . . .	27,828	235	1	1,419	121
1937-38 . . .	26,737	227	1	1,198	36

* Figures for paddy included in rice.

The exports of rice from India during the year declined from 235,000 tons valued at Rs. 2·72 lakhs to 227,000 tons valued at Rs. 2·61 lakhs. These were destined chiefly to Ceylon, Arabia, and African territories having a fairly large Indian population. Table V shows the direction of the export trade of India in rice :—

TABLE V

Exports of rice from India to foreign countries

(In thousand tons)

	1935-36	1936-37	1937-38
United Kingdom	5	8	6
Rest of Europe	4	10	6
Ceylon	72	84	91
Rest of Asia	59	69	62
Union of South Africa	19	23	23
East Africa	8	6	6
Other countries	22	35	33
TOTAL	189	235	227

Prices of rice in the Rangoon market, which greatly influence the prices in India, remained generally on a higher level in the first half of the year than in the second. The slackness of world demand for rice depressed the prices greatly and up to January, except for temporary reaction, the price fell gradually. There was a slight appreciation in the following two months.

THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH continued to promote and finance a large number of schemes for the study of rice genetics and investigation of ancillary problems of rice in various rice-growing provinces. The outstanding events concerning rice are briefly summarized below.

The life of the Standing Committee on Rice, set up in February 1936 for a period of two years, in the first instance, was extended for a further period of one year. The second meeting of the Standing Committee on Rice as reconstituted met at New Delhi on the 5th of March 1938. A Research Subcommittee held its meeting the previous day to scrutinize the progress reports of rice research schemes, and to consider applications for new schemes, and for the extension of old schemes. Apart from the circulation of notes on various subjects for the information of the members, some of the important recommendations of the committee are as follows :—

(1) New varieties intended for export should be sent to local chambers of commerce for opinion, before they are distributed to the cultivators.

(2) Among the list of subjects for the institution of medals, the design of an efficient bullock-driven rice huller should be included.

(3) The Agricultural Commissioner and the Statistician of the Council should collect further available information from the provincial Departments of Agriculture and on its basis replan new manurial experiments for the rice season of 1939.

(4) The Governing Body should approach the Government of India for allotting more funds to finance more rice research schemes.

Before the end of the year, nearly all survey reports on the marketing of rice from the provinces and states were received and the drafting of the all-India report was commenced.

The Royal Commission on Agriculture recommended that testing of new varieties should be carried out on holdings typical of the tracts for which the varieties are deemed suitable, and that the work of distribution of seed of improved varieties should continue to remain in the hands of the Agricultural Departments until reliable seed merchants come into the business. Recently Sir John Russell also, in his review on the work of agricultural research in applying science to crop production in India, stated that, though the standard of selection and breeding of new varieties has reached a high level, improved varieties have not been widely taken up by cultivators, which is due chiefly to the difficulty of obtaining adequate supply of certified seed, through lack of honest seedsmen to multiply and sell seed at a reasonable price.

As far as information is available in the reports of some of the major provinces and states, it is quite evident that the first recommendation of the Royal Commission on Agriculture, to wit, testing new varieties under ryots' conditions, is being largely followed. During the year, an elaborate scheme of testing the new selections under cultivators' conditions has been taken up by the Deputy Directors of Agriculture in the United Provinces in consultation with the research staff. It will be evident from a perusal of the paragraphs relating to the different provinces, that strains that have maintained their ascertained merit under ryots' conditions of cultivation are finally decided upon for release for general cultivation. The table below shows the estimated area cropped with improved strains of rice in the various provinces and states in India during 1937-38.

Area under improved crop (rice) in India during 1937-38 (in acres)

British India	
Madras	1,771,186
Bombay	67,442
Bengal	486,068
United Provinces	226,233
Punjab	..
Bihar	38,517
C. P. and Berar	702,562
Orissa	25,032
Assam	51,698
N.-W. F. P.	..
Sind	328,068
Total for British India	3,696,806

Area under improved crop (rice) in India during 1937-38 (in acres)—contd.

INDIAN STATES	
Hyderabad . . .	2,622
Mysore	47,122
Baroda	7,466
Travancore . . .	218
Cochin	4,697
Bhopal	16
Kashmir	Not available.
Total for Indian States .	62,141
Grand total for British India and Indian States .	3,758,947

Work in the provinces and states

A brief summary of the work in different provinces is given below :—

BENGAL. The estimated area for the year was 22,194,000 acres, which represents 29·1 per cent of the rice area in India and production 9,093,000 tons. Though the area increased by 201,000 acres, the production showed a decrease of 775,000 tons. The average estimated out-turn per acre for the province works out to 912 lb. as against 1,000 last year.

The breeding of better types of rice, for the varying conditions of the province, is undertaken mainly at the Dacca and Barisal Farms. Important items of work are also carried out on the Chinsurah, Bankura and Suri Farms, partly financed by the Imperial Council of Agricultural Research and partly by the local Government. Final tests, as regards the suitability of strains isolated in these farms, are also carried out on all other Government farms.

At the Dacca Farm observations were made on 931 pure lines of *aus* (autumn rice) varieties. A very large number of transplanted *aman* (winter rice) varieties were experimented with and a new species of oryza (*O. Barthii*) was obtained from the Kew Gardens. It is hoped that this new species will be useful for making interspecific crosses with the ultimate object of obtaining strains resistant to drought. During the year, this section took over the work on medium deep-water paddies of which there are at present 700 pure line cultures. Seventy of these could not grow over five feet rise of water and all of them succumbed. Selections are being made from the surviving pure lines to meet the varying conditions. Artificial crosses have been effected between *aus* and *aman* and various exotic varieties and their progenies are in different stages of study.

The study of the effect of dusting paddy plants with two larvicides, to wit, Paris Green, Cuprous Cyanide in 5 per cent strength, with necessary quantities of soft stone powder as the diluent, was continued. On each occasion, 20 lb. of the mixture per acre were dusted at intervals of seven days. Though the yields of the treated plots are less than the control, yet the differences are not significant.

At Barisal 164 strains from different *balam* varieties were under study and at Chinsurah 1,741 cultures were grown. In the preliminary yield trials of *aus* paddy varieties, Jhanji-34 proved superior to local Kele. In the field-scale tests of *aman* varieties, *Bhasamanik* yielded significantly higher than local

Patnai and *Nagra*. Correlation studies with 19 strains of *aman* and seven strains of *aus* paddies showed that the yield of grain is associated with weight of straw, number of tillers and height of plant.

In a factorial experiment, involving three varieties, five dates of planting from 16 July at 20 days interval, and three spacings (6", 9" and 12") and number of seedlings per hole, all the main effects and first order interactions were as in the previous year significant. All strains yielded highest in the first planting. In late planting, closer spacing with three or more seedlings gave the best yield. In another three-fold complex experiment, with age of seedlings, variety and time of planting, the primary effects and the first order interactions between dates of planting and age of seedlings were significant. Eleven weeks old seedlings in the first and second plantings gave the highest yield. The mixed cropping of a late variety as before yielded significantly less than a single late crop.

The collection of pure lines was increased from 750 to 957 during the year at Bankura. Experiments to determine suitable varieties for the different situations were continued. *Sada-aus* that proved best last year was outyielded by *Badkalamkati* 7 and 4/145 C for the higher areas. *Sundrasal* continued to maintain its place for the intermediate situations. For the lowest areas *Sitasail* was found to be significantly better than *Bhasamanik* standard. None of the Pusa varieties could compete with *Nona Ramsail* in yield.

Three cultural experiments, as in the previous year, were conducted at the Bankura Farm. As before, dibbling 9" gave the highest yield of grain. In the experiment involving the trial of different times of planting and number of seedlings per hole, yield decreased with successive periods of planting, but no difference in yield was obtained by planting varying number of plants per hole. In the third experiment on dates of planting and ages of seedlings, different dates of planting alone have significantly influenced the yield of both grain and straw.

MADRAS. The area under rice in the province for the year was 10,141,000 acres and represents 15·3 per cent of the total area under the crop in India. The estimated production during the year was 4,850,000 tons and the estimated yield per acre works out to 1,053 lb. as compared to 1,086 lb. of 1936-37. In both acreage and total production slight increases were registered over those of the preceding year.

Rice improvement work is carried out at Coimbatore, the chief centre of research, and at sub-stations at Aduturai for the Cauvery delta, Maruteru for the deltas of Godavary and Kistna and at Pattambi for the West Coast. During the year under report, two small rice research stations were opened at Buchireddipalayam, in the North Pennar Delta and at Ambasamudram, in the Tamparabarani basin.

At Coimbatore a strain from Sendinayagam of Tinnevelly district, yielding 13 per cent over the ryot's bulk, was released as Co 12. Similarly, three strains, to wit, Mtu 12, in Pedha-Atragada, Mtu 13, in Delhi Bogham and Adt 16, yielding 27·8 per cent over ryot's bulk in Konakuruvai, were released from the respective sub-stations. Promising cultures in half a dozen important varieties await trials in the district. In addition, over 1,500 pure-line cultures from many important local varieties of paddy of the province were under different stages of testing at all the rice stations.

Two synthetic strains isolated from a cross between Co 3 and a thick straw type from Burma continued to be promising in the trials in the district for their non-lodging character and high yield in low-lying areas. It was also reported that they withstood even submersion for short periods. Three hybrid strains isolated for blast resistance were again found to be free from the disease when grown among varieties that were badly affected by blast (*Piricularia oryzae*). One of them was also noticed to stand somewhat alkaline conditions. At Aduturai, a synthetic culture, 7,306, isolated from a cross between Adt 3 Kuruvai, a three-month short duration coarse variety, and Adt 2 White Sirumani, a six-month variety, satisfied a long-felt need for a three-month duration Sirumani type suitable for export to Ceylon.

Six promising cultures isolated from Geb 24 X-ray progenies were selected for yield trials. Four dwarf mutants selected from the same X-ray material, though tillering profusely and yielding better than Geb 24, are unfortunately prone to lodging under manured conditions. Some of the other methods of inducing mutations, such as heat and cold treatments to new and old seeds, have also been taken up.

At Coimbatore dibbling in dry gave higher yield than transplanting. At Pattambi broadcasting early in the first crop season again proved more profitable than broadcasting late after the commencement of the monsoon when transplanting is to be preferred. In spacing experiments, at the different agricultural research stations, close planting has given better yields. Higher yields were also obtained by increasing the number of seedlings per hole with wider spacing. In the experiment to ascertain the effect of grading seed by means of concentrated brine solution, no advantage was gained by such a grading, though in a short duration variety heavy seed seemed to give better results than light but not over ungraded seed. It therefore seems that no particular advantage is gained by processing the seed paddy more than the normal methods of cleaning. The results of irrigation experiments conducted at Coimbatore indicate the desirability of irrigating the rice crop with large supplies at wide intervals.

At Coimbatore the application of superphosphate to seed-beds was without effect on the crop. However, superphosphate applied to the crop at planting was more effective than at other periods of growth. At Pattambi groundnut cake or green leaf manure supplying 30 lb. nitrogen gave an increase of 25-30 per cent over no manure. When sulphate of ammonia is applied as a top dressing to the same plots, the increase over no manure was 40 to 60 per cent. The subsidized manurial experiment at Maruteru terminated at the close of the three-year period. A summary of the findings is given below :—

(i) Application of green leaf at 4,000 lb. per acre to *dalca* (spring) crop was distinctly beneficial and better than the application of 2,000 lb.

(ii) Over a basal dressing of green leaf at 4,000 lb. to the acre, the optimum economic dose of top dressing consisted in the application of 32 lb. of nitrogen and 32 lb. of phosphoric acid per acre.

(iii) No residual effect of the application of manure to the second crop was visible on the succeeding first crop.

Bihar. During the year the area under rice was 9,513,000 acres, representing 13·6 per cent of the rice area in India. The estimated production for the

year was 3,144,000 tons, which works out to 740 lb. per acre as against 756 lb. per acre during 1936-37. In both acreage and yield slight decreases were registered over those of the preceding year.

The large collection of 5,000 samples of rice varieties was studied and reduced to 1,200 units, representing the varieties grown in the different paddy tracts of the province. This provides the material from which high-yielding strains with desirable qualities can be selected. Half a dozen selections, to wit, 115 BK in the early group, 16 BK and 88 BK in the medium and 36 BK and 76 BK in the late group, out-yielded the standard variety by about 15 to 20 per cent. About 200 pure lines have been isolated from among the South Bihar materials. Varietal trials of the selections for South Bihar, at a number of farms, resulted in the isolation of four promising cultures in early, three in medium, and five in the very late group for further trial.

In some tracts the intrusion of wild rice in the cultivated crop is a regular menace. A fully pigmented variety is periodically grown to recognise and eradicate the non-pigmented wild rice appearing in the crop. As the rice colour of the pigmented variety now cultivated is red and poor in yield, pigmented white rice selections from suitable crosses have been isolated and are under study.

The experiment on spacing and number of seedlings planted in each hole has shown that wider spacing (9″) with two to three seedlings per hole is definitely more advantageous than the local practice of planting in bunches 4″-6″ apart. The former practice not only gives higher yield but also reduces the cost of transplanting, which is also done more expeditiously.

At Sabour the application of sulphate of ammonia at the rate of 100 lb. per acre resulted in a clear profit of Rs. 9 per acre. In areas deficient in phosphates, the addition of superphosphate has been found to be more profitable than the application of such compound fertilizers as Niciphos. Studies in the time of application of fertilizers showed that they are best applied when the seedlings are more or less established, say two to three weeks after transplanting. Experiments on green manuring are in progress.

Investigations on the water requirements of the rice crop have established the low transpiration rate of the drought resistant selections and that the maximum requirements of the plant for water occur two to three weeks before flowering. The work done in this respect also seems to indicate that, once the transplanted crop has been established, standing water is unnecessary for the optimum growth of the crop, and it would further appear that a cracked condition of the soil, once the plants are well established, gives the maximum yield in the case of all rice varieties, early or late.

Studies on salt tolerance have established the possibility of gradually inducing the rice plant to withstand a certain degree of salinity by pretreating the seeds with minute doses of common salt. Such pretreated seeds have been grown in natural and artificial saline soils and have given 30 to 40 per cent higher yield than the untreated seeds grown under similar conditions. Investigations on the effect of increased day-length on flowering time have opened out a new field for crossing varieties which flower at different periods and thus bring about new combinations of desirable characters present in varieties ordinarily flowering at different times of the year.

THE UNITED PROVINCES. In the United Provinces 7,004,000 acres of rice produced 2,017,000 tons during the year. This represents about 9 per cent and 8 per cent of the total acreage and production respectively of rice in India. Both in area and out-turn appreciable increases were recorded over that of the previous season.

Research work on rice is chiefly carried out at Nagina Rice Station, financed by the Imperial Council of Agricultural Research. Cultures numbering 1,650 were under study during the year. The study of cross progenies involving the *Sathi* parent which is early and immune to *gundhi* fly (*Leptocorisa Varicornis*) formed the main item of work. As a result of this research, five pure-breeding hybrid strains, with high yield and desirable characters, have been isolated. Of the three hybrid strains, viz. H 33, H 108 and H 755, marked out in other economic crosses, strain H 108 has been found suitable for the Sarada Canal area in the place of T 12 already in distribution.

In manurial trials the effect of the application of sulphate of ammonia (60 lb. nitrogen) was pronounced and more so when this quantity is applied in two or three doses. Green manuring with *sanai* (sunnhemp) of seven to nine weeks' growth was more effective than *sanai* of five weeks' growth, and all treatments better than no manure. Molasses, applied either at the rate of 100 or 200 maunds per acre, resulted in a substantial increase in yield whether applied one or two months before planting, though application just before planting was previously found to be harmful to the crop.

ORISSA. The area under rice during the year was 5,060,000 acres and production 1,623,000 tons. Both the area, representing very nearly 7 per cent of the area in India, and production show but a very slight increase over that of the previous season.

Research on rice in this province, mostly financed by the Imperial Council of Agricultural Research, was continued at the Cuttack Farm and at two sub-stations, one at Berhampore, transferred from Madras, and the other newly opened at Koraput, in the Jeypore Agency.

At Cuttack, in the preliminary yield trials, a number of types in different classes of paddy yielding 15 to 30 per cent higher than the standard varieties were marked out for further trials. In the place of Kujang No. 2, another salt-resistant strain, No. 100, has been released for general cultivation. Promising selections in *dulua*, viz. Nos. 3 and 4, and Dl 8 are being multiplied for distribution. Winter paddy seeds which are dormant after harvest when subjected to smoking for two hours daily for two or three days induced viability in them, while treatment with anæsthetics and high temperature was without effect. All the items of work in progress at Berhampore at the time of taking over from the Madras Government, except agronomic experiments, were continued. Barhampore strains, 1 to 10 already released, are quite promising and large-scale distribution of seed has been undertaken. Promising types of Cuttack were also tried with success at Berhampore.

At Koraput the work was mostly confined to the layout and construction of buildings. Seventy-five local samples together with the promising types isolated at Berhampore and Cuttack were grown and 300 samples were collected for future work.

CENTRAL PROVINCES AND BERAR. During the year under report the estimated area was 5,704,000 acres and represented 7·9 per cent of the area under

rice in India, while production was 1,552,000 tons and worked out to 588 lb. per acre as compared to 689 the preceding year. The seasonal conditions were on the whole favourable for the crop; the average out-turn for the province as a whole was, however, 92·3 per cent of the normal.

The improvement of the rice crop in the Central Provinces is being directed firstly to get high yielding fine rice strains, secondly to improve the yield of coarse rices, and thirdly to eradicate wild rice. The work in all these directions has reached the stage of showing practical results.

Hybrid No. 19 between *Budhiabako* and *Parewa*, evolved to meet the demand for a high yielding fine rice which can also be distinguished from wild rice, has been largely distributed in the eastern circle. Yield trials over a period of five years at research stations and in the districts have demonstrated the superiority of hybrid strains No. 116 and No. 22 over the standard varieties *Bhondu* 10 and *Parewa* 22. Of the eleven cultures of EB 17 × *Nagkesar* under trial, hybrid 9 recorded the highest yield, exceeding the parent *Nagkesar* by 19 per cent. Inter-varietal trials were carried out for four years at Raipur, Woraseoni and Jubbulpore for the isolation of high yielding strains suitable for the three main rice growing tracts of the province. At Raipur EB No. 17 of the early, *Budhiabako* of the medium, and *Luchai* 4 and *Chinoor* 21 of the late maturing group gave the highest yield. At Waraseoni *Sultugurmatia* and *Jalchinga* among the early, *Budhiabako* and *Lalgurmatia* among the medium duration varieties and *Luchai* 4 and *Ajam* of the late varieties yielded better than the local standard variety. Trial at Jubbulpore marked out *Dilpasand* and *Sultugurmatia* in the early and *Motichur* in the medium duration varieties as the best yielders.

Selection work in fine-scented varieties *Chhatri Kubrimohar* and *Banspatri* is in progress. Outstanding among them is selection No. 40 from *Chhatri*, which out-yielded the standard by 32 per cent.

Studies in the development of the root system of rice confirmed the observation recorded in the previous season. The average dry weight of roots per plant from the transplanted crop was more than in *biasi* (broadcast and later cross ploughed).

In manurial trials the application of phosphoric acid at 20 lb. per acre as superphosphate gave a net profit of Rs. 3-12 per acre, while 20 lb. of phosphoric acid with 20 lb. of nitrogen as sulphate of ammonia resulted in a net profit of Rs. 2-14 per acre.

The Agricultural Chemist to Government, Central Provinces, continued his investigations of soil profiles and the losses of valuable plant food through leaching from different types of rice soils. *Matasi* (25 per cent clay) soils are very poor in calcium carbonate throughout the profile and contain a low proportion of clay and a high percentage of fine sand, the former generally increasing and the latter decreasing with the depth of the soil. They are poor in total exchangeable bases and organic carbon. The proportion of organic carbon, carbon nitrogen ratio and the percentage of organic matter humified decrease with the depth of the soil. *Dorsa* (48 per cent clay) soils contain a high proportion of clay throughout the profiles. A high percentage of calcium carbonate is present at lower depths. They are richer than *matasi* soils in total exchangeable bases, phosphoric acid, organic carbon and humus. Percentages of organic matter humified increase with the depth of the soil. *Kanhar* soils

are more or less similar to the heavy type of *dorsa* soils except that the percentages of organic matter humified do not show any variation in the different depths of soil.

In the case of *dorsa* soil, quantities of the leachates obtained at different periods are strikingly lower than those obtained from the light *matasi* soils.

In ASSAM the rice area during the year under review was 5,056,000 acres, representing nearly 7 per cent of the total area in India and recorded a decrease of 378,000 acres over the previous year. The estimated production of 1,745,000 tons shows a decrease of 159,000 tons over the last season.

Research work on rice is concentrated at the Government experimental stations at Karimganj Titabar and Habiganj, the last of the stations alone being financed by the Imperial Council of Agricultural Research.

At Karimganj of the 916 pure-line types and 698 hybrid types under observation, 34 of the former and 32 of the latter groups were also under preliminary yield trials. In the final varietal trials, one hybrid in *sail* (transplanted winter rice) (SC 415-56) and one in *asra* (shallow water winter rice) (ArC 614-25), being definitely superior to the standard varieties, were multiplied for distribution. For late planted areas, after late floods, Jharisail is recommended.

At Titabar, 966 pure-line types and 1,241 hybrid types were under observation. In the final varietal trials, one hybrid strain (SC 308-372) in *sail* yielded higher than S 115 Latamargan, the standard variety. The manurial experiment in *ahu* (autumn rice) with different doses of cow-dung (0-100-200-300 maunds per acre) conducted in the previous season to assess their residual effects was continued. The application of 300 maunds gave significantly higher yields over the rest. Topping of the rice crop twice during its vegetative growth resulted in giving more fodder than once and that without a reduction in grain yield.

Two factorial experiments with *sail*, involving four dates of planting, three numbers of seedlings per hole, three spacings and three varieties at Karimganj and three ' ages of seedlings ' instead of varieties at Titabar, showed that all the primary effects were significant except the age of seedlings at Titabar. Of the first-order interactions those between spacing and number of seedlings, spacing and time of planting, and number of seedlings and dates of planting were significant at both the places, while at Karimganj, those between varieties and dates of planting, spacing and variety, and number of seedlings and variety were insignificant. Both the second and the third order interactions were insignificant at Titabar, while at the other place, that between spacing, number of seedlings and time of planting was the only significant one.

The improvement of *boro* (spring rice) and deep water *aman* paddies was continued at Habiganj. 630 cultures in *aman* and 580 in *boro* were under observation. Seventy-four strains from the important commercial classes of deep-water *aman* varieties were under yield trial. In order to meet the persistent and immediate demand for improved *aman* seed, three promising types suited to three different levels of 6-7, 8-12 and over 12 feet depth of water, yielding on an average 40 maunds per acre, were issued to the cultivators.

The relationship between plant growth and water rise were studied for successive years in a number of *aman* types. Some of the important observations made, so far, are summarised below :—

Quick water rises result in the elongation of internodes, while slow water rise results in shortening the internodes. If the water level becomes stationary, nodal branching sets in, instead of an increase in height. The vigorous nodal tillers eventually produce ears and contribute towards the final yield. The formation of roots at the nodes, with the rise in water, is another feature of deep-water paddies. Varieties which grow faster than others before the arrival of the flood are not necessarily more flood resistant than the slow growing types. In point of withstanding submersion, some types can stand a longer period of submergence than others, while, some can, if water rise becomes stationary, grow and come up again above the water level. The power of withstanding submergence increases firstly with the age of seedlings up to four weeks, and secondly with the duration of the varieties, the early varieties being quicker in growth than the late ones. Plants of *aman* varieties in deep-water areas are also susceptible to uprooting usually when the flood water begins to recede. Cultivators protect the crop from washing away during the receding floods by erecting bamboo enclosures, known as *arhs*.

In *boro* 84 cultures were under preliminary yield trials. A good many of them have given 25-50 per cent better than local unselected bulk. In order to meet the demand for improved *boro* seed, one of the strains with blackish-brown furrow husk was distributed in the Assam Valley where the area under *boro* has increased considerably under pump irrigation. Very favourable reports from the districts have been received about their performance, the maximum yields reaching as high as 51 maunds per acre.

Under agronomic experiments in *boro*, significant differences were once again recorded between broadcasting and transplanting. In a factorial experiment, with age of seedlings and time of sowing, it was found that yields progressively decreased as the transplanting season advanced from the 28th December to the 18th of January. Five and six weeks old seedlings were found more suitable than seedlings of four weeks. In the comparison between *aus* and *tupa*, *aus* gave a higher yield than *tupa*. Further, a gradual increase in yield of *aus* from year to year indicates the possibilities of acclimatising *aus* varieties for the *boro* season.

BOMBAY. This province contributed roughly 2·5 per cent of the total rice area in India, or 1,867,000 acres and produced 860,000 tons of rice, working out to 1,083 lb. per acre as against 860 the previous year.

The improvement of the rice crop of the province is carried out at the rice breeding stations opened in the important rice growing tracts. During the year under review, four promising Mugad and three Antersal strains gave significantly higher yields than the locals at the Mugad Rice Breeding Station. They have also been multiplied for distribution. Study of the selections in the early variety Dodgya is in progress.

At the Kumpta Farm strains in Maskathy, Juddu white and red Halga, and Mugin Bendu yielding between 9 to 30 per cent over the local varieties have been carried over for further trial.

At the Karjat Rice Breeding Station work on the improvement of the rices of the Deccan, Thana and Kolaba tracts of the Konkan is being done. Z 149, a strain in Zinya, a variety grown in North Thana, though only slightly better in yield, is much appreciated for its quality. Trials of a late strain, Varangal No. 487 and Fine Waksal No. 1 conducted at Chiplun, recorded

increases of 17·34 and 21·7 per cent over the respective local bulk seed. These two strains are proposed to be tried in the district in the next season.

SIND. The estimated area in Sind during the year was 1,231,000 acres, showing an increase of 49,000 acres as compared to the area in the previous year. The production of paddy also shows an increase of 12 per cent over that of the previous year, the actual estimate being 519,000 tons. The main problem of the Barrage area, so far as rice is concerned, is to evolve high yielding varieties that would stand early transplanting in May and June, while in the non-Barrage area the problem is to select early maturing varieties of rice to suit the new condition of water supply for a shorter period, late in the season. Research work on rice is carried out at Larkana Farm, with a small sub-station in the Fuleli tract in Lower Sind.

In the Barrage canal areas improved strains—Kangni 27, Jajai 77, Prong 37—and hybrid strains—Silver Jubilee, 34-267-51 and Kangni × Torh cross 16-1-28— are finding great favour with the cultivator.

In North Sind under inundation conditions Kangni 27 and Bengalo No. 1 (Sugdasi variety) are being recommended. In Lower Sind in Fuleli canal areas New Types 'Y' and the improved strains of Ratrya and Motya are being distributed. In the Karachi district the early ripening type, Kangni 27, is being introduced for high lands; while Jajai 27 and hybrid strain 34-267-51 have been found to withstand deeper water.

Monthly planting trials with Kangni 27 and Silver Jubilee conclusively proved that planting in the month of June is superior to July in both the varieties. The results of the experiment laid out to test the relative tolerance of fine varieties of rice to *kalar* in the soil (soil with a high proportion of sodium chloride, sulphate and carbonate) showed the superiority of Torh and Torh cross 16-1-18 over the other four varieties. In a rate of sowing experiment, the lower seed rate of 26 seers gave as good an yield as the high rate at 40 seers used by cultivators.

PUNJAB. Breeding work on rice is carried on at the rice farm at Kala Shah Kaku. Among the approved varieties 349 Jhona and 370 Basmati continue to hold the field. As a result of wide-spread demonstration arranged in collaboration with the Public Works Department officers in the Upper Chenab canal area, selections 346 Mahlar, 246 Palman and 225 Son have found favour with cultivators.

Rice work carried out for the past two years at Saloh in the Kangra district was transferred to Nagrota Bagwan. Thirteen commercial varieties are under observation. The local practice of *hodding* of the *vattar* sown crop gave 25 to 75 per cent increase over the non-*hodded* crop.

The area under rice in the Punjab was 1,086,240 acres as against an area of 1,039,498 acres in 1936-37. This increase is due to sufficient rainfall received at the sowing time. The total out-turn estimated was 546,000 tons, 22 per cent above the normal.

HYDERABAD. The area under rice in this state was estimated to be 962,000 acres during the year, showing a decrease of 173,000 acres compared to that of the previous year. Similarly, the estimated production of 368,000 tons is 50,000 tons less than that recorded in the previous season. Selection work in rice is being continued. Two strains, Himayatsagar No. 263 and 504, are under distribution.

KASHMIR. Rice occupies about one-third of the total cultivated area in the State and is also largely grown in the Jammu province in the canal irrigated areas.

Selection work in rice is conducted on the Pratap Model Farm. Baber selection No. 103, Budiji 111 and 118, Lolawzen selections 1 and 2 and Myshka-budiji selections 40 and 25, which have yielded up to 19 per cent over the local during the past three years, are being multiplied for distribution.

MYSORE. The area under rice in the state was 707,000 acres and production 229,000 tons. Both the acreage and yield during the year under review declined by 17,000 and 7,000 tons.

Rice improvement work is carried on at the Nagenohali Farm which is also the source of supply of pure seed of improved varieties of rice in the state. Selections 661 and 682, strains in Maharaja Bhogam, though yielding well, are not finding favour with the cultivators on account of the high percentage of unset grains compared to other varieties. Two Italian varieties said to be resistant to *blast* (*Piricularia oryzæ*) were added to the collection of varieties.

TRAVANCORE. Rice is the most important crop in the state, occupying 663,000 acres and is the staple food of the population. Nevertheless, local production, being short of the home demand, is largely supplemented by imports from Burma. Seven improved strains, TEB 1 to 7, have been distributed in the Nanjanad area. Selection work in Valseramundan, Jemboly, Veeryavadankan and in some short duration varieties was continued. In varietal trials, Veeryavadankan did well in South Travancore, while GEB 24 appears to suit areas round about Shencottah.

COCHIN. As in the neighbouring Travancore State, rice is the staple food-crop of Cochin State. A number of varieties cultivated during *viruppu* (first crop, May to September) and *mundakan* (second crop, October to January) were under observation. Cochin 1, a selection in Chitteni, is getting popular on account of its shortness in duration, ensuring a sure second crop. The question of selecting suitable salt-resistant varieties for the backwater areas is engaging the attention of the state Agricultural Department.

DACCA UNIVERSITY SCHEME. This scheme is financed by the Imperial Council of Agricultural Research and deals with mechanical analysis and study of physico-chemical properties of laterite soils and nutrition of the rice plant (at Dacca).

In the last year's review, observations were made on the profile characteristics of laterite soils in India. During the year, analyses of the different horizon samples of the soil profiles examined are in progress.

A detailed study was made on the assimilation and translocation of nutrients in the rice plant grown in (i) a field unmanured for many years and growing rice every year, (ii) same as (i) but manured with Nicifos and lime, and (iii) water culture. The scheme which has been running for eight years was extended for a period of two years and the portion of the work relating to the nutrition of the rice plant is proposed to be written up for publication.

Investigation on the quality of rice

The study on the quality of rice was continued during the year at the Indian Institute of Science, Bangalore, in its two main aspects, the chemical

and the biological. The scheme, which was due to expire at the end of May 1938, was extended by one year.

Perhaps the most important finding from the present enquiry is that rice is inherently very much more nutritious than commonly believed. The poor quality of the food that is eaten by a large section of the population in India is traceable to (i) the prevailing taste for white and small-grained varieties of rice, (ii) the process of polishing which removes the major part of the valuable phosphorus and a considerable part of the nutritious protein in addition to the essential vitamin, (iii) the practice of thorough washing (before cooking) which removes a considerable part of the residual phosphorus, and (iv) the present method of cooking, involving drainage of gruel and consequently further loss of nitrogen and phosphorus. Evidence has been adduced to show that some of the coarser and coloured varieties are very rich in the essential constituents and, if cooked without polishing and without extra washing, are nearly as rich as wheat.

The factors affecting the keeping quality of rice have been determined, and it has been shown that the poor keeping quality of unpolished rice is essentially due to oil contained in the embryo and the outer integuments of the grain. It is possible, by suitable control of humidity and storage methods, to prevent or at any rate greatly minimize the deterioration of hulled rice on storage, but further efforts should be made to improve the keeping quality so as to be readily applicable in practice. Parboiled rice has got much better keeping quality than raw rice, even when unpolished.

Extensive feeding experiments with different rice varieties on young rats and pigeons have shown that growth is essentially correlated with composition; particularly protein and mineral contents of the rice sample. Coloured and coarse varieties induce better growth in animals, on account of their higher protein and mineral contents. One of the factors determining growth-rate appears to be the level of protein supply and in this connection it is important to determine the supplements needed to make rice a wholesome diet. The availability of the different constituents of rice and the means of increasing them are under study. The effect of parboiling and of polishing on rate of growth with young rats is also being followed.

The chemical composition and nutritive value of rice varieties grown under (i) irrigated, transplanted, (ii) irrigated, broadcast and (iii) dry broadcast conditions have been studied. Dry cultivated paddy was found to be the least nutritious when compared with wet cultivated rice.

2. Wheat

The world production of wheat during 1937 was reported to be very good after nearly three poor seasons, owing to the increase in acreage under the crop, especially in North America and the United States. This, coupled with a probable decrease in the requirements of the importing countries, is expected to replenish reserves of wheat which had been continuously declining from 1933-34.

The area under wheat in India in 1937-38 was 35,618,000 acres as against 33,237,000 acres in 1936-37 and the yield 10·8 million tons in 1937-38 as against

9·8 million tons the previous year. This increased production, combined with better prices obtainable for wheat in the world market, encouraged exports from India during the year under report. The total quantity of wheat exported from India during 1937-38 amounted to 460,000 tons valued at Rs. 462 lakhs as compared with 235,000 tons valued at Rs. 212 lakhs in the previous year. The prices of Indian wheats, which rose considerably during 1936-37, however, showed a sharp decline towards the end of March 1938. This break in prices is largely due to the recession in commodity prices which started during the second half of 1937 and the unfavourable statistical position of wheat in the world. The fact that the Indian crop of wheat in 1936-37 was a good one and it was followed by a better one in 1937-38 also contributed to the depression in prices.

Breeding

SIMLA. In connexion with the work on breeding rust-resistant wheats F_3 populations of nine crosses were under study. Out of a total of 4,521 plants, 1,631 proved to be resistant. Plants were selected on the basis of rust resistance and other desirable characters for growing the F_4 generation. The study of the F_1 populations of a number of crosses made last year showed susceptibility to be dominant to resistance. The F_1s of two crosses made with Khapli (resistant parent) as one of the parents died without giving any seed. Several new crosses were made between Indian varieties and foreign resistant types.

The study of the 40 hill varieties collected in previous years disclosed their unsuitability for breeding purposes. Some more material was collected during the year. A large number of exotic wheats was under observation with the object of discovering varieties suitable for breeding work.

DELHI. At the Imperial Agricultural Research Institute work on breeding of non-shattering strains of Pusa 114 and Pusa 120 was continued and a number of promising selections were made for further trial.

BOMBAY. In the Bombay Province the testing of selections from the various crosses was continued and further promising material carried forward for trial. Seeds set from open pollination of the sterile F_1 plants of the crosses between rust-immune Russian wheats and improved varieties again yielded sterile plants, which were further back-crossed with a number of types during the year. Six seeds were obtained from these crosses and they will be sown next year.

PUNJAB. The trial of cross-bred strains was continued. C 400, which had done consistently better than 8A at the Rawalpindi Farm for the last seven years, has been finally selected for further trial under *barani* (rain-fed) conditions at Gurdaspur and Rawalpindi. There are preliminary indications that C 228 may give under late sown conditions better yield than any other wheat hitherto available.

The two new wheat breeding sub-stations at Rawalpindi and Gurgaon started work during the year.

CENTRAL PROVINCES. Testing of strains obtained from previous research was continued. Several intervarietal and interspecific crosses were also under

study. The F_1 plants of the cross between *Triticum vulgare* (AO 13)×*T. durum* (No. 58) were backcrossed with *T. dicoccum* and those of *T. durum* (No. 58)×*T. dicoccum* (Khapli) with *T. vulgare* (AO 13) with the object of transferring the rust-resistant quality of Khapli to the high yielding *vulgare* wheats. The cross between *vulgare*×Khapli which proved a failure in previous years was successfully effected during the year. The *Amphidiploid Aegilotricum* with $2n=56$ chromosomes was also crossed with *T. vulgare* ($2n=42$).

The four partially rust-resistant types that were isolated from among a collection of foreign varieties tested during the previous year were used as parents in new crosses.

The crosses between A115×Pusa 4, A115×Pusa 52, AO 68×Pusa 4 and AO 68×Pusa 52 were grown at different centres and desirable single plants with rust resistance isolated.

SIND. The work of breeding high yielding, early maturing good quality wheats with rust resistance was continued.

Varietal trials, seed multiplication and distribution

In the varietal trials conducted by the Imperial Agricultural Research Institute at KARNAL, Pusa 125 was the most successful among early strains, while Pusa 124 and Punjab C 518 did very well among the late maturing ones.

At the Botanical Sub-station, PUSA, seven Pusa wheats were tested for yield with Cawnpore 13 and Punjab C 518 in replicated randomized blocks and the results showed Pusa 80-5 to be the best yielder with Pusa 165 as the next best.

In BOMBAY, the standard strains Bansipalli 808 and 224 were multiplied each on half an acre for maintaining the chain of pure seed supply. Altogether 1,140 lb. seed of various strains were distributed.

C 518 and C 591 continued to be the most popular strains in the PUNJAB. The department distributed 26,000 maunds of pure seed of C 518 and 1·75 lakh maunds of C 591 during the year. In comparative trials in departmental farms both the strains outyielded 8-A. In 15 out of 16 trials C 518 outyielded 8-A on soils with productivity by more than 19 maunds per acre and C 591 in 23 trials out of 30 gave increased yield of 6 maunds 6 seers per acre over 8-A.

In the CENTRAL PROVINCES, the two strains Nos. 76 and 267, derivatives from crosses between A 115 and Australian and Palestine wheats, maintained their reputation as good yielders in field-scale trials at Adhartal and Powerkhera Farms. Three new strains were also released for field-scale trial and multiplication during the year.

In SIND, three selections, including C Ph 47 which proved to be the best yielder in last year's trials, were tested against Punjab and Pusa wheats in replicated plots at Sakrand and the results indicated that C Ph 47 was again the best yielder with 2,441 lb. per acre. Out of the hybrid strains tested at the agricultural station strain No. 139 derived from the cross A T 38 × Pusa 12 gave significantly higher yield than the others with 2,483 lb. per acre. Several

comparative yield trials were also conducted in the districts all over Sind to find out the types suitable for the different tracts. It was found that under irrigated conditions in North Sind C Ph 47 stood first in point of yield with A T 38 as a close second. In Hyderabad division, Punjab 8-A gave the highest yield and under *bosi* (without cold season irrigation) conditions A T 38 and C Ph 47 did very well.

In the varietal trials with Pusa wheats carried out in BENGAL, Pusa 52 topped the list as in the previous year.

Results of several varietal trials conducted by the INSTITUTE OF PLANT INDUSTRY, INDORE, with outside strains against Indore selections both in bread wheats (irrigated) and *durum* wheats (rain-fed) disclosed significant differences in only two of the trials. Among the outside wheats Punjab C 591 appeared to be the most promising both on account of its good quality and rust resistance.

In the Jammu Province the demand for Punjab 8-A, C 518 and C 591 is very keen and even increasing while in KASHMIR local selections of white wheat and the newly introduced Australian varieties are in great demand. Punjab wheats do not fare well in Kashmir owing to the difficulty experienced in threshing them which may be due to climatic conditions.

Miscellaneous

Registration of wheat varieties. At the suggestion of the Wheat Committee of the Imperial Council of Agricultural Research work on the registration of wheat varieties has been kept in abeyance pending the publication of the recommendations of the Committee appointed to report on cotton and rice nomenclature.

Vernalization studies with wheats were continued at the Imperial Agricultural Research Institute, NEW DELHI.

Physiological research. At the BENARES HINDU UNIVERSITY work was in progress to ascertain the growth and protein content of wheat as affected by variations in soil moisture and soil nitrogen. For better protein formation and accumulation in wheat both nitrogenous and phosphatic fertilizers are essential and that they are best applied half at germination and half one month later. The optimum moisture content in soil for protein formation is in the vicinity of 35 per cent of the moisture-holding capacity.

During the year under review 6,929,628 acres were cropped with improved strains of wheat in the various provinces and states exclusive of Baluchistan, Orissa and Kashmir for which figures are not available.

3. Cotton

During the year under review, the area under cotton in India rose to 25,583,000 acres from 24,759,000 acres in 1936-37, the increase being recorded mainly in the Hyderabad State, the Punjab, the Central Provinces and Berar and Sind The ascertained area under improved strains during the year was 5,537,000 acres or 22 per cent of the total. The total estimated out-turn for

1937-38 was 5,663,000 bales of 400 lb. each, against 6,204,000 bales in 1936-37, the average yield per acre being 89 lb. and 100 lb. respectively. The drop in yield per acre was reflected principally in the cotton tracts of the Punjab, Sind and the Central Provinces and Berar, which registered reduced total out-turns in spite of increased acreage. Unfavourable weather conditions were mainly responsible for this. The quantity of cotton pressed, including loose cotton consumed in mills in India during the year, and extra-factory consumption of cotton taken at 450,000 bales, the new figure adopted amounted to 6,332,000 bales of 400 lb. each.

The exports of Indian cotton during the season totalled 2,100,095 bales of 400 lb. each, against 4,267,267 bales during 1936-37, the fall being due mainly to unfavourable parity (price of Indian cotton expressed as a percentage of American) and reduced takings by Japan.

According to the statistics published by the International Federation of Master Cotton Spinners' and Manufacturers' Associations, the world's estimated total mill consumption of Indian cotton amounted to 5,863,000 bales during the year ending 31 July 1938, against 6,022,000 bales during the corresponding period of 1936-37. For the year ending 31 August 1938, the total consumption of Indian cotton in mills in India reached the peak figure of 2,993,839 bales of 400 lb. each, against 2,631,296 bales for the corresponding period of the previous year (including Burma up to 31 March 1937). Imports of cotton into the United Kingdom dropped to 375,358 bales from 658,383 in the previous year.

In order to arrive at a decision as to whether the standard yield figures for cotton in the Punjab required revision, one of the members of the staff of the Indian Central Cotton Committee was deputed to examine and report on statistical data collected by the Punjab Agricultural Department. As a result of this examination, the standard yield figures for cotton in the Punjab have been raised.

The results of the enquiries undertaken by the Indian Central Cotton Committee into the village or extra-factory consumption of cotton in India, referred to in the last review, have since been published in a booklet entitled *General Report on Nine Enquiries into the Village or Extra-factory Consumption of Cotton in India, 1933-36*. On the basis of the investigations carried out, a recommendation has been made suggesting the adoption in official statistics of 450,000 bales as the estimate for extra-factory consumption of cotton instead of the previous conventional estimate of 750,000 bales.

Statistics were compiled and published as usual dealing with the consumption of Indian cotton by Indian mills, the distribution of the crop by staple length and receipts of cotton at mills, exports by sea and stocks held in India classified according to varieties.

Cotton legislation

The Bhopal Cotton Control Act was passed into law during the year. It follows the lines of similar Acts in force in Bombay, Madras, the Central Provinces and Berar, the United Provinces and the Baroda State, and aims at promoting the cultivation of superior cottons and prohibiting the growth of inferior cottons.

The application of the Cotton Transport Act in the Baroda State was extended during the year by the issue of a notification by the Durbar declaring the Mehsana district to be a protected area and prohibiting the import into it of outside cotton either by road or rail, except under licence.

During the year a few cases of infringements of the Cotton Ginning and Pressing Factories Act were brought to the notice of the provincial or state authorities concerned. Most of these were in connexion with the marking of bales—the marks being incorrect, indecipherable or mutilated. In the Punjab three cases were instituted against factory-owners for infringement of the Act with regard to structural requirements.

The Vaktapur taluka (Western India States Agency) introduced legislation for the marking of bales and submission of weekly press returns, thus bringing the number of Indian states having such legislation to 70.

The Government of Madras have drafted a bill for the licensing of ginning and pressing factories on the lines of similar legislation in force in Bombay, with a few additional clauses to suit local conditions. One of the clauses of the draft bill contains provision to the effect that ' no cotton which is ginned or pressed in a cotton ginning or pressing factory shall contain any admixture of cotton without specifying the fact conspicuously on the outside of the bale or *borah* in the prescribed manner, and that every bale or *borah* of cotton not bearing the mark " mixed " shall be considered as containing pure cotton '. As this provision is opposed to the Indian Central Cotton Committee's policy in connexion with the mixing of cotton, a recommendation has been made to the Madras Government for its deletion.

Malpractices

Complaints received regarding watering of cotton at certain centres in the Punjab, the Baroda State and the Central Provinces and Berar were reported and the attention of the authorities concerned was drawn to them.

Cotton markets

Four new cotton markets were established under the Bombay Cotton Markets Act, viz. at Broach, Bijapur, Jalgaon (East Khandesh) and Dondaicha (West Khandesh), thus bringing the total number of regulated markets in the province to nine. In Madras, the question of establishing additional markets has been deferred as the Madras Government are not quite satisfied at present with the working of the Tiruppur cotton market. It has since been suggested to that Government that if another experimental market were tried at a less complicated centre better results might be achieved.

The Agricultural Produce Markets Bill for the better regulation of the purchase and sale of, and the establishment of markets for, agricultural produce, including cotton, was introduced in the Punjab Legislative Council.

No further progress has been made in connexion with the provision by the Indian Central Cotton Committee, in cooperation with All India Radio, of a limited number of rural broadcast receivers in suitable markets for the broadcasting of cotton prices.

In connexion with the adoption of a definite cotton policy in Gujarat, was felt that the crux of the whole problem centred round the better marketing

of 1027 ALF cotton in the Surat district and that the Agricultural Produce (Grading and Marking) Act should be utilised in order that 1027 ALF might be marketed as a special variety of Surat cotton. The first step in this direction has been given effect to by the Government of India by amending the schedule to the Act to include cotton. The question of framing suitable rules applicable to cotton is under consideration.

Universal standards for selected varieties of cotton were passed as usual by the Standards Sub-Committee of the Indian Central Cotton Committee in collaboration with the East India Cotton Association and the Karachi Cotton Association.

Seed distribution

With a view to making the results of botanical and other research available to the cultivator, the Indian Central Cotton Committee finances schemes for the supply of pure seed of improved varieties of cotton. The number of such schemes in operation at the commencement of the period under review was 13. During the year three new schemes were sanctioned, one for financing seed distribution in Sind, one for the distribution and marketing of Buri 107 (acclimatised *G. hirsutum*) in the Burhanpur tahsil, Central Provinces, and one for the extension of BD 8 cotton in the Baroda State.

Technological Laboratory

The Technological Laboratory continued its work of testing samples of cotton, yarn and cloth for agricultural departments and the trade. The samples tested comprised agricultural samples, samples of standard Indian cottons, trade samples and technological samples, and the results were published as technological circulars or bulletins. Investigations of interest completed during the year were (1) effect of employing different degrees of compression in a bale on the fibre properties and spinning quality of cottons, (2) optimum drafts in the fly frames, (3) suitability of two cottons for purposes of mill mixings in relation to their fibre characters, (4) empirical relationships between count, lea strength and staple length of Indian cottons, (5) effect of humidity on the spinning performance of Indian cottons, (6) drawframe speed tests, (7) effect of storage on the quality of Indian cottons, (8) deterioration of BD 8 cotton with lapse of time, and (9) quality of lint in relation to ginning factors.

The Institute of Plant Industry, Indore

This Institute, which is financed mainly by the Indian Central Cotton Committee, completed its 14th year of life. Its programme of work includes the general botany, physiology and genetics of Indian cottons; in addition agricultural investigations connected with the cultivation of cotton and other crops are carried out. The Institute also arranges for the supply of improved seed and gives demonstrations in the use of improved implements, the preparation of manures and improved methods of agriculture. An important function of the Institute is the conduct of yield trials with different established varieties of crops in the States. During the year two sub-strains of Malvi 9 were compared at three centres, Punjab-American 289-F, Mollisoni Cwn 52)

and Local in the Bikaner State, Cwn 520 and Cwn 402 in the Jaipur State and in the Jodhpur State and Ajmer-Merwara, Indore I, Dhar Cambodia, Local, Sind Sudhar and Perso-American were compared. These variety trials have proved definitely the suitability of Malvi 9 all over Malwa, and of Cwn 520 for Jaipur, Indore I for Jodhpur and Ajmer-Merwara, and Punjab-American 289-F, Cwn 520 and Mollisoni for the canal tract of Bikaner State. Improved varieties of seed were also stocked at the Institute for distribution.

The work of breeding for wilt resistance is gradually assuming greater importance as the wilt incidence is reported to be on the increase. Progeny trials were conducted in both wilt-free and wilt-infected fields on the farm and progenies have been obtained from 10 of these families which give 80 to 90 per cent survival in wilt-infected fields.

Cotton improvement

The work of cotton improvement in India continued to be largely financed by the Indian Central Cotton Committee.

A brief account of the work done on the Committee's schemes in the various provinces during the year under review is given below :

BOMBAY. *Gujarat.* The work of cotton improvement in the Gujarat division is centred at Surat, Broach and Viramgam, and at these places scientific botanical research work is in progress with the object of producing improved strains of cotton which will give higher returns per acre to the cotton growers.

Jalgaon cotton breeding scheme. During the year under review, Jarila (NV 56-3), a variety evolved after five years' work, was given extensive village yield trials and compared with Banilla and NR both on Government farms and on cultivators' fields. In these trials it gave significantly higher yields than the other two. The ginning percentage of Jarila ranged from 32·5 to 36. Both farm and commercial samples were tested at the Indian Central Cotton Committee's Technological Laboratory and found suitable for 22's to 36's highest standard warp counts. The prices obtained at auction sales fetched a premium of Rs. 26 to Rs. 43 over Broach. With the object of combining ginning percentage and high wilt-resistance in Jarila, work on hybridization of Jarila with NR and Million Dollar was undertaken during the year. Work of isolating more desirable and promising types than Jarila is in progress.

Cotton wilt breeding scheme. As a complement to the cotton breeding schemes in Broach and Khandesh, scientific research on the breeding of wilt-resistant strains of cotton suitable for the two tracts is being carried out at Poona with the help of the Indian Central Cotton Committee.

Scheme for breeding wilt-resistant cottons in the Surat area. This scheme came into operation in April 1937, the object being to produce a cotton suitable to the conditions obtaining in the Surat tract and one that would, at the same time, be completely resistant to wilt. This is sought to be achieved either by selection in 1027 ALF or by crossing the latter with BD 8 or other wilt-resistant strains. The work is still in the initial stages.

Inclusion of Northerns and Westerns in the programme of the dry farming scheme at Bijapur. The Agricultural Research Sub-Committee of the Indian Central Cotton Committee, while considering the subject of the possibility of growing long and medium staple cottons in the short staple tracts of India, expressed the view that the solution of the problem might be found in devising

suitable dry farming methods. As a result of its recommendations in August 1936, this scheme was sanctioned and it came into operation in June 1937. As the year under review was one of scanty rainfall and abnormal distribution, sowing was postponed to October. The results, however, from such a late sown crop cannot be taken as normal and no conclusion of value can be drawn.

Cotton improvement scheme at Viramgam. Forty individual plants with desirable characters have been selected from F_3 and F_4 hybrid populations of the crosses of the Wagad types with Surti-Broach quality cottons like 1027 ALF and BD 8. The Iranian *herbaceums* have been found unsuitable for Viramgam conditions as the seedlings rot if there is continuous rain in July, and they are also susceptible to anthracnose. A few types of *herbaceum* from Russia have, however, proved less susceptible. Preliminary crosses of Wagad 8 with Iranian and Russian types have been made for quality and earliness respectively.

Scheme for the survey of Goghari cotton in Gujarat. This scheme, which was sanctioned by the Indian Central Cotton Committee in August 1934 for a period of five years, has for its object the carrying out of field to field survey of Goghari, an inferior type of cotton but with high ginning percentage, with a view to tracing it to ginneries and inducing the latter to discourage its cultivation by paying low prices for it. Owing, however, to the passing of the Cotton Control Act, it was reported during the year that Goghari is said to have been completely eliminated.

Interspecific hybridization scheme, Surat. The Indian Central Cotton Committee, in January 1938, sanctioned a scheme for interspecific hybridization in cottons at Surat with the object of obtaining a fully self-fertile hybrid between the Asiatic and American types, capable of being easily crossed with any Asiatic cotton and giving a combination of desirable economic characters, particularly the good staple length of the exotics and the character of hardiness and suitability to Indian conditions of the Asiatics. Strain BD 8, which is highly wilt-resistant, was crossed with several high ginning types and, out of the 14 crosses obtained, the seed of one of the best plants was sown in random replications on wilt-infected and wilt-free soils to test its relative resistance; some of the segregates were found worth retaining for further trials. Three crosses were handed over to the Wilt Breeding Scheme for Surat area in the hope that they would be found useful for that tract. New selection 49, resistant to wilt, having a ginning percentage of 34 and spinning 31's was maintained as a new type. Another new selection, 12, with a ginning percentage of 39 and spinning 26½'s was found statistically superior to BD 8 against which it was tested for yield.

Plant puller propaganda scheme in Surat and Broach districts. This scheme, which has for its object the eradication of the spotted bollworm by the uprooting of cotton stalks with the aid of specially designed plant pullers, was sanctioned by the Indian Central Cotton Committee in August 1933. Owing to the lateness of the crop in one area, continuous heavy rains in another and the slump in cotton prices, the percentage of the area uprooted was not as high as was hoped.

During the year under report there were five organized seed distribution schemes and one nucleus scheme for improved varieties of cotton in force in the province. All these were financed by the Indian Central Cotton Committee.

Surat seed distribution and extension scheme. During the year the Department of Agriculture controlled a seed multiplication area of 26,618 acres, against 25,583 acres in the previous year, and distributed 2,936,110 lb. (including 1,660,449 lb. supplied to Indian States), against 2,687,009 lb. (including 1,477,946 lb. supplied to Indian States) in the previous year.

Khandesh (Jarila) scheme. During the year 84,315 lb. have been made available for multiplication over an area of 4,000 acres under controlled conditions during the next season. Village trials have shown that Jarila gives a significantly higher yield than the local variety. It is reported to have a staple length of 0·84 in. to 0·92 in. and a spinning performance of 28 to 36 standard warp counts against a staple length of 0·63 in. to 0·68 in. and spinning performance of 6's to 7½'s standard warp counts in the case of the local variety. Jarila cotton produced at different centres was pooled together and sold by auction at a premium of Rs. 26 to Rs. 46 over Broach.

Deccan Canals (Banilla) scheme. There were 31 acres under cotton on the Government farm at Kopergaon. A very poor yield of 368 lb. of *kapas* (raw cotton before extracting the seed) per acre was obtained against 678 lb. per acre of the previous year and 733 lb. per acre of the year before. This was due to uneven distribution of rainfall, attack of green caterpillar, pink bollworm and growth of weeds.

BD 8 scheme. During the year under report an area of 6,268 acres was under BD 8 as against 20,012 acres in the previous year, the reason for the fall in area being excessive rains at the beginning of the season. BD 8 realised Rs. 3 to Rs. 4 more per *bhar* (1,020 lb.) than Goghari *kapas*. There were 495 acres under pedigree seed supplied by the Surat and Broach farms from which 130,360 lb. of seed were obtained. These, together with a quantity of 4,120 lb. obtained from the Surat and Broach farms, will be given to registered seed growers and the Amod Cotton Sale Society for seed multiplication.

Revised Jayawant and Gadag No. 1 scheme. This scheme has replaced five schemes in the Southern Division. It commenced work in June 1936. At present it is jointly financed by the Committee and the Bombay Government. The scheme is operated from seven centres, viz. Hubli, Haveri, Navalgund, Bailhongal, Athani, Bijapur and Bagalkot, through the agency of cooperative societies but under the general control of the Department of Agriculture. The scheme is intended to cover within five years 9½ lakhs of acres with improved varieties. During the year under report 2,755,200 lb. of pure Jayawant seed were sown over an area of 245,318 acres against 961,100 lb. of seed sown over an area of 102,306 acres in the previous year. The natural spread of Jayawant is expected to be 1½ lakh acres, bringing the total area under this variety to about 4 lakh acres. 1,295,700 lb. of pure seed of Gadag No. 1 were sown over an area of 92,539 acres against 844,100 lb. of seed sown over an area of 84,410 acres last year. The natural spread of this variety was estimated at 25,000 acres, making a total of 117,539 acres. 2,866,920 lb. of Jayawant seed sufficient for about 3 lakh acres and 1,588,580 lb. of Gadag No. 1 seed sufficient for about 113,470 acres have been purchased so far for the 1938-39 season. The cultivators' produce was pooled together and sold. In all, 14,940 *dokras* of Jayawant and 13,569 *dokras* of Gadag No. 1 were sold during the year and the extra profit realized by cultivators is estimated at about Rs. 37,350 and Rs. 73,000, respectively.

Scheme for maintenance of nucleus of pure seed of improved varieties of cotton in Bombay. In pursuance of the policy of the Committee to maintain a nucleus of all approved varieties of cotton, the above scheme for the following seven varieties of cotton is in operation in the Bombay Province :

1. 1027 ALF
2. BD 8
3. Jarila (wilt free zone)
4. Jarila (wilt zone)
5. Jayawant
6. Gadag No. 1
7. Banilla

MADRAS. During the year four schemes financed by the Indian Central Cotton Committee were in operation in the Madras Province.

Madras herbaceum scheme. This scheme, financed by the Committee since 1923, closed down in May 1938. The results of the investigations carried out are here summarized. Eleven strains in Uppam cotton have been isolated, but there is little scope for improvement by selection as the extent of variability has been found to be very limited. The merit of this strain, however, lies in affording scope for interspecific hybridization as a result of which hybrid plant with great vigour, earliness and prolificity are produced. As a consequence of hybridization 29 strains possessing fineness and lint length equal to Karunganni have been isolated. Amongst these, seven strains, which have been found to behave satisfactorily in years of low rainfall, have excelled the standard Karunganni strain K1 in yield during the last two seasons. In addition, fundamental knowledge has been acquired regarding the origin of lint fuzz and the mode of inheritance of pollen and lint colour in cotton.

Madras pempheres and physiological scheme. The work on the botanical side consisted of crossing Co 2 with several South American types which possess the peculiar feature of producing gum which prevents the larvae from escaping. Some of these crosses which have reached the second and even the fourth generation appear very promising in that they do not show any mortality in plants and no adult emergence. These crosses are now being studied for purity to ascertain whether their progenies behave in the same manner. On the biochemical side an endeavour is being made to find out if there is chemical criteria by which resistant types can be distinguished from the susceptible ones. On the entomological side, though many parasites were found, their incidence on pempheres was too low to produce beneficial results. Further, the discovery of three more alternative host plants renders the problem more difficult of solution. As a result of the physiological work, four strains with a lower shedding index than K1 have been isolated but their behaviour cannot be taken as conclusive. Sowing cotton thick has been found more remunerative to the cultivators of the Tinnevelly tract and mixing cotton with coriander has given better results. The experiments require confirmation.

Scheme for improvement of Mungari cotton. Owing to unfavourable weather conditions, the experiments during the year were robbed of much of their utility, the yields being only 50 per cent of normal. In the 'Progeny Row' trials, 39 out of 92 cultures were found be statistically better than the standards.

Fresh selections were made in local Mungari and in some of the promising imported strains on the basis of number of bolls.

Nadam cotton breeding scheme. A large number of cultures from Asiatic and American crosses were compared for yield with local Nadam and the best 20 cultures were sown for comparison on field plot scale. All except one gave yields lower than 100 lb. per acre. Uganda crosses evolved at the Cotton Breeding Station, Coimbatore, were sown on two dates—29 September and 31 October—in replicated plots to study their response under Nadam conditions. The later sown seed failed, while in the early sown experiment, strain 4383 recorded the highest weight and was found to be significantly better than Co 2.

Tiruppur and Co 2 (Cambodia) schemes. These schemes commenced work in May 1931 and closed down in August 1937. It has been estimated that during the period of their operation the gain to the cultivators amounted to nearly Rs. 70,84,900.

PUNJAB. During the year under report six schemes, financed by the Indian Central Cotton Committee, were in operation in the Punjab.

Botanical scheme. This scheme, which has been financed by the Committee since 1925, has for its object the production of suitable types of American and *desi* cottons to replace the 4F and *desi* cottons, respectively. During the year under review 289F/43, a new strain of Punjab-American cottons, early maturing, drought resistant and a better yielder than 4F, occupied an area of over a lakh of acres. 39 Mollisoni, a *desi* cotton, covered several lakhs, while Jubilee, a new *desi* strain was tried extensively. 119 Sanguineum, another new strain, is being given extensive trials in Multan. Hybridization work with a view to combining desirable characters of several strains into one is also in progress. Tanguis cotton has been used to introduce Jassid resistance in the Punjab-American strains. Watering experiments have indicated that the current practice of delaying the first watering is not good for the crop; it should be given during the fourth week after sowing.

The physiological scheme was started in March 1935 with the help of the committee for studying the physiology of the cotton plant for finding out the causes that lead to the occasional failure of the Punjab-American cotton crop. The investigations during the year have shown that there are two types of soils where *Tirak* appears. These are (1) soils with high concentration of alkali salts in the sub-soil, and (2) soils with deficiency of nutrients. During the year under review, remedial measures were tried to counteract the adverse soil conditions. On soils with alkali salts in the sub-soil, late sowing of cotton (middle of June) proved efficacious, while, on the second type of soils with deficient nutrients, applications of nutrients containing nitrogen, potash and phosphorus produced beneficial effect on the growth of plants. These experiments will be repeated during the next year.

The pink and spotted bollworm scheme. This scheme was started in 1934, with the help of funds sanctioned by the Committee, for the continuation of work on the pink bollworm and for investigating certain economic aspects of the spotted bollworm. The investigations have shown that the most important source of carryover of these pests are the cotton sprouts and certain other weeds and that the carryover can be prevented by cutting the cotton stalks about

2 in. below the surface of the soil and destroying the weeds. This preventive measure is at present under trial in an area of about 500 sq. miles.

Punjab root-rot scheme. This scheme was started in 1932 with the help of the Indian Central Cotton Committee for investigating the root-rot diseases of cotton in the canal irrigated tracts of the Punjab, where the annual damage was estimated at several lakhs of rupees. The organisms responsible for the disease are *Rhizoctonia bataticola* and *R. solani.* The data available show that if the time of sowing cotton is varied there is considerable difference in the mortality of plants and the incidence of the disease is lowered if the crop is sown late, i.e. mid-June. No resistant type has so far been found among the Indian varieties tested so far, but it is possible that a suitable selection from other resistant types may solve the problem.

Scheme for cotton Jassid investigation. This scheme came into operation on 1 April 1937 with the help of the Indian Central Cotton Committee, the object being the study of the Jassid insect in the Punjab as regards its habits, alternate host plant and the characters of the plant which determine resistance to the pest. Observations during 1937 showed marked differences in the incidence of attack between *desi* and American cottons and also between varieties of American cottons. Severe infestation was noticed from the middle of August to the end of September. The conclusions show that the Jassid attacked chiefly the American cotton while *desi* cottons seemed to resist the Jassid attack. Tanguis cotton, a long-stapled variety, has been found to be resistant to Jassids.

Punjab clean-up scheme. This scheme was put into operation in April 1937, the object being to demonstrate that better yields can be obtained by eliminating the spotted bollworm by clearing the whole cotton area of all cotton stalks and stubbles directly the picking is over. For this purpose an area of 500 sq. miles was selected in Lyallpur and Jhang districts and cleared with *kudali.* Extensive educational propaganda was undertaken by the Agricultural Department and with the full cooperation of the Revenue and Canal Departments about 97 per cent of the total area was cleaned. In addition, attempts were made to starve the pest by eliminating all host plants. The effect of these operations will be studied in the next cotton season.

CENTRAL PROVINCES. *Botanical scheme.* This is one of the earliest schemes of the Indian Central Cotton Committee and one that has yielded results of practical value. The main work under this scheme has been concerned with the breeding of new strains suitable to the conditions in the cotton growing areas of the province, especially capable of resisting the handicaps imposed by wilt and other diseases. The chief feature of the year was the success which attended the cultivation and expansion of V 434 which, despite unfavourable season, again showed its superiority over all other types. Late Verum was grown on an extensive scale during the year in areas of heavier rainfall. No. 438 was found to be suitable for lighter soils. Work on Bani Cernuum cross was continued and the results were reported to be encouraging. At its meeting in July 1938, the Committee decided that on the termination of this scheme in March 1939 two separate cotton breeding schemes should replace it, one at Nagpur and the other at Akola, the expenditure to be borne on a 50 : 50 basis between the provincial Government and the Committee.

Verum seed distribution and marketing scheme. This scheme was extended by the Committee at its meeting in July 1938 for a further period of three years

from June 1939. During the year the Agricultural Department distributed 4,233 *khandies* (two bales) of pure seed of improved strains sufficient to cover about 87,649 acres, as against 5,594 *khandies* of pure seed distributed in 1936-37. 4,575 bales of pure cotton were sold through the pool at an average premium of Rs. 39-15 on Broach and Rs. 57-7 on Oomras. The drop in acreage during the season under report was mainly due to the exceptionally low premium obtained for Verum during the previous season.

The Indian Central Cotton Committee at its meeting in July 1938 sanctioned a new scheme for the distribution and marketing of Buri 107 cotton in the Burhanpur tahsil of the Central Provinces.

A scheme for the maintenance of nuclei of pure seed of the improved strains, viz. V 434, Late Verum, No. 438 and Buri 107, was also sanctioned at the same meeting.

SIND. The following schemes financed by the Indian Central Cotton Committee were in operation in Sind during the year :

Scheme for cotton Jassid investigation. In Sind, Jassid attack is most prevalent in the south-east Tharparkar district where it has been decided to establish a compact block of long-stapled cotton. One of the harmful effects of this pest is the improper development of seed, resulting in shortage of good seed for sowing purposes. A scheme for cotton Jassid investigation was sanctioned by the Committee in August 1937 for a period of three and a half years, and it came into operation in May 1938.

Sind seed distribution and ertension scheme. This scheme, which has been financed by the Committee since April 1931, has proved that the Right Bank area of the Indus is as suitable as any other part of Sind for growing long-stapled cotton. Special attention is being given to seed distribution, better methods of cultivation, and extension of cotton in lands under the Barrage area where cotton cultivation was unknown before the commencement of the scheme. As a result of intensive propaganda during the year under report the area under cotton rose to 51,500 acres (including 7,000 acres under natural spread), 45,000 acres being under 4F-98 and 2,000 acres under Sind-Sudhar. The Agricultural Department distributed 14,490 maunds of Sind 4F-98, Sind-Sudhar and Sea Island varieties against 14,060 maunds of 4F-98 and Sind-Sudhar in the previous year. 16,800 maunds of 4F-98 seed and 12,000 maunds of Sind-Sudhar are available for sowing during the next season.

During the year under report, on the Left Bank 445,000 acres were under Sind NR and Sind-Sudhar against 400,000 acres in the previous year. 2,908 maunds of Sind NR, 11,569 maunds of Sind-Sudhar, 500 maunds of 4F-98 and 200 maunds of Sind-Egyptian were distributed during the year. 9,000 maunds of Sind NR, 33,050 maunds of Sind-Sudhar, 150 maunds of 4F-98 and 100 maunds of Egyptian are available for sowing in the next season. In order to ensure a supply of pure seed, the Sind Government have established a ginning factory at Mirpurkhas where the produce of Government farms and of a few selected growers is ginned. During the year 13,000 maunds of *kapas* were ginned and sold under the supervision of the department.

BENGAL. *The Comilla cotton scheme at Rangamati*, which has been financed by the Committee since December 1934, has for its object the botanical and systematic study and improvement of the commercial grades of Cernuum

(Garrow hill) cotton. During the year single plant selections were tried in a replicated experiment but these failed owing to low stand. A survey of the cottons grown in the hilly tracts was undertaken with a view to selecting a suitable type for these tracts to meet trade demands.

BARODA. The following five schemes on cotton improvement, financed by the Indian Central Cotton Committee, were in progress in the Baroda State during the year.

The root-rot scheme, which has been in operation since February 1932, has for its object the study of root-rot disease of cotton in Baroda and the development of strains resistant to it. During the year under review KS selections were tested in sand cultures in glass house in soil heavily infected with root organisms, with Broach 9 as control. Survivals from these strains will be transplanted in the root-rot affected area. Experiments were laid out for replicated family tests on KS strains, progeny row tests, non-replicated progeny row tests, bulk trials, root study and comparative yield trials of KS against B 9. From these trials, plants showing higher resistance to the disease and possessing better yielding capacity and other economic characters have been selected for further trials.

Scheme for survey of Goghari cotton. The objective of this scheme is similar to that of the corresponding scheme in Bombay. During the year under report the cotton crop (in 47,986 *bighas*) was surveyed and the percentage under Goghari was found to be only 0·2. The range of mixture varied from 1 to 2 per cent. Propaganda was continued along the lines of the past year. With the enforcement of the prohibition Act against Goghari, the menace to the reputation of Navsari cotton has disappeared.

Plant puller propaganda scheme. This scheme operates on the same lines as the corresponding scheme in Bombay. During the year under report the number of plant pullers sold in the Navsari district was 400 and the area handled 170,000 *bighas*. The value of the plant pullers as a means of facilitating tillage operations is also appreciated.

Scheme for improvement of Mathio cottons at Amreli and Jagudan. This scheme, which commenced work in June 1937, has for its object the improvement of Mathio mixture in respect of yield, ginning percentage and quality, and, secondly, the trial at Amreli of the early strains of Wagad evolved at Viramgam with a view to replacing, if possible, inferior Mathio by early herbaceums. Replicated tests have shown that C 520 is promising both as regards yield and ginning percentage, and that V 434 and V 438 are as good yielders as C 520.

The cotton work at Jagudan is confined to duplicating, on a small scale, important types of Wagad cotton grown at Viramgam as a precautionary measure against their extermination due to precarious nature of seasons at Viramgam. Varietal trial experiments with Wagad 8, Seg. 4-1, Seg. 7-1 and Local Wagad have shown Segregate 4-1 to be a promising type.

Baroda (Navsari seed storage) scheme. During the year under report, 21,830 lb. of seed raised from pedigree seed were secured under the supervision of the Department and of this 21,675 lb. were issued to A Class growers for sowing on an area of 2,500 *bighas*. From the controlled area of 2,506 acres of A Class growers and 3,544 acres of B Class growers, 1,255,727 lb. of 1027 seed were produced, out of which 447,680 lb. were distributed to B Class growers for

sowing on an area of 13,194 *bighas*. The approximate area under improved seed during 1937-38 was about 75,000 acres. In the past, the Baroda seed organization had no farm-grown seed for supply to A Class growers, but last year the Baroda Government opened a seed farm of about 70 acres near Vesma, a village about eight miles from Navsari, to serve as a nucleus from which A Class growers would receive their seed. During the year under report, 700 lb. of pure seed, secured from the Surat Agricultural Farm, were sown over an area of 52 *bighas* at the Vesma Farm and 93 *bighas* at Parthan by two selected growers. The seed from these areas will be distributed to specially selected A Class growers. To secure better prices for 1027 ALF cotton, a marketing office was opened at Surat in February 1938. Certificates of purity for 559 cotton bales, ginned under the supervision of the department, were issued. Most of this cotton was sold at a premium ranging from Rs. 3 to Rs. 11 per *khandy*.

MYSORE. *Mysore (Doddahathi) cotton scheme.* This scheme came into operation in November 1935, the object being the breeding of suitable types from the local (*Doddahathi*) or American cotton which would be resistant to red leaf disease. During the year under review five new selections showed great resistance to red leaf disease. About 3,000 crosses were either back-crossed or crossed with promising hybrids. Seeds of Co 2, X-rayed for 7½ minutes and selfed, have now, in their third generation, given plants with a ginning percentage of 38 to 40 and lint length of 25 to 28 mm. as compared with the ginning percentage of 33 to 35 and lint length of 20 to 23 mm. of unexposed Co 2. Good yields were obtained from the bulk trials of MA 2 and Co 2 for multiplication of seed, the first strain yielding 633 lb. and the second 424 lb. of seed cotton per acre.

HYDERABAD. During the year five research schemes and one seed distribution scheme were in operation in the Hyderabad State.

Under the *botanical research scheme* the work of selection of types of Gaorani was continued and comparative strain tests and varietal tests on these were undertaken. Comparative study of the improved strains revealed the superiority of G 3-B-1 and G 4-B-5 and G 12-F in respect of both yield and spinning quality. Tests for wilt resistance were also carried out and selections were made from plants which showed a fair degree of resistance to wilt for further study.

Pink and spotted bollworm scheme. Investigations carried out till the end of the 1936-37 season indicated that the bollworms were responsible for an annual damage ranging from 25 to 33 per cent of the harvested crop. Control of the spotted bollworm was considered to be possible by the observance of a strict close season, by the removal of all cotton and other host plants during the off-season and the ginning of all cotton by a certain date. The experiments to determine the carry-over of the pink bollworm through soil revealed that some caterpillars did not go into soil for hibernation earlier than 10 January, that fewer caterpillars were recovered from plots growing early maturing varieties, that more caterpillars were taken from soils that were well mulched or from plots in which plants were allowed to stand for longer periods. The experiments are being repeated for confirmation.

Bollworm clean-up scheme. This scheme commenced on 1 October 1937. The chief activity during the period under review was concerned with the com-

plete clean-up of cotton fields, prevention of the growing of *bhendi* and *ambadi* in the off season and the completion of the ginning of *kapas* before 1 May 1938. Intensive propaganda by means of public lectures and demonstrations was also carried out from February to April. The effects of these measures will be reported in the next review.

Scheme for inclusion of Northerns and Westerns cottons in the programme of the dry farming scheme at Raichur. The scheme was sanctioned in March 1937 with a two-fold object, viz. (1) to consider the possibility of growing medium and long-stapled cotton in areas of short-stapled cotton in India, and (2) to find out how far the devising of dry farming methods would suit for the successful growing of such cottons in dry tracts and in tracts of low rainfall. The experiments laid out did not yield significant results owing to the abnormal season.

Scheme for the improvement of Kumpta cotton. This scheme was sanctioned in August 1936 with the object of developing suitable strains of Kumpta cotton from the local variety of Raichur. The work during the year yielded a strain Raichur-Kumpta 19 which is superior to others in all respects. The strains RK 4, 15, 25, 26 and 29 show some promise. The tests will be continued during the next season.

Hyderabad seed distribution and extension scheme. This scheme started in March 1938. The total quantity of Jayawant and Gadag No. 1 seed distributed during the year under report amounted to 263,945 lb. sown over an area of 21,092 acres, against 374,633 lb. sown over an area of 13,871 acres the previous year. To procure pure seed of improved varieties for distribution in the ensuing season, the Agricultural Department earmarked a reserved area of 3,500 acres in the Kopbal and Yelburga talukas. This area sown, rogued and supervised by the departmental staff is expected to yield 360,000 lb. of pure seed sufficient for sowing 26,000 acres.

BIKANER. *Bikaner Bengals cotton improvement scheme.* This scheme was sanctioned by the Indian Central Cotton Committee in January 1931 for the purpose of obtaining by selection and hybridization one or more superior types of cotton suitable to the area under the Gang Canal. At the end of five years it was found that Cwn 520 was the most profitable cotton to grow in the tract and that American cottons were generally unsuitable because of their low yield and susceptibility to disease. Since then re-selection in Cwn 520 has yielded strains which show much better germination and possibly also a little higher yield than Cwn 520. Some local selections have proved better yielders than Cwn 520 but are poorer in quality. Breeding tests have shown that there are possibilities of improving the quality by hybridization. The results of a variety *cum* agronomy experiment showed that the *desi* cotton Cwn 520 can respond as well as American to more favourable conditions—liberal watering and manuring, etc.

Improved varieties of cotton

The table below indicates the progress made in the introduction of improved varieties of cotton in the various provinces and states during 1937-38; the actual area under these varieties is probably higher than given in the table, as complete information for area under ' natural spread ' is not available.

Area under improved varieties of cotton

Name of province or state	Variety of cotton	Area in thousand acres		Remarks
		1937-38	1936-37	
PROVINCES				
(1) Bombay	1027 ALF	92	120	
	Jayawant	402	104	
	Gadag I	125	84	
	Banilla	81	78	
	BD 8	6	20	
(2) Madras	Cambodia	244	191	
	N 14	4	4	
	H 1	223	240	
	Karunganni (C 7, A 10 and K 1)	205	165	
(3) Punjab	Punjab-American—			
	4F	1,076	1,187	
	289F & 289F/K 25	126	85	
	289F/43	122	20	
	LSS	116	69	
	Mollisoni	981	704	
(4) Sind	Sind-Sudhar	269	210	
	Sind-American—			
	4F (& unspecified)	380	283	
	4F-98	68	52	
	Sea Island and Boss 111	1	2	
	27 WN	250	202	
(5) Central Provinces and Berar	Verum	137	118	
	Buri	3	..	
(6) United Provinces	C 402	3	4	
	C 520	20	22	
	A 19	13	10	
STATES				
(1) Bombay States	1027 ALF	142	130	
(2) Baroda	1027 ALF	50	75	
	BD 8	1	..	Figures for improved *desi* and Mollisoni are not available.
(3) Punjab States	Punjab-American strains	337	265	
(4) Khairpur	Sind-American 4F (and unspecified)	15	14	
	27 WN	74	57	

Area under improved varieties of cotton—contd.

Name of province or state	Variety of cotton	Area in thousand acres		Remarks
		1937-38	1936-37	
(5) Hyderabad . . .	Gaorani 6	40	9	
	Banilla	1	5	
	Jayawant	23	50	
	Gadag I	5	4	
(6) Central India and Rajputana	Malvi strains . . .	7	3	
	Total .	5,651	4,676	
	Percentage of the total area under cotton in India	22	19	

Cooperative cotton sale societies

The number of cooperative cotton sale societies working in BOMBAY was 29, an increase of one over that of the previous year. During the year 1937-38, the total quantity of *kapas* sold was 574,952 maunds, the price realized being Rs. 37,82,899. In MADRAS 16 cooperative cotton sale societies dealt in cotton during the year, as against 9 in the previous year and the total value of the cotton handled by them was Rs. 22,75,275. The Co 2 seed development scheme, which was financed by the committee from September 1932 to August 1937, was continued by the Tiruppur Cotton Sale Society and during the year under report 13,138 bags of pure seed were purchased by it for supply to growers in the Coimbatore and neighbouring districts. The Pudur Cooperative Society in the Tinnevelly district constructed a ginning factory which was of great benefit to its members as they were able to get their cotton ginned at this factory at rates lower than elsewhere. In the CENTRAL PROVINCES AND BERAR, there were two cooperative *adat* societies working during the year which dealt largely in cotton, as against three in the previous year. Both ginned and unginned cotton of the aggregate value of Rs. 35,495 were handled by them. Twenty 'cooperative commission shops' in the PUNJAB, dealing largely in cotton, handled 262,394 maunds of *kapas* of the value of Rs. 16,30,853. There was a fall in the quantity handled as compared with the previous two years, due chiefly to the following causes: (1) the cotton crop was poor, (2) a new *mandi** was started and ginning factories erected near a place where there are two commission shops, (3) the tendency on the part of villagers, as soon as market conditions show a favourable turn, to dispose of their produce to the big agents and representatives of firms rather than cart it on *kacha* roads. In BARODA 18 cotton sale societies worked during the year under report, as against 16 in the previous year. They handled 2,352·2 *khandies* of lint and 54 *bhars* and 13 maunds of cotton of the aggregate value of Rs. 4,39,586. The special feature of these societies during 1937-38 was the improvement in

* Market.

sale due to the appointment of a special marketing officer at Surat by the Agricultural Department. In MYSORE there were no sale societies which dealt exclusively in cotton but one credit society at Maradihalli in Chitaldrug district purchased 6,994 maunds of cotton from its members and, after getting it ginned, sold it and realized roughly Rs. 14,000. In HYDERABAD, the cooperative cotton sale societies at Kopbal and Nanded did good work during the year. The societies at Sailu and Jalna could not transact any business in the absence of the *takkavi* grant on which their business depended.

4. Sugarcane

During the year the area occupied by sugarcane in India was 3,818,000 acres. This represents a decrease in area by about 14 per cent as compared with the previous year, and one of the factors responsible for this was the overproduction during 1936-37, when the cane grower suffered for want of remunerative prices for his crop. The total estimated yield of raw sugar (*gur*) was 5,307,000 tons, which is less by about 21 per cent than that of the previous year.

The total quantity of sugarcane crushed in modern sugarcane factories in India was 9,916,400 tons and the production of sugar direct from cane totalled 930,700 tons, giving a fall of about 16 per cent in the former and 17 per cent in the latter from that of the previous year. The large decline in the production of sugar is attributable to (1) shorter duration of season in all provinces, (2) shorter supply and inferior quality of cane due to attack of insect pests in some parts of the United Provinces, and (3) the crushing period being particularly short in Bihar where the majority of factories worked only for 95 days on account of inadequate supply of cane. The average recovery of sugar from cane in India decreased to 9·38 per cent from 9·5 per cent of the preceding year despite the fact that five factories gave over 11 per cent recovery during the season under report as against only two factories during 1936-37. The highest recovery for the season was 11·63 per cent which is slightly more than the corresponding figure of the last year, viz. 11·43 per cent.

The production of sugar refined from *gur* in India during the season amounted to 19,500 tons, representing a decrease of as much as 61 per cent from the previous year. The large decrease in the output is due presumably to the fact that in the later stages when the price of sugar gradually declined, the refineries found it unremunerative to produce more sugar from *gur* and restricted the purchase of the raw material to the minimum. Sugar was refined in nine factories as against 13 factories during 1936. Six of them were pure refineries and three were cane sugar factories refining *gur* in the off-season.

IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI. At the sugarcane section of the institute, i.e. at the Imperial Sugarcane Station, Coimbatore, the work on sugarcane breeding was continued. The spread of the heavy yielding Coimbatore canes coupled with the rapid development of the factory industry during the first half of the present decade is throwing up fresh problems in the matter of breeding varieties. There is now a more pronounced demand for distinct classes of canes—'early', 'mid-season' and 'late' — to feed the factories suitably during the different periods of the

cane-crushing season. Importance is also attached to the quality of cane brought to the mill-yard. To meet the above, the breeding programme of the sugarcane station has been adjusted suitably. The varieties Co 419 and Co 421 are proving increasingly useful in the breeding of vigorous seedlings. Other useful parents are Co 312 for vigour, Co 354 and Co 440 for early ripening and Co 349 for vigour and habit. The sugarcane × bamboo hybridization has resulted in certain seedling canes with good habit and profuse tillering. The preliminary refractometer readings of these hybrids have been encouraging. This new line of work is being further exploited at the sugarcane station. The cyto-genetical studies have thrown some light on the genetic composition of certain canes as also on the mode of inheritance in *Saccharum*. The studies on photoperiodism were continued, to see the effect of this treatment on flowering in sugarcane. The arrowing and the flower opening were also studied in greater detail.

At the agricultural section of the institute at New Delhi 75 Co sugarcane varieties were grown. Co 313 went up to 18·10 per cent sucrose in March. Most of the heavy tonnage canes, except Co 313 and Co 421 showed poor sucrose content.

At the chemical section of the institute studies were made on the chemical composition of the sugarcane and its juice and on the bodies responsible for colour development in raw sugar (*gur*). The pigments in the rind of the sugarcane were successfully obtained in their crystalline form. Laboratory and large-scale factory investigations showed that the colouring matters could be successfully eliminated in the sulphitation sugar factories without alterations to the existing plants by heavy liming and then using aluminium hydroxide. Investigations were also carried out on the development of colour on boiling sugarcane juice in open pan. It was found that by the use of paddy-husk-active-carbon about 60 to 80 per cent of the colour developing constituents could be eliminated.

UNITED PROVINCES. Research work on sugarcane was conducted as usual at Shahjahanpur and Muzaffarnagar.

Varietal trials. The varieties Co S 87 and Co S 109 gave satisfactory results as ' early ' canes. Among ' medium ' and ' late ' varieties Co 421 again showed its superiority over the standard Co 312. In regard to the first year ratoons Co S 70 out-yielded Co 421 and Co 312, but as it showed low purity it is not considered better than either Co 421 or Co 312.

Manurial trials. The complete nutrient experiment again gave for the third year remarkable responses to nitrogen application but practically none to potash or phosphate application. The most economic dose of nitrogen was 100 lb. per acre, higher doses having an adverse effect on quality and a pronounced delaying effect on maturity.

Chemical investigations. The experiment on the manurial value of different portions of *sanai* (*Crotalaria juncea*) showed that whole *sanai* was the best, the order being :—whole *sanai*, top *sanai*, roots, and no *sanai* (control). As regards nitrogen accumulation, nitrogen goes on increasing in the first foot of the soil after *sanai* inversion, till it reaches its peak in February, followed by a sharp decline in March, steady level till July, and a marked decline in August. The accumulation of nitrogen in the second foot of soil follows more or less the same lines.

Physiological studies. The experiments on the inter-relationship of nitrogenous manures, water duty, and sowing date showed that maximum generation was attained on the 14th of May irrespective of the date of sowing and that it was distinctly poorer in the early sown canes. At all sowing dates ammonium sulphate lowered germination appreciably. Fourteen varieties were studied for drought resistance and it was found that Co 421 and Co 432 gave the highest available sugar.

BENARES HINDU UNIVERSITY. In addition to the departmental work detailed above, a scheme of research on the physiology of sugarcane was in progress at the Benares Hindu University. The Benares experiments showed that application of 150 lb. of nitrogen, 75 lb. of phosphorus and 75 lb. of potassium in the form of ammonium sulphate, superphosphate, and potash sulphate, respectively, soon after germination gives best yield, whereas, from the point of view of sucrose content, the application of N and P soon after germination and K two months later appears to be more profitable.

BIHAR. The Bihar sugarcane research scheme which was so far located at Musheri was shifted to Pusa on the acquisition of the Pusa estate by the Bihar Government. Certain of the more important items of work at Pusa and the sub-station at Patna are given below :

Varietal trials. In the 'early' group Co 299 was outstanding. Its comparative freedom from pests and diseases and good juice quality till almost the end of March are in its favour, the drawbacks being low yields and difficult thrashing. In the 'medium-early' group Co 313 is the standard variety and Co 385, Co 386, and Co 393 were promising. Co 356—a sugarcane × *Sorghum* hybrid—which also belongs to this group gave very good results in mill trial. In the mid-season group Co 213 is the standard and Co 413, Co 421, BO 3, and BO 4 have given encouraging results.

Manurial trials. A dose of 10 maunds castor cake and one maund superphosphate per acre was better than when the same quantities were supplied entirely by artificial fertilizers. It was further found that higher doses of fertilizers were uneconomical. It was also noticed that there is no advantage in applying the fertilizers in two doses as a single application gives quite as good results. Manuring with potash depresses the yield. The beneficial effects of sulphitation-process, molasses and press mud were confirmed but the cost of transport and difficulty of application would appear to militate against its acceptance.

Cultural experiments. Spacing trials at both Pusa and Patna showed that the optimum distance between the rows was three feet. Trench planting gave interesting results but requires further confirmation. The average weight per stock of cane was greater in the trench cane and the incidence of stem borer was less but the tillering appeared to be adversely affected.

In addition to the above studies, work was carried out on root studies, moisture requirement, varietal behaviour in relation to insect pests and refractometer studies for standardizing juice sampling technique.

PUNJAB. Research work on sugarcane was continued at Risalewala, Lyallpur and Jullundur.

Varietal trials. Among the early varieties Co 313 and Co 385 have given high yields while Co 396 is decidedly the earliest to mature. In the mid-season series Co 312 stands unbeaten in yield, but was found to be highly susceptible

to pyrilla. In the late group Co 421 stood first in yield. Co 331 and Co 395 are equal to Co 285 in yield, but they are decidedly superior to it in the quality of produce. Co 312 and Co 395 are superior to Co 285 in their ability to withstand shortage of water.

Cultural experiments. In the case of heavy yielding varieties, planting cane in rows two feet apart, in trenches or on flat and ridging up the crop with the break of the monsoon was found to be decidedly better than the ordinary method of planting cane. As for the best time for planting cane the results are in favour of March planting.

Manurial experiments. It was found to be better and economical to apply about 140 lb. of nitrogen per acre, half as farmyard manure and half in the form of *toria* cake (*Brassica napus* var. *dichotoma*) or sulphate of ammonia, instead of applying the same dose as farmyard manure alone. The *toria* cake is a better supplement to farmyard manure than sulphate of ammonia for soils deficient in organic matter.

Chemical studies. Liberal watering under Lyallpur conditions does not delay maturity. The higher doses of nitrogen also, viz. 175 lb. at Risalewala and 200 lb. per acre at Jullundur, did not delay ripening of Co 285 and Co 313 to any appreciable extent. Frequent irrigations (i.e. at intervals of seven days) were found to be effective in lowering the mineral matter in the juice at Risalewala.

BENGAL. The cultivation of the two new early varieties Co 381 and Co 281 and the late variety Co 331 has been extended to all Government farms. Several farms have been supplied with the early cane Co 508 and also with Co 421 which is a very heavy yielder and if it can stand local conditions may oust Co 213 as the standard cane for the province.

A number of varieties are being tested at the sugarcane testing station, Dacca farm. In addition to those that have been mentioned above, other varieties that have done well are Co 518 as an early cane, Cos 313 and 375 as mid-season canes and Cos 243, 370 and 432 as late canes. Co 432 has also been tested at the Gosaba farm in the Sundarban tract. Its *gur*, though not free from saltish taste, has been found to be much less saline than the *gur* of Co 213.

MADRAS. At Anakapalle Cos 419 and 421 gave the maximum yield, viz. 53·5 tons and 44·7 tons respectively as against 29·0 tons obtained from J 247, a variety grown extensively in the locality. Satisfactory yield, viz. 30·0 tons was obtained from Co 508, a promising early variety. Six varieties were tested for their behaviour under water-logged conditions. Of these, Co 421 gave the highest yield, closely followed by Co 419 when planted both in February and May. Among the promising varieties that were grown as purely rain-fed crop, Co 419 gave the maximum yield.

In Gudiyattam, from the varietal trials under normal conditions, it was found that Cos 408 and 419 yielded the highest with little difference between themselves. Under restricted conditions, Co 213 gave the highest yield, closely followed by Co 243. In the ratoon experiments, the ratoon crops of Co 213 and Co 414 yielded more than the planted crops of the same varieties.

At Samalkota, in one of the varietal trials, Co 419 proved again its superiority with the highest yield of 69 tons of cane per acre. In another trial Co 417 gave the highest yield of 60 tons per acre followed by Co 421. Under purely

rain-fed conditions, except for one irrigation at the time of planting, the varieties Co 421 and Co 213 gave a good account of themselves.

At Palur, ten varieties were, as last year, compared with one another for yield in garden lands where Co 419 closely followed by Co 413 topped the list for the third time by yielding 55 tons of cane per acre, as against 23 tons of J 247. In wet lands, where also the same varieties were under trial, Co 421 gave the highest yield of 60 tons of cane per acre closely followed by Co 419. The variety Co 421 withstood both drought and water-logging better than other varieties.

Besides the departmental work mentioned above, a scheme of research on the anatomy of sugarcane was in progress at the university of Madras. The anatomical features of *Saccharum* and allied genera, including *Sorghum*, have been investigated and based on them certain conclusions have been drawn on the inter-relationship of the several groups or species.

BOMBAY. At the sugarcane research station, Padegaon, Bombay-Deccan, Co 429 and Co 413 have completed three years of testing and gave significantly higher yield over the control varieties POJ 2878 and Pundia. Co 421 and Co 426 have again out-yielded POJ 2878 and Pundia for the second year of testing both in tonnage and sugar. As a July planted crop Cos 421, 426 and 419 gave higher yields than POJ 2878. As a ratoon crop Cos 419, 426 and 360 have proved to be the best. In the chopan soil Cos 419, 413 and 421 have established their superiority. In regard to the keeping quality in the field Cos 290, 360, 413, and 419 are at their best till the end of February, show a slight drop in March, and a distinct drop in quality from April onwards.

Physiological studies on wilting coefficient and water and mineral intake in the sugarcane plant were continued. It has been found that leaving the crop to the stage of permanent wilting, though showing a temporary bad effect, does not affect the yield. The system of irrigating once in ten days during summer was found to be the best from the point of view of economy of water without affecting the yield or maturity. Studies in nutrition showed that an initial application of 100 lb. superphosphate is conducive to the better performance of the crop. Experiments on the utilization of the waste products showed that trash incorporated in the soil with sulphate of ammonia was as good as compost and gave better yields than trash alone. Molasses alone did not produce any beneficial effect but its neutralization by means of *gurhal* ash has shown definite advantage.

At the Kopergaon Farm yield trials of different sugarcane varieties were continued and Co 419 gave the highest yield. At the Gokak farm J 213 (POJ 213) out-yielded HM 544.

ASSAM. The distinct superiority of the two new Coimbatore varieties, viz. Co 419 and Co 421 was maintained this year as well. The variety Co J1 gave a yield of 49 tons stripped cane per acre. It is a medium quality cane with good habit. Other varieties that are promising to some extent are Cos 436, 418 and 432.

In the combined spacing and manurial experiments very little difference in the yield of cane was found between the different spacings of 3 feet, 3½ feet, and 4 feet between rows of cane. A spacing of 3 feet is recommended for thin varieties and 4 feet for thick varieties. The higher doses of manures, viz. 400 and 350 maunds cowdung per acre, which were equal amongst themselves,

gave significant increase over the lowest dose of 300 maunds cowdung per acre and this was more evident with 3-feet spacing. With narrower spacing, more manure is required for the optimum growth of canes than with broader spacing. Planting in trenches 9 in. deep gave an increase of 3·34 tons of stripped cane per acre than planting in trenches 3 in. deep. Canes planted in shallow trenches lodged to a much greater extent than those planted in deep ones.

SIND. Experimental work on cane is being conducted at Sakrand and also at Pritamabad. The varieties Cos 312, 313, 213, 270 and POJ 2878 were again tested and certain new varieties were also obtained from Coimbatore for trial. Co 213 has become very popular in the Karachi district.

In MYSORE sugarcane occupies about 50,000 acres, the varieties most commonly grown being HM 320, Pattapatti, Cheni, HM 544 and a few others. Of the improved varieties HM 320 is spreading fast. Experimental work on cane is being conducted at (1) the Hebbal and (2) the Irwin canal farms. At the former, the work also includes the breeding of sugarcane varieties and the economic types produced are distributed as HM (Hebbal Mysore) canes. At the Irwin canal farm the following manurial dose has been found to be the best: Six tons compost from cane trash with 7 to 10 cwt. of ammonium sulphate *plus* 1½ cwt. of concentrated supersulphate *plus* 1 cwt. potash.

In HYDERABAD there are about 30,000 acres under sugarcane and the variety Co 213 is quite popular. Experimental work on cane is being conducted at the Himayatsagar and Rudrur farms. The varieties Cos 290, 301, 313, 331, 419, 423, 426 and 434 have been found to possess very good quality. Analysis has shown that Co 419, though an early variety, does not deteriorate in sucrose content till the middle of April. Co 313 and Co 331 also do not deteriorate till the end of April.

In BHOPAL Co 331 has been found to do quite well and POJ 2878 and Co 419 are also quite popular in places where ample irrigation facilities are available.

In BARODA Co 213 is quite commonly grown. The experimental work on sugarcane is conducted at the Vyara farm. Recently POJ 2878 has been introduced and the area under this variety is increasing. Two or three of the recent Co canes are likely to give higher yields. The practice of planting whole canes has now been discarded almost entirely in favour of planting sets. Mixture of castor cake and ammonium sulphate applied as top dressing has been found very effective.

Introduction of improved sugarcane varieties

The improved varieties of sugarcane (mostly Coimbatore canes) now occupy about 79 per cent of the area under cane in India, excluding the Indian states. The sugarcane cultivation in the UNITED PROVINCES and BIHAR is dominated by the Coimbatore productions which cover about 90 per cent of the area. The universal cane both in the United Provinces and Bihar is Co 213. The varieties Co 290 and Co 244 are the next favourites in the United Provinces and Cos 312, 313 and 331 are just getting into cultivation. Co 421 is among the promising canes at the Government farms. In Bihar Co 210 is a close competitor to Co 213. Co 299 is the favourite as an early cane and Co 313 as mid-season cane.

The PUNJAB is the only major sugarcane growing province where the indigenous canes are as yet cultivated over fairly large areas, occupying as much as 40 per cent of the area. Of the improved canes, Co 285 is the most favoured. Other popular canes are Co 312 and Co 313. In Bengal Co 213 is now the dominant cane occupying about 80 per cent of the total cane area and is steadily replacing Tanna. Among the promising canes in Government farms are Co 381 and Co 281 as 'early' and Co 331 and Co 421 as 'late' canes. In ASSAM the improved varieties occupy about 40 per cent of the area. Magh, Teli, Bogapura, and Striped Mauritius were once popular. The canes now largely grown are POJ 2714 and Co 213. The new canes of promise are Co 419 and Co 421. In the NORTH-WEST FRONTIER PROVINCE, the improved varieties occupy about 60 per cent of the area. 'Peshawar Pounda' was the cane chiefly grown but is getting replaced by Co 290. The new promising canes are Co 361 and Co 412.

In BOMBAY, which is on the whole a tropical cane region, the improved canes occupy about 50 per cent of the area. The thick cane Pundia is grown in the Deccan Canal tract and Dharwar. POJ 2878 and EK 28 were the first to successfully replace Pundia in the estate plantations. The thicker productions from Coimbatore like Co 419 are now proving useful and have out-yielded the Java canes in more than one estate. In the areas represented by the Nasik and Surat districts Co 213, POJ 213, and Co 290 together with indigenous canes like Khadya are being grown.

In MADRAS, which is entirely tropical, the improved varieties occupy about 60 per cent of the area. A cane similar to Pundia of Bombay is grown in certain districts and Purple Mauritius, Fiji B (Badila of Australia) and 247 B (under the name of J 247) are also being cultivated. The promising canes of the future are Cos 413, 419 and 421. Co 281 and Co 352 have a limited range of usefulness confined to the factory plantations at Nellikuppam.

In the CENTRAL PROVINCES the improved varieties in cultivation in certain parts are Cos 219, 210 and 237. In ORISSA Co 213 is the dominant variety in the drained high lands and Co 285 is popular in the water-logged and flooded areas. These improved varieties occupy 80 per cent of the total area. Among the new promising canes is Co 421.

In MYSORE the dominant cane is HM 320, occupying nearly 25,000 acres, i.e. about 50 per cent of the area.

5. Jute

The total crop produced during the year is calculated to be 111·7 lakhs of bales as against the official forecast of 86·81 lakhs of bales. The restriction by propaganda of the area sown was again in operation but in this year the effect was hardly noticeable. With the removal of all restrictions in the mills, the output of manufactures remained at a very high level, approximately 105,000 tons per month of jute goods being produced. There was during the year a steady fall in the prices obtained for these manufactures—Porter Hessians falling from Rs. 10-10 to Rs. 8-10 per 100 yards, and B Twills falling from Rs. 22 to Rs. 19-5 per 100 bags. But throughout the year the output of manufactures was steadily absorbed by the market. During the year the price of raw jute fell from Rs. 38 to Rs. 29 per bale of 'firsts'.

During this year the Department of Agriculture, Bengal, continued to carry on the agricultural research work on jute, as the laboratory being built for the Indian Central Jute Committee at Dacca for this purpose was not completed and the staff not appointed till after the end of the year. The Indian Central Jute Committee carried through during the year a large part of the outside investigation work for its enquiry into the marketing and transport of jute. It also got well started the building of its technological research laboratories and the recruitment of the staff for these. Towards the improvement of the jute forecast experiments were carried out during 1937 to compare in costs and accuracy the method of random sampling of the jute areas with complete enumeration of the jute plots. The report embodying this work was completed at the end of the year and further experiments were undertaken immediately afterwards. The report indicated that the method of random sampling could be utilized for the estimation of the areas sown to different crops. During the year considerable progress was made in the collection of statistics and information of importance to the various sections of the jute industry and the information so collected was published in the form of monthly bulletins. At the end of the year, a considerable portion of the agricultural staff, sanctioned by the committee for propaganda and liaison work in the interior, had been appointed.

The Indian Jute Mills Association's research department functioned during the year with its Scientific Adviser in London and a laboratory in charge of a Chief Chemist in Calcutta. In addition to various items of research being carried out in different laboratories in England, the Scientific Adviser is also responsible for the collection and publication of jute abstracts, which contain a summary of all the available information and literature on developments connected with jute of value to the jute-mill industry. The laboratory in Calcutta was largely occupied with investigations into batching oils and emulsions and with giving advice and assistance to member-mills on their batching and softening processes.

The two varieties of jute seed at present being recommended by the Department of Agriculture, Bengal, are (1) D 154 Capsularis and (2) Chinsura Green Olitorius. The production and supply of seed of these varieties are carried by Messrs. Godden & Co. under a contract from the Government of Bengal, whereby the Department of Agriculture, Bengal, tests all seed before distribution and only that which germinates 90 per cent is allowed to be sold. During 1937-38, 304 maunds of D 154 and 534 maunds of Chinsura Green were supplied by the contractors. In the same year, the Indian Central Jute Committee set aside a sum of Rs. 50,000 to form a permanent advance to finance the supply of jute seed of improved varieties on a much larger scale.

6. Other fibres

Hemp (*Hibiscus Sabdariffa* var. *Altissima*)

In BENGAL its area is extending in the chief Mesta growing tracts of the Madaripur sub-division. It has proved itself a formidable substitute to Mesta. In quality, length and strength it compares very favourably with it. The comparative glabrous surface of the stem is also in its favour. If the question of

pure seed supply can be assured there is a possibility of ousting Mesta the problem of seed supply of which is also difficult. At present this is being imported from the United Provinces and some parts of Bihar. Besides, the seeds of Mesta are not of good quality and have poor germination quality.

In BIHAR, the work on selection of *ganja* (*Cannabis sativa* L. hemp) is still continuing. The cultures of three available types were studied in lines and seed of selfed single plants was collected for future study. The colour of the grain as determined with the help of *Reportoire de Couleurs* (1905) by H. Danthenay is of smoke grey with fine reticulations on the testa. The percentage of female plants in different cultures was found to vary between 51 and 54. The multiplication of seed was withheld as there was practically no demand for seed from the licensed growers of the province.

In SIND, the cultivation of *bhang* (*Cannabis sativa*: Indian hemp) is centralized in Bubak (Dadu district) where it is grown under the supervision of the Excise Department. At the request of that department one acre was put under this crop at the Agricultural Research Station, Sakrand, to determine the cost of cultivation. The crop was sown in the third week of November and it took 4½ months to be ready for harvest. The total yield was 929 lb. of *gundhies* (dried blossom) and 1362 lb. of *bhor* (leaf powder). The yield was rather low, presumably due to inexperienced labour as the crop was grown for the first time on the farm. The total cost of cultivation including *bardana* charges was Rs. 186-10.

At the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, four fixed hybrids from the cross between *albus* and New Hibiscus were grown alongside the latter for comparative tests. Arrangements are being made to have the fibres tested by the Assistant Fibre Expert to the Government of Bengal.

Sunn-hemp (*Crotalaria juncea*)

The steady increase in the demand for Indian hemp continued in the year under review and exports advanced from 769,000 cwt. valued at Rs. 69 lakhs in 1936-37 to 830,000 cwt. valued at Rs. 74½ lakhs in 1937-38. Exports to the United Kingdom and Belgium which between them took more than 56 per cent of the total quantity exported in 1937-38, amounted to 232,000 cwt. and 236,000 cwt. as against 243,000 cwt. and 237,000 cwt. respectively in the preceding year. Exports to France and the United States of America also declined slightly. There were, however, increased shipments to Germany, Italy and Greece, which amounted to 100,000 cwt., 48,000 cwt. and 51,000 cwt. as compared with 47,000 cwt., 32,000 cwt. and 46,000 cwt., respectively in 1936-37.

At the PUSA sub-station of the Imperial Agricultural Research Institute pure strains of sunn-hemp were raised and studied. A few sterile plants similar to those in pigeon peas were observed in sunn-hemp.

In MADRAS ten varieties obtained from different parts of the province were tried with Dummugudem variety as control. Highest yield of green stalks was obtained in the Tirutharaipundi variety. As regards the quality of fibre, the early varieties gave clean and fairly white fibre, but it contained bits of pith. The medium varieties produced the longest fibre which was clean and bright without any pith. The late varieties produced fibre of inferior quality with dirty colour.

In manurial experiment no differences were seen in the growth of the crop under differently manured plots, nor were there any significant differences in the yields of the crops under various treatments.

In a seed-rate experiment where 50 lb., 75 lb., and 100 lb. of seed-rate per acre were tried, increased yields were obtained with 75 lb. and 100 lb. seed rates as compared to 50 lb. But there was no significant difference in yield between 75 lb. and 100 lb. seed-rates.

In a trial to find out the best time for harvesting, it was found that the crop when harvested at the full bloom stage gave the highest quantity of green stalks per acre. Stalks retted after drying for three days gave the highest yield of fibre, while stalks retted after drying for two months and three months gave fibre of poor quality. Retting was earlier by about six to twelve hours, in still conditions of both clean and muddy water than in running water, the difference between clean and muddy water being not significant. The fibre obtained with clean water was cleaner in both still and running conditions than with muddy water. The quality of fibre could considerably be improved by beating and combing but a loss of about 25 per cent by weight was entailed in the process. Bleaching powder, washing soda, dilute acids and 0·5 per cent of potassium permanganate solution in conjunction with one per cent of acidified sodium bisulphate were tried. The last material was found to bleach the fibre well, without effecting its strength much.

In BOMBAY the experiment on the relative efficiency of different species of bees for pollination purposes was continued. Sunn-hemp being a self-sterile plant the idea is to devise a simple method of cross-pollination for multiplying the seed of the wilt-immune strains. The work on the relative pollinating efficiency of Apis and Megachile bees was continued during the year. The results were similar to those of the previous year. There was, however, no marked difference in the seeds in Megachile and Apis stimulated pods. The seed of D-IX, the wilt-immune strain, was multiplied in a large muslin cage on the college farm; Megachile bees were used for pollination. Heavy rains in September affected flowering and there was also severe attack of anthracnose caused by *Colletorichum curvatum* Briant and Martyn. Both these factors adversely affected the yield. In order to maintain purity of the seed, a few plants of D-IX were grown in large galvanized iron containers and covered by muslin cages. These plants were sib-crossed by hand to produce seed. Three pounds of D-IX seed was sent to Dharwar for multiplication in the open. The plants suffered from lack of moisture, and only 19 pounds of seed was produced. The F_1 progeny of the cross between the immune and susceptible individuals of sunn-hemp was tested in heavily infected soil with temperature of about 26°C contained in visconsin tanks. All F_1 plants showed wilt symptoms, thus indicating that susceptibility to wilt is a dominant character. Fourteen of the F_1 plants showing wilt symptoms were transferred to sterilized soil but only six plants survived. These plants were grown under cages and cross pollinated by hand. The F_2 progeny will be tested during the next season. Some of the F_1 plants were also back-crossed with resistant and susceptible parents.

In BIHAR as a result of a general survey of the sunn-hemp type conducted during the year, 26 more samples of sunn-hemps were collected from different ecological localities of the province. Preliminary experiments made in the

botanical section, Sabour (Bihar) during the past three consecutive years, on the extraction of fibres of sunn-hemps, have definitely shown that early (*desi*) varieties in general are the best quality fibre-yielders, and the highest yield of poor quality fibre is obtained from the late (*parwaria*) varieties. This led to attempts being made to select suitable strains from among the late varieties also. Thirty-five cultures raised from single plant seeds of last year were sown in lines along with 26 new samples (including 17 late ones). Desirable materials have been collected out of these for future studies. The cultures from samples obtained from Raneshwar (Santal Parganas) have proved to be the earliest. The selfed single-plant seeds were obtained by the new method of controlled pollination in *sanai* evolved at the botanical section, Sabour. The Bihar variety has been found to be the best fibre yielder and combines the character of length of fibre with lustre and softness. In the *Pakur* variety, the fibre is very lustrous but is only moderately soft and possesses medium length. In the *Nawada* type, the fibre is extremely soft but is short in length and possess moderate lustre.

In the CENTRAL PROVINCES, a close study was made in relation to the opening and closing of flowers on sunny and rainy days representing different conditions of temperatures and humidity. It was observed that the percentage of the opening of flowers between 1 to 2 p.m. was reduced by 8 per cent on a rainy day, while the percentage of flowers opening within 2 to 3 p.m. was increased by 10 per cent on a similar day. The blooming is delayed on rainy days. It was observed that 17 per cent of dehiscence occurred between 10 and 11 a.m., 67 per cent between 11 to 2 p.m., and 15 per cent between 2 to 2-45 p.m. and no dehiscence occurred after 3 p.m. When flowering was allowed to occur inside the muslin bags, dehiscence and opening of the flowers occurred in the usual way but no setting took place. However, if the stigma was rubbed before selfing, the percentage of setting rose from 27 to 57. By the newly devised method of applying a drop of glucose solution (strength 5 per cent) to the stigma after rubbing, the percentage of setting increased to 65 per cent. In varietal trials, no significant difference was found in the yields of dry straw between the two varieties—Jubbulpore and Chhindwara, but both of these were found to give significantly increased yield over the Pusa variety. The cultural trials were conducted to see the effect of (*a*) different seed rates, (*b*) different times of sowing, and (*c*) different times of harvesting on the yield and quality of the fibre. The results of the first year, which were analysed statistically, were in favour of a seed rate of 80 to 100 lb. per acre, early sowing, and harvesting at the dead ripe stage. Retting experiments in standing and running water were conducted in December, March and May, i.e. under low, medium and high temperature conditions. Fibre retted in running water was observed to be superior in colour and fairly free from gummy matter. The retting process took seven days in the cold weather and could be extended without adverse effects for two more days. In March and May the optimum retting period was five to six days. Longer periods produced deterioration in the fibre. The Imperial Council of Agricultural Research has sanctioned a scheme for investigations in sunn-hemp in Madras, Bombay, Bihar and the Central Provinces. A coordinated trial to find out the behaviour of a few selected types at different centres was started during the year.

Flax

In BENGAL, during the year under review, a few more varieties besides JWS and Liral Monarch were grown with a view to finding out a strain which will serve the dual purpose of the production of fibre and a high out-turn of seed. One of these varieties named 'Oil flax' was received through the courtesy of the Indian Trade Commissioner, Hamburg. Nine strains were also received from the Oil Seed Botanist. Some of the promising varieties were found to be late flowering. It has been calculated by experiments on the process of retting and extraction that 30 to 40 maunds of dry straw capable of yielding four to five maunds of fibre can be obtained from one acre. Besides this two to four maunds of seed can also be obtained. It has further been found by experience that the crop should be retted and broken immediately after harvesting. The process of scutching may be left till the advent of the rainy season in July and August. The crop does not deteriorate on keeping but on the other hand the quality of fibre is said to improve the longer the straw is kept stored. Up to now over 10 maunds of clean fibre have been obtained from the last two years' crop. A big jute firm wish to make a mill trial with the fibre provided a sufficient quantity is supplied. This is being arranged. If the mill trial succeeds, then it may not be necessary to export the fibre to Europe for sale. India imports a large quantity of flax goods annually and if these could be produced locally then the cultivator may expect to get a better price for the fibre. Until recently all straw used to be retted at Dacca, but quite recently the work has been extended to Brahmanbaria and Rangpur as well. The products obtained from these places point to the fact that the quality of fibre is probably dependent on the locality. To determine this point, analysis of water in different localities has been started. During the year, the total quantity of seeds obtained from different centres in Bengal was roughly seven maunds of JWS and ten maunds of Liral Monarch. An area of five acres was also sown at Karnal, where a high yield of 12 maunds of seed per acre was obtained. Forty maunds of seed was sent from Karnal to Dacca and 8½ maunds of seed was reserved for further multiplication. It has been further proved that it is advantageous to grow seed at Karnal as the fibre produced from these seeds showed no deterioration. Two maunds of seed was supplied to the Deputy Director of Agriculture, Jullundur circle (Punjab), who is anxious to introduce this crop in Kangra and submontane districts where natural irrigation water is available. If the crop grows there successfully, the need for renewal of seed from Europe will no longer arise. If in addition to seed production, extraction of fibre is also undertaken there, then it may become possible to produce the seed at a cheaper cost.

Further improvements were made in the scutching machine and it is proposed that, if the results of this year's experiments are satisfactory, from the point of view of length, strength and yield of fibre, these experiments will be considerably expanded and will include provision of scutching machines to various cultivators in the interior. Six scutching machines were made by Messrs. Renwick and Co. of Kushtia. One scutching and one breaking machine were made at Dacca by the Coronation Iron Works. Besides these, seven wooden hand scutching machines were made by a local carpenter. It is considered necessary to make a few more breaking and scutching machines of improved pattern when more funds become available. Arrangements will be

made with the cultivators during the next year to grow flax on a larger area. Four centres have been selected for this purpose in Rangpur, Murshidabad, Tippera and Faridpur districts. In each centre there will be a godown where the crop grown by cultivators in the vicinity will be collected and where machines for breaking and scutching will be kept. The retting will be done under the supervision of expert labourers and the method of extraction will be demonstrated to persons who want to undertake this as a cottage industry. Work will also be done by hired labour to find out the cost of production.

Sisal hemp

A large number of suckers were supplied to the Baroda State and to the Economic Botanist, Assam. A fairly rapid extension is taking place in some parts of the province. The utility of sisal as a profitable industry is further enhanced by the fact that it can be successfully raised in unproductive land.

Rhea

There has been some interest in this important fibre crop during the year under report. The difficulty in degumming and extraction of fibre still continues. It has not been possible yet to evolve any suitable method that may prove to be commensurate with the labour and cost involved.

7. Tobacco

The total area under tobacco in India in 1937-38 was 1,288,000 acres as compared to 1,183,000 acres in 1936-37 and the total yield of dry leaf was estimated to amount to 511,000 tons in 1937-38 as against 493,000 tons in 1936-37.

Exports of unmanufactured tobacco improved from 41·1 million lb. valued at Rs. 104 lakhs in 1936-37 to 42·5 million lb. valued at Rs. 118 lakhs in 1937-38. Exports of cigarettes of Indian manufacture, almost entirely to Burma, declined from 2·6 million lb. to 2·5 million lb. in quantity but the value rose from Rs. 67 lakhs to Rs. 70 lakhs. Exports of other manufactures were valued at Rs. 11 lakhs in 1937-38. Imports of unmanufactured tobacco remained stationary at 6·6 million lb. in quantity but the value thereof declined from Rs. 48 lakhs in 1936-37 to Rs. 45 lakhs in 1937-38. Although Indian factories have been meeting, for some time past, the local need with popular brands of cigarettes, the demand for foreign varieties is on the increase and the imports of cigarettes advanced from 855,000 lb. valued at Rs. 30 lakhs in 1936-37 to 993,000 lb. valued at Rs. 34 lakhs in the year under review, as usual the United Kingdom being the largest supplier. Of the other descriptions of tobacco, imports of cigars amounted to 191,000 lb. and tobacco for pipes and cigarettes 51,000 lb. in 1937-38.

Research on the various aspects of cigarette tobacco production was continued at the Tobacco Research Sub-station, Guntur. The following items of work received attention : (1) manurial experiments to test the effect of different manures on the yield of cured leaf, (2) curing experiments to test the value of the leaf produced under different manurial and cultural treatments and (3) the study of the flue curing processes with reference to quality of the leaf.

The work on leaf-curl of tobacco was continued at Pusa by the botanical, entomological and mycological sections of the Imperial Agricultural Research Institute. As regards the incidence of leaf-curl at different times of the year,

the general trend was similar to that of last year ; the incidence of the disease was greatest in the months of October and November especially in plots where the crop was sown in June and July. Further experiments on the insect vectors were conducted and it was shown that *Ageratum Conyzoides* is an important alternate host of tobacco leaf-curl.

Experiments under the cooperative scheme to determine the most suitable areas in which to extend the production of cigarette tobacco were carried out for the third year. As in previous years, Adcock, Harrison's Special and Pusa Hybrid 142 were grown in the different centres and samples of cured leaf were sent to the Imperial Economic Botanist for valuation. The valuations on the samples of the current year are not yet available but the results of last year from Bilaspur and Warangal were decidedly encouraging. The trial will be repeated during 1938-39 at the end of which the results of the entire period will be reviewed and suitable modifications effected in any further scheme that may be adopted.

The chief items of work in progress during the year at the important centres are given below :

MADRAS. The comparative trials of both cigar and cigarette types were again continued. In cigar types, No. 20 maintained its superiority over all other strains and in cigarette types, Adcock 13 closely followed by Adcock 14 gave significantly higher yields than Harrison's Special, HS 8 or HS 9. A cross between a local variety and an exotic type has proved to be superior to all other strains both in yield and quality and it will be issued for general cultivation. Green manuring was found to have a depressing effect on the yield of tobacco.

BOMBAY. At the Nadiad Tobacco Breeding Station, selections in the Keliu variety, which is widely grown in the tract, were tested for yield, and Nos. 24 and 49 were found to be promising. The study of the economics of the different flue-curing processes was continued with a view to reducing the cost of flue curing to make growing of cigarette tobacco more profitable than local tobacco.

Preliminary tests for resistance to *Orobanche* were carried out among potted plants of three varieties, viz. Poona, Adcock, Harrison's Special and G 6 and it was found that six plants from Harrison's Special and one from G 6 were resistant. This trial will be repeated on a large scale in the coming year.

BENGAL. During the year 3,124 tolas of improved tobacco seed were supplied to the cultivators from the various Government farms. Several *desi* types and exotic varieties were under trial. The curing was carried out at two centres, Dacca and Rangpur. A hail-storm at harvest time practically destroyed the leaves at Dacca and spoiled all chances of obtaining good flue-cured leaf. At Rangpur, however, the experiments were more successful and good yellow coloured leaf was obtained. It seems likely that this type of leaf could be developed in this province.

The sale of cheroots at Dacca farm continued to be satisfactory, the proceeds being Rs. 1,488-6-0 in the year under report as against Rs. 1,291-12-9 in the previous year.

BIHAR. The August sown crop having been found unsuitable under Sabour conditions, early sowing in June was tried during 1936-37 and repeated in 1937-38. The experiment proved to be a failure owing to adverse weather

conditions. The average yield of the cured leaf, however, increased this year from five to over eight maunds per acre. The whole of the out-turn amounted to 2,708 lb. and was sold for Rs. 980. The total cost of raising the crop was Rs. 520 so that there was a profit of Rs. 523 which is equivalent to Rs. 115 per acre approximately. These results are most encouraging and show that a definite opportunity exists for flue curing of tobacco in Bihar for people with a little money to invest.

PUNJAB. Various crosses of tobacco were under study. Culture No. 1-4 of the cross Bombay 6 × Kabriwala showed promise of becoming one of the best varieties of the province. Punjab type 12 was tested at the Jullundur Agricultural Station and it yielded 31 maunds 38 seers more than the local type. At the Agricultural Farm, Karnal, this type produced 22 maunds 2 seers or 10 maunds 14 seers more than the local type, thus maintaining its reputation for high yield.

SIND. The work on this crop was concentrated on the high class varieties capable of being used for cigarette purposes, the technique of growing and curing them receiving particular attention. Among the several cigarette varieties, Adcock, Harrison's Special and Pusa Hybrid 142 proved to be high yielders.

TRAVANCORE. Owing to the failure of the monsoon and inadequacy of water supply the crop was not a complete success but the cured tobacco and the cheroots prepared at the agricultural farm were reported to be as good as, if not better than, those imported into the state. With the return of the officer deputed to study the methods of cultivation and curing of tobacco in important centres in British India and Ceylon, arrangements for the cultivation of the crop on a large scale in the Government farm at Puliyara are in progress.

BARODA. During 1936-37, Virginia tobacco was successfully grown for the first time in a private farm at Ramol. During the year 1937-38 the cultivator extended his plantation to 26½ *bighas* and also put up an additional barn at his own expense. The cured leaf totalled to 17,000 lb. and was sold at an average price of 6 as. 6 pies per lb. The actual cost of cultivation and curing came to about 1 a. 10 pies, the farmer thus netting a profit of about Rs. 190 per *bigha*. The possibilities of further extending the cultivation of tobacco in the province are being explored.

8. Oil-seeds

The estimated area and yield of principal oil-seeds in 1937-38 are presented in the following table:

	1936-37		1937-38	
	Area in thousands of acres	Yield in thousands of tons	Area in thousands of acres	Yield in thousands of tons
Groundnut	6,663	2,714	8,745	3,436
Sesamum	4,144	439	4,456	449
Rape and mustard	5,889	964	5,481	1,021
Linseed	3,677	420	3,839	457
Castor	1,409	128	1,146	104
Cotton	..	2,233	..	2,039

In 1937-38 the production of cotton was 5,663,000 bales and the out-turn of cotton seed calculated at 0·36 ton per bale may be estimated at 2,039,000 tons.

The Imperial Council of Agricultural Research continued the grant of Rs. 30,000 to the Oil Technology Section of the Harcourt Butler Technological Institute, Cawnpore, for assisting the oil industry by giving technical advice, undertaking technical researches and imparting specialized training in the technology of oils and allied products to the students from all parts of India.

Introduction of improved varieties

There are a number of improved varieties of groundnut, rape, mustard and linseed which have been taken up by the cultivators. The distribution of improved oil-seeds has lagged behind as compared with rice and cotton. This is partly due to the late start in improving oil-seeds and partly due to the paucity of funds and lack of organization for multiplying and distributing the improved seed. Good progress has been made in distributing improved groundnut seeds in Madras, Bombay and the Central Provinces. The distribution of improved seeds of oleiferous *Brassicæ* is well developed in the Punjab.

Groundnut

In 1937-38 a record area of 8·7 million acres was under groundnut. The principal areas in which this crop is grown are Madras, with 4·6 million acres; Bombay, with 1·2 million acres; and the Hyderabad State, with 1·05 million acres.

The prospects of a big crop coupled with business recession depressed the prices of groundnut in India. The price of machine decorticated groundnut which stood at Rs. 36-12 per candy (500 lb.) in March 1937 had dropped to Rs. 24 by the end of March 1938.

Madras. The demand for the seed of the popular improved variety AH 25 could not be met fully. An intensive study of groundnut was started with the financial help of the Imperial Council of Agricultural Research. Selection No. 678 yielded 10 per cent more than AH 25 and is superior in shelling percentage and weight volume relationship. It also gives a saving of 25 per cent in the seed rate as its kernels are smaller in size. Sixty spreading selections and twelve bunch selections were under trial. Over 300 selections were made from the progenies of the crosses.

Examinations of the root-systems of different groundnut varieties revealed that in general spreading varieties possess a better developed root-system than the bunch varieties. The maximum growth rate was observed in the first fortnight after the flowering in the spreading varieties, and during the second fortnight in the bunch types. AH 25 gave the maximum percentage of fertilization while the indigenous variety was the poorest in this respect.

The groundnut plant did not respond to the nitrogenous manures. Potassium sulphate at 1 cwt. and superphosphate at 2 cwt. per acre increased the yield.

In the Central Provinces AK 12-14 has proved to be the best small podded variety. Among the large seeded varieties AK 8-11 is recommended on account

of its higher yield and better shelling percentage. Out of the eight pure lines under observation, 22 have been selected for further trial.

In the PUNJAB the groundnut is stated to give Rs. 20 more per acre than *jowar*, *moth* or *mung*. The most promising groundnut varieties are A-2 and D-3. In SIND the groundnut and particularly the Spanish peanut suffers from the white ant attack, but the Madras selections AH 25 and AH 36 escape with much less damage. In BENGAL the Madras selection AH 18 has already been established in some parts and there is a great demand for seeds of this type.

The field trials carried out by the INSTITUTE OF PLANT INDUSTRY, INDORE, have shown that AK 12-24 is the most suitable variety for greater parts of Rajputana. AK 8-11 holds out promise in Makrara and Bundi areas. The local Gangapuri variety is a spreading variety which matures late and is difficult to harvest.

Sesamum

At the Imperial Agricultural Research Institute, New Delhi, the breeding of sesamum with a view to produce high-yielding, white-seeded types is in progress. Some of the hybrids appear to possess the desired combinations of characters. In Madras, SI 84 gave about 54 per cent of oil, i.e. 4 to 6 per cent more than in most of the local varieties. Thirty selections were under investigation. In the Central Provinces, the relation between the size of the seed and its oil-content is under investigation. In the Punjab, types 5, 15 and 22 appear to be most promising.

Rape and mustard

Almost half the acreage of these crops in India is in the United Provinces (2·4 million acres), the other important provinces being Bengal (0·77 million acres), the Punjab (0·74 million acres) and Bihar (0·52 million acres).

The Imperial Economic Botanist has taken on hand the investigation of the inheritance of self-sterility in *Brassicæ*. He has observed pseudo-fertility in some of the types.

In the Punjab the Imperial Council of Agricultural Research has financed a scheme for additional research on oleiferous *Brassicæ* crops. Highly improved strains of *toria* and brown-seeded *sarson* have been evolved by ' mass selection '. In yellow *sarson* and *raya* which are normally self-fertile, a large number of unit species have been isolated and described. OBI (L 18), a drought-resistant type, has given the best results so far. The effects of various frequencies of irrigation and different manures on yield and oil-content are under investigation. The course of the development of oil in a growing seed was determined.

In Bihar the purity of two mustard types, Nos. 4 and 5, has been established. In Bengal mustard No. 5 and *tori* No. 7 continue to maintain their superiority. *Torio* crop is becoming popular in North and Central Sind. Among the early varieties selection No. 45, and Lyallpur No. 36 are recommended and among the late types Mirpu-khas selection is preferred. Mustard is the only crop that can be sown as late as 15 December in Central and North Sind, thus allowing the widening of the sowing period of *rabi* crops. Sakrand and Jhatpat varieties are popular. The important problem in the rape crop is the control of the *mahlo*

disease which is brought about by the aphids. In the United Provinces selections have been made which are resistant to aphis.

Linseed

Unlike the other oil-seeds, the prices of linseed were higher during the year 1937 as compared with the earlier two years. Larger demand, especialle from the United States of America, and threatened short supplies of Plate linseed were responsible for the rise in Indian linseed prices which occurred in spite of the higher Indian out-turn.

In the Central Provinces and Berar (1·2 million acres), the principal linseed growing province, a scheme for research in linseed and other oil-seeds was inaugurated by the Imperial Council of Agricultural Research. About 4,000 selections have been made. Six Argentine flax varieties and several improved strains of linseed from the Indian provinces were tried, but none of them showed any special advantage.

The breeding of rust-resistant strains was continued at Pusa and Karnal, where most of the F_4 hybrids were free from rust. Progenies of crosses between linseed and flax varieties made with the object of producing satisfactory dual-purpose strains were under study.

At Indore several selections have done better than IS 11 and IS 65 which are rich in oil and resistant to wilt. Linseed breeding at Poona has been financed by the Sir Sassoon David Trust Fund. Eighteen selections suitable for Karnatak and Deccan tracts are available as a result of four years' breeding work. The percentage of natural crossing under Poona conditions is found to be as low as 0·5 per cent.

In Bihar the purity of Sabour wilt-resistant linseed No. 6, Sabour selected and Gaya local was established. In Bengal preliminary examination of 309 types was completed. In Sind Cawnpore strains Nos. 1150 and 1193 proved superior. In Kashmir the Russian type 39730 shows considerable promise. It is dwarf and hardy and possesses bold seed.

Castor

About half of the area under castor is concentrated in the Hyderabad State (520,000 acres), the next important province being Madras with 247,000 acres.

In Hyderabad 297 single plant cultures were under study. Preliminary yield tests were run with 33 high yielding and 7 mono-spined and 4 non-spiny cultures. In Madras the hybrid selection No. 59-2-1-1 has yielded about 30 per cent more than the control, and two other hybrid selections appear promising. All these selections mature earlier by at least a month. In Bombay two promising strains S 20 and S 5 are under district trials. They were selected for high oil-content and yield. In the Central Provinces correlation between the yield and the number of branches and the length of the spikes has been established. Types 31 and 16 have shown promise. In Sind Dwarf Surat No. 4 proved best among the Bombay strains.

Coconut

In Madras the breeding of the coconut has been taken on hand. Since 'natural' and 'cross' progenies show more vigour than the 'self' progenies,

the production and utilization of heterosis are recommended. That the shedding of buttons (very young nuts) is not due to the scarcity of pollen has been proved by artificial fertilization. From the anatomical examination of the buttons it was found that about 50 per cent of the shed buttons are fertilized, the remaining fifty per cent are either unfertilized or ineffectively fertilized.

In Travancore it is found that a spacing of 30 ft. × 25 ft. is most profitable. Manurial and spacing experiments are in progress in the Cochin State also. A scheme for investigations on the diseases of the coconut in South India was sanctioned by the Imperial Council of Agricultural Research. A survey of the disease in the infected areas was made and the symptoms of 'root' and 'leaf' disease of coconuts were studied. Good infection of the leaf was obtained when a mixed inoculum of *Helminthosporium* sp. and *Gloeosporium* sp. was used. Wilt symptoms were observed on seedlings inoculated with Botryo-Diplodia thobromæ and *Rhizoctonia bataticola*.

9. Tea

The stocks of tea held in Great Britain have shown an improved position as indicated by the following figures:

	London stock at the end of February
	In million lb.
1934	283
1935	298
1936	262
1937	206

With this improving stock position, the export quota was increased from 82½ per cent of the basic year crop for the year 1936-37 to 87½ per cent for the year 1937-38 being an increase of 5 per cent, which gave a total export quota for India distributed as follows:

	lb.
Northern India	274,771,789
Southern India	53,628,360
TOTAL	328,400,149

as compared with 307,986,301 lb. for the previous year. With this greater release by the end of February 1938 stocks of tea in Great Britain increased to 217 million lb.

The average price obtained in 1937 was 15·18*d.* per lb. of tea, which is a considerable increase over the average price obtained during 1936 which amounted to 13·07*d.*

Country of origin	Average price	
	1936	1937
Northern India	13·01	15·05
Southern India	12·61	14·69
Ceylon	14·08	16·00
Java	10·81	13·76
Sumatra	10·26	12·20
Africa	11·66	13·81

The improvement in price in the London market was reflected in the Calcutta market for export teas but no improvement in price was obtained for the internal market in India—

	Export price	Internal price
	As. P.	As. P.
1935-36	9 5	4 10
1936-37	10 1	4 8
1937-38	11 4	4 9

It is estimated that approximately 87 million lb. of tea was available for consumption in India during 1937-38.

Under the Indian Tea Control Act no new areas of tea can be planted, consequently the acreage of tea does not alter to any great extent. The total tea area in India on 1 March 1938 exclusive of Burma was 839,685 acres.

Field experiments carried out in the tea districts of North-East India clearly indicate a general need for nitrogenous manuring and that potash and phosphoric acid show apparent gains higher than could be expected if either of them was really without effect. The conclusion, however, is justified that the average tea soils so far examined showed little immediate need of phosphoric acid or potash for mature tea. In the case of young plants in their second and third years from seed it is evident that the use of potash has been beneficial. This is shown in the greater weight of new growth both in framework of the young plants and in the amount of leaf grown.

The value of application of readily available nitrogen is also demonstrated but it is also evident that in their second year young plants can easily be damaged by an overdose; the young tea plants receiving an application of 20 lb. of nitrogen per acre having grown better than the plants receiving 60 lb. of nitrogen per acre.

Field experiments on mature tea continue to show that the response to nitrogen manuring is proportional to the amount of nitrogen applied for any particular manure. Also that the use of sulphate of ammonia combined with superphosphate and potash when added for 19 consecutive years to plots still carries the best looking and the best cropping bushes compared with bushes receiving the same quantity of nitrogen in other forms.

There has been considerable discussion upon the relative merits of inorganic and organic manures. Experiments carried out in North-East India have shown that bulk organic manures such as cattle manure and vegetable compost have not more than 50 per cent the efficiency of sulphate of ammonia for an equal quantity of nitrogen so far as crop is concerned.

Experiments to ascertain whether there was any difference in the quality of the final product indicated that change in quality is associated with change in crop, and loss in quality is associated with crop increase but is not determined by the type of manure used to bring about the increase, the artificial manure mixture giving no greater loss in quality than the bulk organic manures for the same crop increase. This loss in quality was not confined to any particular period of the year but remained fairly constant throughout the cropping period.

A great deal of work is now in progress in the various tea growing countries with the object of improving the tea bush. Much work is being done in vegetatively reproducing selected bushes.

Owing to the tea plant showing an appreciable degree of self-sterility a larger crop of seed is invariably obtained by pollination from another bush. The average crop of seed set by the tea bush with its own pollen is about a quarter of what would be set if the flowers receive adequate supplies of pollen from numerous other bushes. Russian botanists report that plants resulting from self-pollination are inferior in vigour to those resulting from cross-pollination, also a self-fertilized seed showed a marked reduction in germinating capacity.

The fermentation of tea is in the main an oxidation process dependent upon the difference in the amount of vitamin C oxidase in the shoots of the different tea varieties. This varies little during the season for any one bush whereas the peroxidase content varies considerably during the season.

10. Coffee

Of the three species of coffee, namely *Coffea arabica*, *Coffea robusta* and *Coffea liberica*, grown in India on a plantation scale, *Coffea arabica* is by far the most important. It has been a cultivated crop of India for over three centuries, and on its quality India has earned a reputation as a producer of one of the finest coffees in the world. Decades ago, there was a very large area in South India under *Coffea arabica*, but at present it may only be just over 180,000 acres. *Coffea robusta*, a hardy and disease-resistant plant, is a later introduction, and the area planted has extended to about 17,000 acres. The present area under *Coffea liberica* is almost negligible.

Coffee is largely a plantation crop grown on the hills of South India. On the Bababudan Range, the hills lying to the west and south of the Bababudan Range, the Billigirirangan Range, the Coorg and Wynaad Hills, the Nilgiris, Nelliampathy, Anamalai, the high ranges of Travancore, Shevaroys and Pulni Hills, coffee is grown on an estate-scale. A considerable area has also been planted in small patches of a few acres each, and in domestic holdings scattered around the main coffee producing areas.

Official statistics for area and yield of coffee are collected only from plantations of five or more acres in extent. The number of such reporting plantations in 1937-38 was 5,728, showing a total area of 343,446 acres of coffee land in the possession of planters. Of this, only 181,742 acres had actually been planted. Of this area, Mysore accounted for 52 per cent, Madras 24 per cent, Coorg 22 per cent and Orissa, Travancore and Cochin together 2 per cent.

The season under review was unfavourable to the Indian coffee crop, which, therefore, turned out to be a short one. The total reported production of coffee in 1937-38, according to official statistics, amounted to about 15,000 tons only. Exports during 1937-38 were also small, being only 6,757 tons. The principal customers of Indian coffee were, in the order of their importance, France, the United Kingdom, Norway, Iraq and Belgium.

According to the weekly circulars issued by the Mangalore Curers' Association, the highest and lowest weekly average prices for FAQ Plantation Assortment in the Mangalore market during the curing season were Rs. 33-12 and Rs. 28-4 per cwt. respectively. From returns furnished by curers to the Indian Coffee Cess Committee it is noted that 8,223 tons of coffee passed through the major curing yards at Mangalore, Tellicherry, Calicut, Coimbatore, Hunsur and Mysore, during the curing season of 1937-38.

Since 1925, scientific work on coffee has been centred at the Coffee Experiment Station, Balehonnur, in the Kadur district of Mysore State. This station is maintained by the Agricultural Department of the Mysore State, and a number of problems concerning coffee receive the attention of the specialist officers of the department. In addition, a Coffee Scientific Officer is maintained on this Experiment Station by the United Planters' Association of Southern India, who receive a small grant for the purpose from the Madras and Coorg Governments. The Coffee Scientific Officer is mainly concerned with the study of the fungus diseases of coffee with a view to devising cheap and efficient preventive or control methods, while the Agricultural Department devotes its attention to the study of pests and their control, the breeding of high-yielding and disease-resistant plants by individual selection and hybridization, manurial treatment, vegetative propagation, etc.

As stated in previous reports, the spraying of coffee with suitable spray materials has been found generally effective in controlling such diseases as leaf disease, black-rot and die-back. The work on spray materials and methods was continued during the year of report. The results obtained fully bear out the conclusion that so far as the control of leaf disease (*Hemileia vastatrix*) is concerned, the success of the spray does not depend primarily on spraying when the largest amount of leaf is available on the trees. The study of the behaviour of various families of coffee strains derived from known parents towards strains of *Hemileia* was continued on the station. It was found that Strain I was much commoner on the station than Strain II. The isolation and culture of Strain III, to which certain families of coffee resistant to Strains I and II have been found to be susceptible, met with some difficulty. Further work is in progress with a view to confirming the tentative conclusions already reached.

Studies on the coffee fruit and seed were also continued. The data collected in the course of the investigations during the year under review and previous years show that there is a relation between a good set of fruit and the rapid, growth of flush immediately after the blossom showers. The cause of such defects as ' Black Jelloo ', spotted bean, black bean, ' burnt ' bean, green bean and dry or coated bean was also investigated. An anatomical study of defective beans and microchemical tests on the tissues were undertaken particularly on the black bean, the ' burnt ' bean and the green bean. All the evidence that has been collected goes to show that these defects are due to a disturbance of the moisture or nutritive supply of the bean during its development.

As to the coffee stem borer, which is at present the most serious pest of Arabica coffee, no suitable remedy has so far been discovered, though investigations have been in progress for a quarter of a century. Enough information has been collected on the habits of the pest, but preventive or control measures have still to be found out. The scrubbing of stems and washing them with such washes as the Bhadravathi Wood Tar Distillate Emulsion, Mortegg, etc., have all been tried, but none of them has proved a complete success as a practical, effective and cheap ovicide, larvicide and repellant. For the moment, the only hope appears to be in the removal of the attacked plants. In 1937, the Mysore Government applied the Pest Act to the Manjarabad taluk a of the Hassan district and ordered the destruction of all infested coffee plants. It is estimated that as a result about 19 lakhs of coffee plants were destroyed in 1937. In 1938, the Government of Mysore extended the Notification to the Kadur district as

well. As a result over 16 lakhs of coffee plants were destroyed in each of the two districts, Kadur and Hassan.

Experiments were also conducted at the Experiment Station to test the beneficial aspects of sulphur dusting in the control of the shot hole borer which infests Robusta coffee. A few experiments on different manurial treatments for coffee yielded no definite results. Experiments on the proper method of pruning of coffee were also in progress, but no conclusions can be reached from such experiments until after several more years' work. Two per cent hongey oil resin spray was found successful in combating the green bug pest.

Not less important is the work done in the selection of individual plants for their high yield. The plants which yield 5 lb. or more of ripe cherry every year over a number of years without fail are selected as high yielders. So far, some 16 plants have proved themselves up to this standard. These mother plants and their progenies are under observation. One of these families appears to be very promising in the matter of individual plant yield. Several plants in this family are also resistant to leaf disease. It has, therefore, been proposed to distribute in the season 1938-39 the seeds from selected plants from this family for trial under estate conditions in different localities.

Experiments were also in progress on the station to determine the best method for the vegetative propagation of coffee. Marcotting, layering and planting of cuttings were tried under varied conditions. A series of experiments was also started to study the possibility of propagating coffee from leaf bud cuttings. Preliminary trials started in the preceding year were continued to find out the effect, on the quality of coffee, of the elevation at which coffee is grown, the time of picking coffee, the various methods of drying coffee, the grading of wet parchment and the process of fermentation. The results obtained on the drying of coffee under different climatic conditions are encouraging. A number of other minor problems affecting coffee were also under investigation on the station.

The Indian Coffee Cess Committee constituted by the Government of India under the Indian Coffee Cess Act, XIV of 1935, continued to work for the improvement of the economic condition of the Indian coffee industry. An all-India marketing survey in respect of coffee commenced in 1936 was still in progress in the year of report. Propaganda for increasing the consumption of coffee in the cities of Bombay, Hyderabad and Lahore, the Salem district and Travancore State was also in progress. The efforts made in the United Kingdom to bring Indian coffee to the notice of the coffee trade and the public were continued. The Committee also moved the provincial and state Governments in India to frame rules to regulate adulteration in coffee.

11. Rubber

Owing to the existence of a large number of small holdings devoted to rubber cultivation and the voluntary nature of the returns on which the statistics are based, it cannot at present be stated to what extent the information given, particularly with regard to production, is complete.

The number of reporting plantations in the year under review was 11,817, covering an area of 202,990 acres, as against 11,710 with an area of 201,441 acres in the preceding year. The area of old cultivation abandoned during the

year amounted to 294 acres, while the new extensions (including replanting in areas abandoned in previous years) are reported to have been 305 acres. The area actually under rubber in these estates amounted to 125,062 acres, showing an increase of 1,011 acres on the area (revised) reported in the previous year, and of this area 119,476 acres were tapped. Of the total area under cultivation, 78 per cent was in Travancore, 11 per cent in Madras, 8 per cent in Cochin, 2 per cent in Coorg and 1 per cent in Mysore.

The total production of raw rubber during the year is reported to be 32,266,479 lb. (*Hevea* 32,249,544 lb. and *Ficus elastica* 16,935 lb.) as against 30,447,919 lb. a year ago. The yield per acre of tapped area was 337 lb. in Cochin, 280 lb. in Coorg, 266 lb. in Madras, 265 lb. in Travancore and 41 lb. in Mysore.

The total stock of dry rubber held on 31 December 1937 was estimated at 5,254,265 lb. (*Hevea* 5,237,330 lb. and *Ficus elastica* 16,935 lb.), as against 3,218,366 lb. on the same date of 1936.

The exports of rubber by sea from India to foreign countries during 1937-38 amounted to 21·4 million lb., as compared with 19·6 million lb. in the preceding year. Of this, the United Kingdom absorbed 42 per cent, the United States of America 20 per cent, Germany 14 per cent, Czechoslovakia 11 per cent and Ceylon 9 per cent. These figures are exclusive of exports from Burma which has been treated as a foreign country from April 1937.

Early during the year, the text of the proposed new agreement between the Governments of France, the United Kingdom, India, Netherlands and Siam was circulated to the Government and producing associations concerned for consideration. The new agreement provides for a considerable increase in the basic quotas for each territory. and the quota for India, exclusive of Burma, is increased from 13,000 tons to 17,500 tons in 1939. The chief innovation, however, in the new agreement is the provision permitting the planting up of new areas to a limited extent, that is to say, up to an area not greater than 5 per cent of the total planted area in each territory during the first year of this agreement. New planting is to be permitted in the subsequent years of the agreement to such extent as the International Regulation Committee may fix from time to time. The committee also has the power to allot a special limited amount of replanting to any or all of the territories in such manner as it deems appropriate. Under this scheme, during the first year of the agreement, India is permitted to plant 6,400 acres of rubber and it will be necessary for the Government of India to draft rules as to the allotment of planting licences. It has also been decided that any grower who does not wish to make use of his licence for new planting may dispose of his right to another estate.

Under the trade regulation between India and Burma it was laid down that there were to be no restrictions or prohibitions on exports from India to Burma or *vice versa* except in regard to any matters mentioned in the Schedule. Under this regulation, during the pendency of the current international agreement, all imports of rubber from Burma into India have had to be accepted free of export licence, and amongst growers in South India a good deal of uneasiness has arisen through the very heavy increase of the imports into Calcutta of rubber from Burma, which has depressed the price of rubber in that market to such an extent that it is now below the cost of production. Strong representations were made to the Government of India by the U. P. A. S. I., the Indian

Rubber Licensing Committee and, to the Diwan of Travancore, by the Indian Planters' Association of Kerala to prohibit the importation of Burma rubber into India without licence as from 1 January 1939, in order that the Calcutta market shall not continue to be flooded with uncouponed rubber to such an extent as to cause the market price to continue to be less than the cost of production.

The internal consumption in India is showing a steady increase. In 1936 the quantity of rubber shipped in South India to other ports in the country amounted to 6,888,867 lb. which increased to 8,517,180 lb. in 1937.

A leaf spot disease of rubber plant *Hevea brasiliensis*, received from the Mundakayam Valley Rubber Plantation, was investigated at the Imperial Agricultural Research Institute, New Delhi, and the cause of the disease was found to be *Oidium hevea* Steinman. An account of this important disease has been published in the *Indian Journal of Agricultural Science*, Vol. VIII, pp. 185-8 (1938).

12. Fruits

In addition to the work at the fruit research stations financed by the Imperial Council of Agricultural Research, this review embraces practically all the horticultural investigational work carried out by the provinicial Departments of Agriculture and some of the Indian states during the year 1937-38. It is chiefly due to the interest taken by the Imperial Council of Agricultural Research that horticultural work today figures so prominently in the programme of agricultural research and development in India.

The Imperial Council of Agricultural Research spent Rs. 1,27,023 in financing horticultural research work in various provinces in India. The provincial Governments and some Indian states also spent a good deal in financing their fruit research.

Import and export

The large quantity of the import of foreign fruits and vegetables by sea and land which is valued at about Rs. 300 lakhs (this includes the value of the fruits imported by land) would not appear so embarrassing when this figure is read against Rs. 208 lakhs, the value of fruits and vegetables exported from India to foreign countries. The export of fruits and vegetables, dried, salted and preserved has increased from Rs. 137 lakhs in 1936-37 to Rs. 148 lakhs in 1937-38. The chief dried and preserved fruit which is exported is cashewnut, being valued at Rs. 129 lakhs of which 54 per cent was exported to the United States of America.

Propagation, selection of stock and scion and establishment of nurseries

Research on propagation of plants and nursery work has attracted to some extent the attention of workers. The value of the American method of bud insertion with a slice of wood attached to it in the case of Chinee orange, when it is budded on Kichili stocks, is well proved. Observations on the lopping of Kichili root stocks, root growth of citrus stocks, the possibility of inarching three to four months old mango stocks and propagation of mango by ringed cuttings are made at the Fruit Experiment Station, Anantarajupet. The use of synthetic

hormones in encouraging the root growth on the cuttings of mango and pomelo is under observation at Dacca. Better gootie plants have been obtained by allowing a short drying interval between the ringing of the bark and the application of mud in litchi plants at Sabour. Large number of reliable plants of almonds, mango and sapota are made available to the growers by the Baluchistan, Travancore and Cochin Agricultural Departments. It is now definitely known that top working of mango can be successfully done in Bihar.

The citrus stocks raised from seeds have shown more lateral roots and larger zone of root distribution than those raised from cuttings in the Punjab, where it is also observed that Kharna Khatta imparts vigour to the scion worked on it. The rate of mortality of plants belonging to various stock and scion combinations have been studied as affected by transplanting and transhipment in the case of various Malling types of apple stocks and scions under trial at Chaubattia. It is also observed that Crab C stock gives the best growth. The apple varieties, viz. Delicious and Jonathan, have produced more wood than Rymer when used as scions. The root system of various citrus stocks is being studied at Nagpur where it is observed that root stocks seem to affect the *santra* scions greatly. A large collection of root stocks is obtained from East Malling and is under trial in Baluchistan.

It is observed that very little has been done in encouraging private enterprise in establishing reliable nurseries. The Bombay Agricultural Department has a nursery registration scheme which is yet to operate. At any rate, a few nurseries in Western India are cropping up as a result of the increased interest which the grower is taking in fruit cultivation. Baroda State has a scheme for starting nurseries at Dhari and other places. Cochin, Travancore, Baluchchistan and some other provinces have got their own nurseries from where reliable plants are being supplied.

There is also very little which can be mentioned in regard to the selection and classification of root stocks except a few observations here and there as stated above. It is, however, observed that such studies are included in the programme of work in Madras, the Central Provinces and Baluchistan.

A good deal of work, however, is being done by the Agricultural Departments in various provinces and states in establishing experimental fruit farms. It is anticipated that investigations relating to root stocks will be taken up in due course when the preliminary work is completed by the various provincial departments.

Improvement of fruit crops by breeding, selection and artificial pollination

This line of research is very restricted. It is observed in the Punjab that the shape of the berries of the Khalili variety of grapes may be changed by the pollen of Kandhari. Hari Jha guava has given the best performance at Krishnagar. Special study of papaya is made at Allahabad to find out the benefits of controlled pollination. Several selected strains of guava are being given field trials at Poona.

Physiological and cultural observations

The earlier ringing of the bark of apple trees is found to be beneficial at Chaubattia. Nitrogen alone or in combination with other manures has given

more growth in peaches at the same station. The liming of the soils in Malta oranges is found to be a useful practice and pine-apple grown on ridges has given better yield at Krishnagar. In Madras off-season bearing varieties of mango have been selected and their performance is being recorded. The records show that biennial bearing is not a regular phenomenon. A detailed study of the problem of periodicity in bearing in mango is also undertaken in Bihar and Orissa. Cultivated mango trees have shown superiority over uncultivated trees as regards growth and yield in Bihar. A good deal of work on the manuring of mango trees is in progress in various provinces. The success of Cordon system of fruit culture is demonstrated in Baluchistan. The value of American 'bush system' of growing vines as compared with the indigenous trench system is under trial at Malezai farm.

Picking, packing, marketing, storage and prescrvation

As regards the development of fruit crops with special reference to picking, packing, transport and market, some progress has been made. This work is being done by the marketing organisations working under the control of the Agricultural Marketing Adviser to the Government of India both at the centre and in the provinces. Some experimental grading stations have been established in various parts of India for grading fruit. The quantity of fruit graded is increasing day by day, indicating that the packers have realized the benefit of grading. Apart from a few regulations as regards grading of fruits, there is not much which can be mentioned. The Government of Bombay have under consideration a Market Act to regulate fruit markets and have also extended the life of the Provincial Fruit and Vegetable Market Committee for another year. Some of the railway companies have extended freight concessions and have made arrangements to supervise the transport of fruit and vegetable packages but such improvements are restricted to particular zones only.

As regards storage, it is observed at Poona that fully ripe Nagpur orange can be kept in good condition for three months at 40°F without any appreciable wastage. Ripe Malta orange can be kept at 40°F in good condition without any wastage for four months. The size of the Malta fruit is found to influence its storage behaviour. The big fruit retains fresher appearance for a longer time than small fruit in cold storage. Wrapping Alphonso fruit in tissue paper spoils the ripening power after cold storage. Rice straw and wood wool used as packing material do not affect Alphonso fruit while in cold storage but do spoil the subsequent ripening to a certain extent. A well-ventilated crate of the size 24 in. × 12 in. × 12 in. capable of holding about a hundred Alphonso fruits has been found to be a suitable kind of package for cold storage. The fruit of 'B' stage of maturity of the Pairi variety can be kept in good condition for seven weeks at 45°F. Similar observations have been recorded with regard to potato, cabbage, cauliflower and other vegetables. At Benares it is found that iodized wood shavings have a definite advantage over iodized paper in the prevention of rot in tomatoes.

At Anantarajupet, an 'eye' extractor of pine-apple is devised and is found very useful in taking out the 'eyes' of the pine-apple fruit.

In the Punjab it is observed that vitamin C is more lost in orange squash than in lemon squash during one year's storage. SO_2 is found useful in pre-

serving vitamin C. Pre-heated orange squash is also found to be richer in vitamin C than the one prepared from unheated juice. Maturity test in pears with a test 13 lb. pressure has given the best canned products. A good deal of work on lime juice is done at Baroda where a scheme of the Baroda Industrial Board is in operation. Mango canning work is done in Madras with a view to determine the optimum period of exhaustion and sterilization. At Benares the physiology of the life duration of fruit has has been investigated and the possibility of the use of atmospheric oxygen is suggested for storing mango. Banana flour is prepared in Travancore.

Insect pests and diseases of fruit crops

A detailed study of citrus diseases is made in the Punjab. A new disease, viz. *Ramularia* sp., is also recorded in grape vines. At Chaubattia one per cent sodium chlorate when sprayed on leaves of *Oxalis* sp.—a weed in apple orchard—prevents the formation of new bulbs and kills the old bulbs. Siroo (*Imperata Cylindrica*) could be controlled by 4 per cent solution of sodium chlorate. The variability in the intensity of attack of apple borer has also been studied. The vapour para-dichlorobenzine is found effective as a larvicide to about six inches deep in soil and up to 12 in. in sandy soils. Observations on the woolly aphis (*Eirosoma lenigerum* Hans.) on apples have shown that the migration of aphis from roots to shoots and *vice versa* occurs throughout the year. Grease banding and spraying nicotine and soap mixture were effective in controlling aphis. Observations on other crops such as *Pyrus malus*, *Pyrus communis* and some Prunus varieties in regard to aphis are on hand. At Nagpur it is observed that *santra* budded on pomelo is the least susceptible to foam disease. Investigation on the yellowing disease in orange is conducted in Assam.

Organization

As regards the organization for the development of the fruit industry, there is very little to write. The Dhari (Baroda State) Taluka Fruit Association has shown good progress. It is observed that very little effort has been made to introduce improved varieties of foreign fruit crops in India with the exception of a few varieties of citrus, grapes, peaches, rambusteen, langsat-daku and santorikum. Effort is being made at several places to give varietal trials to indigenous varieties of fruit crops to find out which variety is likely to thrive well in a particular tract.

There is, however, an increasing tendency on the part of provincial Governments and state authorities to encourage the development of the fruit industry. A very substantial start has been made in tackling a variety of problems on fruit research at the various fruit research stations. Much depends upon the success of these research stations to give a further fillip to the fruit industry on a scientific basis in India. It is anticipated that the results of researches now on hand when complete would enormously benefit the growers.

13. Fodder crops and grasses

In the majority of the provinces and some of the Indian states more attention is being paid to increased production of fodder crops and improvement of

grasslands. This is evident from the constitution of provincial fodder and grazing committees in the United Provinces, Bombay, Madras, the Punjab and Baroda State. In those provinces and major Indian states in which grazing committees have not been set up fodder and grass improvement does receive the attention of the authorities concerned to a greater extent than it did in the past.

In all the provinces and some of the Indian states there is greater cooperation between the Agricultural and Forest Departments to provide better grazing facilities. The introduction of suitable exotic fodder grasses from South Africa, West and East Africa, U. S. A., Australia and other countries is actively being pursued. The report from the provinces show that more propaganda is made on conservation of fodder by preparing ensilage: Efforts are being made to make a collection of legumes of fodder value suitable for introduction in pastures.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH. *Central Fodder and Grazing Committee.* The *ad hoc* committee mentioned in the previous report has been constituted into a standing committee consisting of representatives from different provinces. The second meeting of this committee was held in Delhi in November 1938.

The Central Fodder and Grazing Committee acts as a liaison body between the provincial committees and discusses grazing and fodder problems affecting majority of the provinces. Within the two years since its inception the central committee has done very useful work.

IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI. Fodder investigations consisted chiefly in paying attention to overcoming problems of seed production, water requirements and yield of alternative crops of berseem (*Trifolium alexandrinum*). The slow spread of this very useful fodder appears to be due to its high water requirement and high cost of seed.

Trials on a few strains of oats were conducted at Pusa sub-station.

IMPERIAL DAIRY INSTITUTE, BANGALORE. Sufficient perennial fodder grasses were grown for preparing ensilage to provide the dairy stock throughout the year. Over 1,100,000 lb. of ensilage was prepared at a cost of 8 as. 4 pies per 100 lb. A tower silo in addition to trench silos was used.

The following is a summary of work done relating to fodder crops and grazing in the provinces :

MADRAS. In all the circles efforts were made to persuade the *ryots* to grow fodder to supplement rice straw. Spread of sann-hemp, *Kolukattai* grass (*Pennisetum cenchroides*), lucerne and some of the perennial grasses was undertaken. Trials of preparing silage from groundnut husks were made at Kalahasti and it was found that the material prepared was fair. Seed of important grasses was distributed in different parts of the province.

BOMBAY. The large-scale rotational grazing experiment had a successful year. The season and the condition of vegetation was the best ever since the experiment commenced. The grazing area recovered from the set-back it had during the previous rainless year. An interesting correlation between green condition and increase in live-weight and the dry condition and decrease in live-weight of animals maintained on grazing without supplementary stall feeding was observed successively for about four years.

At Betegaon Cattle Breeding Farm more area under green fodder was grown to provide green fodder to cattle throughout the year. *Gowar* (*Cyamopsis psoraloides*) was found to be very good both as green fodder and dry *kadbi*.

BENGAL. Napier grass is grown on all farms for fodder as well as supplying cuttings to cultivators. Demonstration on silage making is given but the cultivators appear to take little interest in matters of conserving fodder by silage and other methods. Encouragement is given to increase fodder cultivation required for feeding better stocks.

PUNJAB. Sudan grass is becoming more popular and the demand for seed has outgrown the supply. Some new selections in *jowar*, cowpea (*Vigna catjang*), *moth* (*Phaseolus aconitifolius*), teosinte and oats have been added to the existing ones and fresh selections are under way. Attempts are being made to select a non-hairy type of *guara* (*Cyamopsis psoraloides*) which the cattle could readily eat. Root stocks of perennial grasses were distributed.

BIHAR. A survey of the important grasses of the province and their importance from the point of fodder value and mineral contents has been undertaken from grants sanctioned by the Imperial Council of Agricultural Research.

CENTRAL PROVINCES. Botanical composition of grass areas and the effect of different fertilizers on them is being studied. Burning had the effect of increased vigour in growth but *Andropogon contortus* was unaffected.

ASSAM. *Marua* has been found to be suitable both for fodder and ensilage. A number of fodder gardens (*baris*) were established and silo pits were dug. Trials on local aquatic grasses are expected to yield valuable results. The production cost per maund for some of the fodders was determined.

SIND. Berseem (*Trifolium alexandrinum*) is becoming very popular and is used as a rotation crop and also in reclaiming *kalar* soils. Mongold, turnips and *senji* (*Melilotus parviflora*) are grown for fodder purposes.

HYDERABAD (DECCAN). Sets of Guinea and Rhodes grasses were sold for growing fodder crops. Ensilage of maize, *jowar* and cowpea was prepared.

TRAVANCORE. Investigations on the mineral composition of pasture grasses in the state have revealed that they are deficient in lime and phosphoric acid. The exotic grasses such as Guinea and Napier grasses introduced into the state are richer in mineral contents. Distribution of cuttings of Guinea and Napier grasses was done and growing of Guinea grass is established all over the state. Selection of other fodder crops is in progress.

COCHIN. Guinea grass is found to thrive even on dry lands and hillocks. Six to eight cuttings are taken and the surplus is converted into ensilage. Other fodder crops are under trial.

BARODA. Reinfection of cleared areas of *beeds* by *khadi* grass seed from adjoining military *beeds* was prevented by providing a belt of cultivated land of suitable width in between. *Beed* lands when fertilized gave better yield but the practical aspect of manuring has not been worked out. Trials on different fodder crops are in progress.

14. Millets

The work of millets was in progress at different places in India. Considerable amount of work has been done and quite a number of selections suited for different parts of India are being distributed to the cultivator. The problem

of producing varieties of crops resistant to different diseases are being studied by the local officers concerned.

The three main millets cultivated in India—*jowar* (*Andropogon Sorghum*), *bajra* (*Pennisetum typhoideum*) and *ragi* (*Eleusine coracana*)—occupy an area of thirty-three million, sixteen million and eight million acres respectively.

Jowar (*Andropogon Sorghum*)

The largest area under this crop was in Hyderabad State (8·4 million) followed by 8·1 million in Bombay, 4·5 million in Madras, 4·2 million in the Central Provinces and Berar, 2·9 million in Bombay states, 2·2 million in the United Provinces and 0·83 million acres in the Punjab. Other provinces and states have less than 0·8 million acres each. The total estimated yield of grain was 6·4 million tons.

In HYDERABAD eight *jowar* varieties were under trial at the Dry Farming Research Station, Raichur, on the *rabi* black soils. Varieties M 35, M 47-3, and BD 34 seem promising.

In BOMBAY efforts were continued to produce a *jowar* which is resistant to the Striga parasite. Bilichigan and a new type Muddinandyal show promise of yielding resistant strains. Experiments at the Dry Farming Research Stations at Sholapur and Bijapur remained in progress. At Mohl farm selection and purification of Maldandi *jowar* strain was continued. Strains 35-1 and 47-3 are liked in the district.

In MADRAS, in the Chetrai Vellai variety, two strains AS 732 and AS 1543 and Chitrai Manjal variety AS 1195 proved better than the standard strains AS 1575, 2095 and AS 809. In Guntur J 103 and J 106 and in Nandyal selections 233, 628, 294 and 653 appear promising.

Among the fodder types of *jowar* AS 3355 has proved to be the best in every respect and will be tested on a field-scale trial. A cross between Peria Manjal *cholam* of Coimbatore and Yerra Jonna of Vellary has given very high yields of fodder. One variety from Tanganyika and another from Bombay Province have been observed to be fairly resistant to Striga parasite. Studies were also continued on the habit of flowering, chlorophyll deficiency in seedlings, etc. 11,800 lb. of improved seed was distributed.

Investigations on the keeping quality of malt from *cholam* show that when packed in vaccum its quality remained unimpaired even after lapse of six months. Biscuits prepared by blending a fair percentage of *cholam* malt with white flour are as palatable and nutritious as imported biscuits and better than ordinary bread.

A machine has been devised by the Agricultural Engineer to the Government of Madras for polishing *cholam*.

In the Central Provinces and Berar No. 33, a white grained variety, appeared to be specially suited for lighter types of soil in the Nimar tract. Improved Saoner continued to be popular and there is a great demand for its seed. The new strains 123 A and EB 1 have also given good results. 16,830 lb. of pure seed of improved varieties was distributed.

In the PUNJAB J 8 has continued to show its superiority over other types regarding yield of grain, yield and quality of fodder and dry straw. At Dry Farming Research Station, Rohtak, type 908 gave the maximum yield of fodder

while in another set Duggi has given good results. The results of the trials at Rohtak are not conclusive.

In BIHAR studies in different *jowars* were continued.

In SIND improved varieties suited to different tracts have been evolved. Red Janapur is greatly appreciated in Upper Sind, Sukkur and Larkana districts on account of its high yield of grain and fodder, early ripening and less susceptibility to stem borer. For middle Sind Saoro, Kartuho No. 1, Depar No. 1, Red Janapur No. 3, for Karachi districts Acho Bazigar and Acho Kartuho No. 1, and for Dadu districts Acho Kodri No. 25 have been found suitable.

In TRAVANCORE work is being conducted at Puliyara farm.

Bajra (*Pennisetum typhoideum*)

The total area under *bajra* was 16·2 million acres and the main *bajra* growing areas in order of importance are Bombay (3·5 million), Punjab (2·6 million), Madras (2·5 million), Hyderabad (2·1 million), United Provinces (2·1 million) and Bombay states 1·9 million acres. None of the other provinces contribute more than a million acres.

In BOMBAY the strains 187·4 outyielded the Niphad-local. Trials with African variety were also conducted and it was found in no way superior to the local. It has been established that contamination through muslin bag occurs and inbreeding in *bajra* results in decreased vigour with various disabilities, hence breeding methods were revised and group breeding and mass selection was also adopted for improvement of the crop.

In the PUNJAB *bajra* types A 1/3 and G 61/21 (a hairy type of *bajra*) continued to give good results.

In MADRAS among the irrigated strains PT 700 (a strain from Punjab Cumbu) faired better than PT 499, while no difference was observed between PT 229 (Kotta Pali Cumbu) and PT 2125 (Vellai Cumbu). Of the rain-fed types, PT 367, a selection from Bombay varieties, gave better yields than PT 248. 2,000 lb. of improved seed was distributed.

In SIND Jamnagar Giant, Sujawal and a few types of the Punjab were under test. Attempts to evolve an early maturing type combined with high yield is in progress.

In BIHAR Sabur type 1 has been found to be quite satisfactory.

In the CENTRAL PROVINCES AND BERAR 145 single lines were under study with the object of testing their purity and yield. Selection work on Jamnagar Giant is also in progress. At Indore Jamnagar Giant has given satisfactory performance. A $\frac{1}{3}$ from the Punjab has done definitely better at Khatri.

In COCHIN Nawanagar variety is also thriving well.

Ragi (*Eleusine coracana*)

Ragi is grown in an area of about seven million acres in India. Mysore and Madras are the two important centres for its cultivation though it is also grown in Bombay, Bihar and Orissa and the Hyderabad State.

In MYSORE at Hunsur all pedigree types of early maturing *ragis* continued to be under observation. ES 11 and ES 13 are doing well. K 1 is becom-

ing popular on account of heavy ear heads and its uniformity. C 3, a Nasik variety, also seems promising.

In MADRAS EC 593 and EC 3775 gave 21 per cent and 33 per cent more yields respectively than the local *ragi*. EC 592 continues to be popular in spite of its larger duration owing to its high yield. In Anakapalle where *ragi* is grown as an irrigated crop both in *Pyru* (January to April) and *Punasa* (April to June) seasons, VZM 33 and EC 593 in *Pyru* season and BAM 10 in *Punasa* season gave the highest yield. At Hagari R 42 proved its superiority in yield of both grain and straw. 7,507 lb. of improved seed was issued during the year.

Other millets

Korra (*Setaria italica*). In MADRAS S 1523, a selection from rain-fed varieties, proved its superiority over all the other rain-fed varieties. S 1523 and S 1544 are being tested in districts under local conditions. 100 lb. seed of this was distributed.

Panivargo (*Panicum miliaceum*). In MADRAS strain PV 36 gave 14 per cent increase over PV 31.

In the CENTRAL PROVINCES AND BERAR work on lesser millets, Kodon and Kutki, was continued. Kutki No. 8 was found to be fairly early type. Nos. 7 and 17 are medium while No. 24 is very late but is a heavy yielder.

15. Other cereals

Barley

An area of nearly $6\frac{1}{4}$ million acres was estimated to be under barley, to which the United Provinces, Bihar and the Punjab, with their respective shares of $3\frac{1}{4}$, $1\frac{1}{3}$ and $\frac{3}{4}$ millions, contributed jointly about 93 per cent.

Malting and brewing tests

The three-year scheme, financed by the Imperial Council of Agricultural Research for investigations on the malting and brewing qualities of Indian barleys grown in the above three important barley-growing provinces, has been completed. These studies have yielded very useful results, of great potential value for shaping future policies, which results can briefly be summarized as follows :

UNITED PROVINCES. Samples submitted from here for valuation and analysis consisted throughout of type Cawnpore 251, grown at four different farms, viz. Raya, Kalai, Kunraghat and Kalyanpur, and with eight different manurial treatments described last year. Results show that while malting and brewing properties are not affected appreciably by differential manuring, soil and climatic conditions, jointly or severally, exercise a considerable influence over them. For example, in 1934-35 the Raya farm samples were described, by the Valuation Committee of the Institute of Brewing, London, with whose collaboration these tests were carried out, as very ordinary and of little interest to brewers, whereas samples from the same farm in 1935-36 and 1936-37 were rated to be of exceptional value, fully equal to the best Californian barleys.

Similarly, samples from Kalai farm were likened in 1934-35 to the best Egyptian barleys, but rated better than ' superior to standard ' Californian barley in 1935-36, while in 1936-37 they were described to have the appearance of low grade barleys. Further, the samples from Kunraghat farm in 1934-35 were considered to be very useful barleys for making malts. In 1935-36 they were simply described as ' kind little barleys ' whose value had been affected by the presence of thin corn, while in 1936-37 they had a very bad appearance. Last of all, samples from the Kalyanpur farm equalled Chilean forage barley in value in 1935-36, whereas in 1936-37 they were as good as FAQ barleys from the same country.

BIHAR. The samples from Sabour were considered about equal to Chilean forage barley of which a good deal is malted for English brewers. In the case of these, the malt made was never below, and in about 30 per cent of cases malted above the quality expected from the appearance of the barley samples. In the case of these barleys also, the finding was that climatic and edaphic factors play a very important part in determining the malting and brewing quality of a barley type.

PUNJAB. The first instalment of samples from the Punjab comprised six types grown under uniform conditions, but in later years they consisted of two types only, found to be the all-round best of the lot, viz. Nos. 4 and 5, grown (i) on two different kinds of soil with two irrigation treatments, and (ii) at five different places ; and, finally, of bulk samples of 300 maunds of each of these two types.

The samples from different places exhibited some difference as regards nitrogen content. It was also found that the higher number of irrigations reduced the nitrogen content and increased the brewers' extract, but the reduction in nitrogen was something appreciable only in the case of Type 5 grown on clayey soil, which with four irrigations had, on grain basis, 0·4 per cent less nitrogen than the same with two irrigations. Further, in both the types (Nos. 4 and 5), and with both the frequencies of irrigation, samples from clayey soils contained decidedly less nitrogen than those from sandy soils.

Conclusions. The upshot of these studies is that barleys of the type of C 251 from places like Raya can hold their own against the best Californian barleys, and that barleys of the kind of Types 4 and 5 from the Punjab, giving as they do analytical figures exceptionally high for Indian barleys, are a promising potential material, and could be employed with advantage for malting and brewing in England provided once their intrinsic value is realized and the bias against their appearance removed. Further, it was noted that high nitrogen content did not appear to affect the malting quality of the Indian barleys to the same extent as of the European barleys. In this respect, Indian barleys seem to resemble ' Manshuri ' rather than the Mediterranean type barleys.

It may be added finally that the samples tested were all obtained from the crops raised at Government farms and it remains to be seen whether production of the same quality can be secured from the cultivators' fields. There is no doubt that Indian barleys of the right kind can find a ready sale in England for malting and brewing purposes provided they can be shipped free of *khapra* beetles, and if an export trade in these barleys springs up, assuring for the cultivator higher returns for his barley crop, he will most readily take up the production of the desired qualities of barley.

Yield trials

In yield trials at PUSA with seven Pusa selections, twelve Pusa hybrids, one Punjab type and one Cawnpore barley, Pusa Type 21 gave the highest yield.

In the PUNJAB four new cross-bred barleys, selected from among the 14 put under field-scale trials for the first time last year, were under comparison against the standard Types 4 and 5, at Lyallpur, on both light and heavy soils. On the sandy soil, Type 4 yielded better than Type 5, and crosses C 111 and C 107 better than Type 4, the former significantly so. On the heavy soil, however, Type 5 scored over Type 4, and crosses C 111, C 103 and C 107 out-yielded Type 5, but the differences in all these cases were non-significant. In addition to these, ten still newer cross-bred barleys were under field-scale comparisons against Types 4 and 5. Of these, only No. 354 (Am 1311×T 4), which has also more attractive (brighter) grains than those of Types 4 and 5, out-yielded Type 5 (best yielding sort on heavy soils) by 4½ maunds of grain per acre.

The six varieties (five foreign and one local) tried in Kashmir fared badly and gave lower out-turns. Out of these, Californian Wonder, a new introduction, topped the list with a yield of 1,110 lb. per acre.

Other studies

Studies at Pusa on the incidence of rust in F_2 plants of the cross Alpha × Type 21 showed that the inheritance of reaction to rust is digenic. In the F_2 of a number of crosses between the virescent mutant observed in type 21 and normal green-leaved Type 21, the green condition was found to be dominant and the ratios obtained were approximately 3 green : 1 virescent plants.

In manurial trials carried out with Type 21, the application of unfermented cake gave higher out-turns of both grain and straw than the fermented mixtures.

In BIHAR the work of isolation of pure lines with a view to evolving disease-resistant strains having desirable malting and brewing qualities was continued, and 40 homozygous cultures were studied in detail, the most promising of which have been retained for further work.

In connection with the work on grade standards of the Marketing scheme of the Imperial Council of Agricultural Research, 383 samples were examined for refractions, size, nitrogen content, etc., at the Imperial Agricultural Research Institute, New Delhi, and about two-thirds of these samples were also submitted to malting tests at the Solon Brewery and also analysed for diastase.

Maize

In British India, maize occupied an area of about 5·6 million acres, of which 82 per cent was grown in the United Provinces, Bihar and the Punjab, these contributing to the total about 1·9, 1·6 and 1·1 millions respectively.

Yield trials

Twenty-six foreign varieties were tried at Sirsa (PUNJAB). The best foreign sorts now available in the Punjab are Silver King, FC 6035 and

6036, of which the first has established itself in Murree Hills and is in great demand. In yield trials in the Punjab, Type Red 1, which has cobs over 6 in. in length and 4 in. in circumference, out-yielded the local varieties at Jullundur and Lyallpur by twelve seers and two maunds per acre respectively.

Eight varieties of sugar corn, three of pop corn and eleven (nine foreign and two local) of field corn were under trial in Kashmir. Among the sugar corn varieties, Golden Bantam, a fresh introduction, gave the highest yield of 2,037 lb. of grain per acre. In the case of pop corn, White Rice and Amber Pearl yielded equally well. The cultivation of sugar corn is spreading in the state as it fetches a higher price (Rs. 5-8 to Rs. 7 per maund) than the local, which sells at only about Rs. 1-8 per maund.

Other studies

Inbreeding at the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, was continued and, out of about 1,200 selfed lines, some 600 promising ones were selected and inbred further. The seedling counts as to the segregation of V_{21} indicated a close linkage between Y and V_{21}. The F_2 generations of the crosses of glossy 94 × glossy 9A and glossy 94 × glossy 326 were studied. Each segregated into 9 normal : 7 glossy, thereby indicating that glossy 94 is not allelomorphic to either of the other two glossies.

In BIHAR 56 cultures were under study and, as usual, the promising selfed single-cob seeds of all samples were collected for further study.

In the PUNJAB evidence, which requires further confirmation, has been obtained that sugarcane Co 285 may be successfully and more profitably utilized, instead of elephant grass, as a border crop for preventing cross-pollination between two adjacent plots of maize.

In ASSAM a variety obtained from Messrs. Sutton and Sons was found to be very promising.

Studies at NEW DELHI, pursued in continuation of similar investigations carried out at Pusa in previous years, strongly suggest that the maize plant is able to fix atmospheric nitrogen. Further work to obtain unassailable evidence on the point and to understand clearly the mechanism of fixation is in progress.

A statistical examination of some manurial and miscellaneous experiments carried out at Pusa since 1932 shows that for maize 40 lb. of nitrogen per acre in the form of rape cake is superior to 8,000 lb. of farmyard manure per acre. Potash did not increase, and in fact showed a tendency to depress, the yield. Maize preceded by gram and peas gave fairly high out-turn, more so in the former case. Maize after oats and wheat gave low yields in all plots except in those manured with 40 lb. of nitrogen in the form of rape cake.

Partial regression coefficients worked out between the yield of maize and rainfall in the months of June, July, August, September and in the remaining eight months of the year prior to sowing showed that under Pusa conditions any additional inch of rainfall over the average for the period under consideration did not produce any significant increase or decrease in the yield of the crop.

In connexion with the work on grade standards 351 samples of maize were examined in respect of refractions, size and water-content by the Cerealist, Punjab Agricultural College, Lyallpur.

Oats

In the yield trials at Pusa between ten strains of oats, hybrid J outstripped all others in the matter of green fodder and grain yield. Studies on the inheritance of seed colour in the F_3 generation of a cross between BS 1 and PF 2 oats gave a ratio of 3 black : 1 yellow seeded plants.

A statistical examination of the results obtained from green manuring experiments at Pusa shows that, among the different species of *Crotalaria*, *C. Minjussi* was the best and that sunn-hemp, *dhaincha*, *guara*, cowpeas, velvet bean and *meth* were better legumes than soya bean for green-manuring purposes in the case of oats. Green manure in conjunction with superphosphate gave a higher yield than when applied alone, and sunn-hemp applied six weeks old plus $\frac{3}{4}$ maund superphosphate per acre gave the best out-turn. Six times sunn-hemp (i.e. sunn-hemp grown on six acres and applied on one acre) applied after fermenting gave the highest out-turns and the residual effect continued for two to three years without any appreciable deterioration. Fermented sunn-hemp plus superphosphate gave also high yield and the fertility of the plot so treated was at a fairly high level even at the end of the fourth year. On small-sized plots leaves of green manure appeared to possess better manurial value than the whole plant or its parts, but on field-scale no difference in the yield of oats was observed between manuring with leaves alone and with the entire plant.

Tapioca

Work on this crop is in progress in Travancore, where it has been found that tapioca responds readily to manuring. Studies to determine the most suitable rotations have indicated that, subject to confirmation, tapioca does best when it follows bananas or yams.

16. Potatoes

The work on potato breeding both at Simla and Nanjanad was continued. At the former centre, 294 stocks received from various parts of India were again studied and, after elimination of duplicates, about 50 varieties were carried forward for further study with a view to determining their suitability for crossing with new species and varieties received from abroad.

The study of the South and Central American species and hybrids was continued. Some of them were found to be highly immune or resistant to late blight and also to possess a certain amount of cold resistance. The F_1 generations of a number of crosses between promising indigenous and foreign types were studied and selections made on the basis of resistance to late blight and other desirable characters, a natural epidemic of late blight which appeared late in the season facilitating this work. Study of the incidence of early blight and of virus diseases was also in progress.

A number of new interspecific crosses were also made successfully. It was observed that in certain cases one direction of the cross was much more easily made than its reciprocal. This was particularly noticeable in crosses involving *S. demissum* as one of the parents.

Cold storage trials of potatoes were continued at the Cold Storage Research Station, Ganeshkhind. It was found that only the fully mature

potatoes were suitable for cold storage; the under mature ones rapidly lost water and got severely shrivelled in storage with subsequent growth of *Penicillium* on them. Analyses of tubers of Khed potatoes stored at 30°, 35° and 40°F. showed that an accumulation of sugars took place at 30° and 35°F. The potatoes at 30°F. began to suffer from internal breakdown after three months of storage. The tubers remained without sprouting for about seven months at 40°F. and were good for table use. A part of the sugars accumulated in the potatoes stored at 35°F. disappeared when the tubers were allowed to remain at 68°F. for some days.

At the Cold Storage Research Station, Ganeshkhind, Khed potatoes were found to remain without sprouting at 40°F. for seven months and at 35°F. for more than a year.

Studies in potato storage were also in progress at the BENARES HINDU UNIVERSITY. It was found that marketable tubers are characteristically divided into three more or less well defined stages designated as adolescence, maturity and ripening. In the adolescent tubers, the loss in weight during storage is high and decreases with increasing maturity of the tubers, the value of total loss being about the same in mature and ripe tubers. Mature tubers, however, can be kept considerably longer in storage than ripe ones. Irrespective of the developmental stage, tubers stored for 10-12 days at 18°C. lose considerably less weight during subsequent storage than those pre-stored at 7°C. prior to permanent storage.

MADRAS. At the Agricultural Research Station, Nanjanad, three crops of potatoes were grown as usual. The work on artificial hybridization was continued and a large number of intervarietal and interspecific crosses were effected. In all 3,798 flowers were operated upon and 141 berries were gathered. Of the 73 cultures tested in row yields in the main crop season, 19 promising cultures were split up into two groups and compared in the second crop season with Great Scot as standard. Three of the cultures gave significantly higher yields.

In the permanent manurial plots, the beneficial effects of phosphatic manures and lime and the evil effect of the absence of potash and nitrogen were again distinctly noticeable. In irrigation experiments, irrigation in furrows once in two weeks gave better results than irrigation in furrows once a week. In experiments to judge the value of different weights of individual tubers sown at different spaces, tubers weighing 1-2 oz. at distances of six to nine inches in rows gave better yields than smaller tubers planted closer than six inches apart. It was also noticed that new seed gave better yield than old seed.

PUNJAB. The variety Factor continued to be the premier variety in the Murree hills and has practically displaced all other varieties in cultivation there. The Kangra local variety has given encouraging results in September sowing in the plains, particularly in the submontane districts. Arrangements are being made to distribute the seed of this variety among potato growers at rates much lower than they generally pay for other varieties imported from outside the province.

SIND. The common varieties grown are Italian white round and Italian white long, the former being more successful. In spite of frost, 40-80 maunds yield per acre was obtained in Tharparkar and Hyderabad districts during the year. On the Right Bank, the yields were still better. Potatoes grown

as *bosi* (without cold season irrigation) on *katcha* land yielded on an average about 57 maunds with a maximum of 63 maunds per acre in Jherruck.

ASSAM. In the Upper Shillong Experiment Station, the total area under potato was 21 acres and the average acre yield 95 maunds as against 87·7 maunds in 1936-37. 832 maunds were distributed as seed.

In a field-scale trial with 10 varieties, the average yield per acre was 135·8 maunds as against 87·7 maunds of the previous year. In manurial experiments, the superiority of 200 lb. of Nicifos+200 lb. sulphate of ammonia has again been confirmed. It has also been shown that 300 maunds of farmyard manure per acre is the most economical and productive dressing for potatoes. The value of compost as against farmyard manure as a manure for potatoes was tested for the first time and found to be the same.

Records of dryage and rottage of potatoes maintained at the experimental station at Upper Shillong showed that 4·03 per cent rottage and 7·4 per cent dryage had occurred during the year.

The work on the selection of types resistant to late blight has been given up.

Area under improved strains

The total area cropped with improved strains amounted to 17,946 acres during the year under review.

17. Beans and pulses

Gram (*Cicer arietinum*)

This crop occupied an area of 15·7 million acres during the year under report and the estimated out-turn was 3·5 million tons. The areas important for its cultivation are the United Provinces (5·7 million acres), the Punjab (3·7 million acres), Bihar (1·3 million acres), Hyderabad (1·2 million acres) and the Central Provinces and Berar (1·2 million acres). Trials conducted at New Delhi and Karnal with different gram varieties showed that gram types 25, 58 and PF 3 have done well as compared with other varieties at both these places. Experiments on the study of wilt in gram were also continued. At Pusa sterility in gram was studied. It is believed that defective setting as well as shedding of flowers in the crop are due mainly to environmental conditions and are governed by certain lethal genetic factors.

In the UNITED PROVINCES 72,580 acres were under improved types of gram.

In the PUNJAB trials conducted with different varieties of gram have shown that Punjab 7 is still the best type of the province. F 8 is a new type which is resistant to gram blight fungus. Work on producing better types by hybridization was continued during the year. Numerous crosses are under study and some of these appear to be promising.

In BIHAR 12 different varieties were under study and were found to be breeding pure. There were 6,750 acres under improved types of gram.

In the CENTRAL PROVINCES the average area under gram is 1,191,000 acres. Crosses 36, 37, 38, and 42 are promising. Selections 28, 62, and 352 are popular on account of good colour of seed, wilt-resistant capacity and high yield.

In BOMBAY G 693 and G 816 have given good results and are ready for village trials. Nipping of grams was studied

(*a*) Before flowering (31 days after sowing)

(*b*) At flowering (after 38 days)

(*c*) After flowering (47 days after sowing)

The experiment showed significant differences. The unnipped crop exceeded in yield all the nipped crop. The yields progressively decreased with later nippings.

The strain 18 at Dharwar farm showed only 2·2 per cent wilting as compared to 95 per cent in the local. The yield of No. 18 was 395 lb. per acre as against the failure of the local.

In SIND there were 363,000 acres under gram. Most of this is in North Sind. Sanyasi and Red Jacobabad varieties proved to be superior.

In MADRAS there were 52,000 acres under gram. Strains 468 and 482 were found to be significantly better than other varieties.

In BENGAL there were 279,000 acres. The work of improvement of this crop is at a standstill. Sabour 4 and Pusa 58 are departmental recommendations.

In JAMMU AND KASHMIR gram suffered to a large extent in the Jammu Province owing to the lightning and thunder-storms.

In the N.-W. F. PROVINCE out of 142,000 acres there were 425 acres under improved grams.

In BHOPAL 3,600 acres were under improved types of gram.

Pigeon peas (*Cajanus indicus*)

At PUSA the work was continued on varieties which combine resistance to wilt disease with other desirable qualities. C 15 and T 80 gave significantly better results, and highest yields were obtained with two feet spacing between the rows and lowest with four feet spacings.

In BOMBAY Type 24 gave significantly higher yield than the local.

In BIHAR efforts to produce early strains of *rahar* which were high yielders were continued.

In SIND White Hyderabad is the best with White Digri as the second best. These varieties being early escape damage by frost.

In MADRAS 44 cultures have been selected for further test. The yield trials conducted during the year did not give conclusive results.

In BENGAL attempts to find out short durationed busy types of *arhar* suitable for mixed cropping and for *rabi* season are being made.

In the CENTRAL PROVINCES Type No. 38, the wilt resistant strain, continued to be popular. Investigations into the cause of sterility of a newly discovered mutant with simple leaves are in progress. Demand for seed of Nos. 3 and 38 is on the increase. Work on evolving white-seeded types possessing wilt resistance, early maturity and good cropping power is in progress.

Peas (*Pisum sativum*)

In BIHAR 17 types of peas were maintained pure.

In the JAMMU AND KASHMIR State the runner variety (up to date) yielded the highest. In dwarf group ' Hunderfold ' gave the highest yield.

Soya bean (*Glycine hispida*)

In BOMBAY the American types of soya bean were found to be fairly early but grew very meagerly and the yields were very poor.

In BIHAR the work is in progress. Twelve varieties received from Washington were under study. At Pusa attempts are being made to isolate botanically

pure strains of yellow, black, and chocolate soya beans.

In the CENTRAL PROVINCES Nos. 53 (white seeded) and 59 (black seeded) have continued to give high yields.

In ASSAM work is being continued with a view to isolate early maturing types possessing a high yield of oil.

In JAMMU AND KASHMIR the cultivation of soya beans is being given up on account of there being no demand for it.

Cowpea (*Vigna catjang*)

In MADRAS four types C 37, C 42, C 422 and C 512 gave heavy yield of foliage and appear to be fit for fodder and green manuring. Four other types C 20, C 92, C 100 and C 521 gave satisfactory yields of grain and C 419 only gave good yield of pods. All these will be fur ther tested.

In SIND Larkana Red was found to be superior to Sakrand and Mirpurkhas types.

Guara (*Cyamopsis psoraloides*)

In SIND *guara* selection No. 19 from Sind Makhani gave a high yield of grain and was less susceptible to root-rot.

Urid (*Phaseolus mungo*) and *Mung* (*Phaseolus radiatus*)

In BOMBAY *urid* occupies an important place among the pulses. Preliminary work was started and forty samples were collected and studied.

In SIND the local varieties of *mung* and *manh* have given better results than the imported material.

In BENGAL pure-line cultures and *matikalai* and *mung* were grown at Krishen Nagar including a collection of Chinese *mung* and selections are being made out of this material.

In the CENTRAL PROVINCES *mung* Type 10 is early and Types 6, 7 and 35 are good yielding and medium in maturity. *Urid* Types 8, 17 and 21 are big seeded, high yielding and early in maturity. The demand for selections Nos. 4, 160 and 178 of *mung* and Nos. 110-A, 112 and 126 of *urid* is steadily on the increase as these are good yielders both of grain and fodder.

In ASSAM 17 varieties of *matikalai* and three of *mung* were under observation and a few have been selected for trial next year.

In KASHMIR about 12 selections have been retained for final trials.

CHAPTER III

INSECT PESTS OF SUGARCANE*

WORK on the insect pests of sugarcane was conducted at the Imperial Agricultural Research Institute, New Delhi, and its sub-stations, Karnal, Pusa, and Coimbatore and also in various provinces and states.

1. Work at the Imperial Agricultural Research Institute

At New Delhi the study of the seasonal incidence of the borers in sugarcane revealed that the young crop two to four months old was attacked by the stem borers, *Argyria sticticraspis* Hmpsn. and *Raphimetopus ablutella* Zell., and the root borer, *Emmalocera depressella* Swinh., while, later on up to harvest time, *Scirpophaga nivella* F. was the chief pest prevalent.

Among the parasites that were reared were *Trichogramma minutum* Riley on the eggs of *Emmalocera depressella* Swinh.; *Phanurus* sp. on the eggs of *Scirpophaga nivella* F.; an unidentified Encyrtid, and *Tetrastichus pyrillae* Crawf. on the eggs of *Pyrilla* spp.; *Melcha ornatipennis* Cam. and *Rhaconotus scirpophagae* Wilkn. on larvæ of *Scirpophaga nivella* F.; *Epipyrops* sp., an unidentified Dryinid, and a Stylopid on nymphs of *Pyrilla* spp.; *Azotus* sp. on nymphs of *Aleurolobus barodensis* Mask.; and *Stenobracon deesae* Cam. on larvæ of *Emmalocera depressella* Swinh. Among the predators noticed were *Nimboa basipunctata* Withycombe and *Brumus suturalis* F. on eggs of *Pyrilla* spp. and *Chrysopa* sp. on nymphs of *Pyrilla* spp.

In the laboratory of the Second Entomologist (Dipterist), studies on the biology of *Epipyrops* sp. and an unidentified Encyrtid, both parasites on *Pyrilla* spp., were carried out.

At Karnal the following work was done: (1) Observations were carried out on the seasonal incidence of the major pests on four varieties of sugarcane, Co 285, Co 312, Co 313, and Co 331, grown in replicated plots, each variety having nine replications. Regular periodical examination of all the dead-hearts produced, noting the causal agents, was carried out and the following conclusions were arrived at.

Scirpophaga nivella F.—This borer started its activity in the middle of July and continued right up to the time of harvest. The number of dead-hearts caused by it steadily increased up to the first week of September after which there was a significant decrease. In July and August the number of dead-hearts produced by this borer was practically the same in all varieties. There was no difference between the resisting capacity of Co 285, Co 312, and Co 313. In the case of Co 331 from the middle of November the number of dead-hearts due to *Scirpophaga nivella* F. was significantly less than in the other three varieties and hence this variety may be considered to be comparatively more resistant than the other varieties.

* The assistance of Mr. P. V. Isaac, B.A., M.Sc., D.I.C., I.A.S., Second Entomologist (Dipterist), Imperial Agricultural Research Institute, New Delhi, in the preparation of this Chapter is gratefully acknowledged.

Argyria sticticraspis Hmpsn.—In all the varieties the number of dead-hearts increased rapidly up to the third week of June after which there was a steady fall and was practically zero in the third week of July. The varietal differences were not significant. The pest did very little damage to the stalks.

Emmalocera depressella Swinh.—In the initial stages the extent of attack in all the varieties was the same and it reached a maximum in the first week of June and was practically *nil* in the third week of July. In August, it again increased. No difference could be said to exist between the resisting capacity of the various varieties to this borer.

(2) Examination was made of all the cane stalks and roots at harvest time, to note the incidence of borers, on the four varieties, Co 285, Co 312, Co 313 and Co 331, grown in the replicated plots. The examination was done in two sets of plots—one, the periodical observation plots in which the dead-hearts had been removed at different periodical examinations, and the other, the final observation plots, which had been left undisturbed throughout the season, and the following conclusions were arrived at :

(*a*) Attack due to the top borer *Scirpophaga nivella* F. was significant in both sets of plots, and in all the varieties except in Co 331 of the periodical observation plots. Attack in Co 331 in the final observation plots was significantly less than in the other varieties.

(*b*) The percentage of attack by the stem borer *Argyria sticticraspis* Hmpsn. in cane stalks was insignificant. The other stem borers were found in still less numbers.

(*c*) The percentage of healthy canes in the periodical observation plots and final observation plots was the same.

(*d*) The weight of canes attacked by *Scirpophaga nivella* F. was significantly less in the final observation plots for all the varieties, while in the periodical observation plots it was significantly less only for Co 312 and Co 331. The average weight of canes attacked by *Scirpophaga nivella* F. was the same for all the varieties in both sets of plots.

(*e*) The number of canes damaged by *Argyria sticticraspis* Hmpsn. at the time of harvest was too small for the estimation of losses in weight due to this borer. A small percentage was damaged by miscellaneous causes, such as lodging, and mycological diseases other than those dealt with above.

(*f*) There was a significant attack of roots by *Emmalocera depressella* Swinh. in both sets of plots. The percentage of root borer was significantly more in the case of Co 331 for the periodical observation plots. In the final observation plots also the percentage of the root borer for Co 331 was more than in the other varieties but the difference was not significant.

(*g*) The percentage of roots attacked by termites in the two sets of plots was significant, but the differential susceptibility of the varieties was not significant.

At Pusa the periodical examination of some of the varieties of sugarcane, to note the incidence of the different pests at different parts of the season, revealed that *Scirpophaga* spp. (the top borers), *Diatræa* spp., and *Chilo zonellus*

Swinh. (the stem borers), *Emmalocera depressella* Swinh. (the root borer), and termites were doing damage throughout the year. Among the sucking insects, *Pyrilla* spp., *Assamia Mœsta* Westw., *Trionymus sacchari* Ckll. and *Aleurolobus barodensis* Mask. were common during November and decreased later.

At Coimbatore observations on the biology and seasonal occurrence of the pests of sugarcane and their parasites, throughout the year, were carried out. The common borers observed were *Scirpophaga nivella* F. and *Scirpophaga monostigma* Z., boring the top shoots, and *Argyria sticticraspis* Hmpsn. and *Diatræa venosata* Wlk., boring the stem.

The many varieties of canes bred at Coimbatore by the Sugarcane Expert were under observation for pests and for comparative judgment of susceptibility to borers.

Detailed study of the life-history of the parasites, *Stenobracon deesæ* Cam., parasitising the larvæ of *Argyria sticticraspis* Hmpsn., and *Diatræa venosata* Wlk. and *Rhaconotus scirpophagæ* Wilkn., and *Elasmus zehntneri* Ferr., parasitising the larvæ of *Scirpophaga* spp., was carried out.

Work on the mid-rib structure in sugarcane affecting the incidence of the top borer, *Scirpophaga nivella* F., was started. A strong mid-rib appears to afford resistance to the pest.

Biological control research. An attempt was made at Cuttack, with the cooperation of the Director of Agriculture, Orissa, to experiment in the control of the chief borer pest of Orissa, *Argyria sticticraspis* Hmpsn., by introducing large numbers of its egg-parasite, *Trichogramma minutum* Riley. Two similar blocks of sugarcane, one acre each, and some distance apart, were selected for the experiment. In one of the plots *Trichogramma* parasites were released four times during February and March at the rate of 5,000 parasites at each release. Periodical counts of dead-hearts in the two blocks and examination of the canes at harvest time during January, 1938, gave the following results:

(*a*) The dead-hearts produced in the *Trichogramma* distributed block was less than in the control block. The observed difference between the number of dead-hearts produced in the *Trichogramma* released block and control block was significant, i.e. the number of shoots destroyed by borers in the control block was significantly greater than in the *Trichogramma* distributed block.

(*b*) Judging from the percentage of stem borer in stalks examined at harvest time there was some evidence to the fact that *Trichogramma* was effective in checking the population of the stem-borer, *Argyria sticticraspis* Hmpsn.

Pyrilla studies. Spraying experiments carried out in the laboratory of the Second Entomologist (Dipterist) early in 1938 showed that soap solution at the rate of 1 lb. of soap in 20 gallons of water gave satisfactory kill against Pyrilla nymphs.

2. Work in the Provinces

In the PUNJAB, the comparative susceptibility of Coimbatore canes to the attack of top borer was noted both at Jullundur and Risalewala. It has been found that Co 285, Co 313, Co 331, Co 371, Co 373, Co 356, and Co 396, are

highly resistant, while Co 300, Co 312, Co 323, Co 508, and Co 421 are more susceptible.

Observations on the effect of top borer attack on maturity of canes showed that as the upward growth stops as a result of top borer damage, the canes begin to mature earlier, and are richer in sucrose and purity coefficient.

The bionomics of *Scirpophaga nivella* F. was studied in detail. The study of the oviposition behaviour indicated that the female of *Scirpophaga nivella* F. preferred new cane sprouts to old crop of the last season, for egg-laying, during March and April. The important species among the larval parasites of *Scirpophaga nivella* F. included *Goryphus* sp., *Rhaconotus scirpophagæ* Wilkn., *Elasmus zehntneri* Ferr. and *Glyptomorpha deesæ* Cam. The bionomics of the important egg-parasite, *Phanurus beneficiens* Z., was studied in detail.

Regarding Pyrilla, Co 285, Co 331, Co 373, Co 356, Co 395 and Co 396 were found to be attacked less, while Co 213, Co 290, Co 300, Co 312, Co 421 and Co 508 were most susceptible. Varieties with soft, succulent, broad, and drooping leaves, having loose leaf sheaths, were attacked more.

In the UNITED PROVINCES ecological studies of cane pests were carried out. The incidence of borers, Pyrilla, white-fly, and white-ants was investigated in different cane varieties under different manurial conditions, times of planting, cultural and mechanical treatments, and under water-logged conditions. Further progress was also made in the study of the natural enemies of cane pests. Co 411 is one of the most resistant variety to top borer, among the early varieties, and Co S-70 and Co 421 among the later ones. Long periods of intermittent dry weather during the monsoon were found to be very conducive to the severity of Pyrilla attack. Pyrilla incidence, it was found, could be minimised by the stripping and removal of dry leaves, systematically carried out on the standing crop.

In BIHAR the top borers did not make their appearance on the new crop till the last week in March. In April and early May their attack became excessive. Pyrilla and white-fly were present only as minor pests.

In ASSAM the usual control measures against the sugarcane borer pests were continued and it was noticed that the removal of infested shoots during roguing operations reduced the borer incidence without affecting the normal out-turn.

The removal of plants showing dead-hearts and hand selection of borer-free sets for planting, combined with the liberation of *Apantales* sp., have shown interesting results in the control of stem borers, whereas the light traps have helped in the control of the top borer. Co 213 and Co 419 were found to be the most suitable types of canes for Assam, as far as the borer attack is concerned.

In MADRAS much attention was devoted to sugarcane borers and mealy-bugs. The method of removing the basal leaf-sheath of young canes and earthing them up, and even mere earthing up without removing basal leaf-sheath, were found effective against borers under Coimbatore conditions.

The incidence of the topborer, *Scirpophaga* spp., in certain localities of the Madras Presidency was as high as 28 per cent. Seven larval parasites of this pest, viz. *Stenobracon nicevillei* Bingh., *Stenobracon deesæ* Cam., *Rhaconotus scirpophagæ* Wilkn., *Rhaconotus* n. sp., *Elasmus zehntneri* Ferr., *Goniozus* n. sp. and *Shirakia* sp. have been collected, of which, detailed studies were made

of three. Regarding the species of *Scirpophaga* present in South India, it was found that both the spotted (*monostigma*) and the spotless (*auriflua*) forms were got from the progeny of either.

Two species of mealy-bugs were found attacking the stems of cane, of which one was found to be *Ripersia sacchari* Green. Two species of mealy-bugs were noted for the first time on cane roots.

3. Work in Indian states

In MYSORE the control of sugarcane stem borers in the Irwin canal area was continued in a systematic manner. It was reported that the removal of the basal leaf-sheath from canes of four to five weeks old, followed by one light earthing up immediately, combined with the releasing of the egg-parasite *Trichogramma*, when necessary, have kept the borers under control.

CHAPTER IV

DRY FARMING RESEARCH*

EXTENSIVE areas in several provinces in India and in some Indian states are subject to periodic famine and scarcity, on account of low and precarious rainfall. The Royal Commission on Agriculture in India recommended in their Report (para. 112) that attention should be given to problems of cultivation in dry and precarious tracts. For want of irrigation facilities in these tracts, the crops grown are entirely rain-fed and are such as would ordinarily succeed under the trying climatic conditions.

The weather conditions of these tracts are so uncertain that two seasons seldom resemble each other even in a period of ten years. Owing to uncertainty of crop yields consequent upon the vagaries of the season the holdings in these tracts have become relatively large and the number of cattle required for cultivation relatively less. Every field operation here requires greater labour and expense and under unfavourable seasonal conditions, even thorough cultivation may fail to give profitable returns. This leads invariably to indifferent cultivation which in turn results in very low yields or crop failures.

Several important items of cultivation or treatments of the land, which are likely to secure normal or even increased yields under the normal seasonal conditions, are known to the cultivator. But in spite of this knowledge, he experiences crop failures which by chance happen to coincide with certain items of cultivation he has adopted. He knows for example, that ploughing is beneficial in general. But if the operation coincides with a year of severe drought, it may result in complete crop failure, whereas an unploughed field may give him some return. Similarly, he knows that manuring is the best method of increasing the yields and to avoid frequent or annual additions, resorts to heavier doses. If the season happens to be a dry one, it will result in complete failure of the crop. He knows that bunding prevents run-off of rain water and the loss of soil by erosion. But his method of bunding at the lower end of his field, based on local advice and local talent, proves more harmful when the bund breaches under exceptionally heavy rainfall of a season and results in the loss of accumulated soil of several seasons.

It is computed that nearly one-third of the total cultivated area of the Bombay Province is liable to conditions of scarcity and famine. Madras, Hyderabad and the Punjab have each equally extensive areas liable to similar conditions of famine. The total area in these four provinces which are liable to famines but which is capable of being treated by the dry farming method is estimated at 27 million acres. Several other provinces may have similar areas, though smaller in extent than those mentioned above.

Governments in these provinces are required to make provision almost every year in their budget estimates for remission and suspension of land

* The assistance of Mr. N. V. Kanitkar, M. Sc., M. Ag., Chief Investigator, Dry Farming Research Station, Sholapur, Bombay, in the preparation of this Chapter is gratefully acknowledged.

revenue in case the crops fail, in part or whole, in the famine area under their control. They have also to make some provision for starting famine works to relieve the distress of cultivators by giving them at least a subsistence wage, during years of famine or scarcity. In spite of the seriousness of the problem, no systematic efforts were made until recently to solve it by agricultural research.

BOMBAY. Amongst the earliest attempts in dry farming research may be mentioned some experiments conducted in Bombay by Prof. J. B. Knight at two or three places in Ahmednagar district from 1913 to 1917. Prof. Knight hailed from Massachusetts of the U. S. A., and naturally wanted to try some of the methods then newly started in America. The experiments consisted of field-scale trials of ploughing, wider sowing and mulching. But on account of the inconsistent results obtained under the extremely varying nature of the seasons during which these experiments were carried out, the work was not considered satisfactory and was not pursued.

In the year 1914, one particular aspect of the problem of these dry tracts attracted the attention of the Bombay Department of Agriculture, viz. the run-off of rain water and the subsequent erosion of agricultural lands. On the Government farm of the college of agriculture, a series of bunds were constructed including the harnessing of an existing *nalla*, to study the effects of these measures in stopping run-off and in accumulating silt. This experiment being laid on a more or less rocky area did not prove in any way very promising. The bunding experiments started in 1916 on the Dharwar and Gadag farms, however, gave very promising results and served as a great impetus to the spread of this activity in that division.

The other important aspect of the problem, viz. improvement in the existing methods of cultivation, received no attention till 1923. With the introduction of the Montagu-Chelmsford Reforms in the early twenties, there was a strengthening of the staff of the nation-building departments. The Government of Bombay created a post of Soil Physicist along with those of Horticulturist and Plant Pathologist. Dr. H. H. Mann, who was then Director of Agriculture in Bombay, decided in consultation with the Hon'ble C. V. Mehta, Minister of Agriculture, to entrust the Soil Physicist, Mr. V. A. Tamhane, M.Sc., M.Ag., with the task of solving the problem of the famine areas in the Province of Bombay. After some preliminary laboratory work at the College of Agriculture, Poona, the actual field work for research in dry farming in the Bombay-Deccan was started in 1924 at Manjri, about eight miles to the east of Poona, on the Poona-Sholapur road.

During the first three years at Manjri, viz. from 1924 to 1926, preliminary field experiments were carried out to test the effect of bunding, mulching and green manuring. One of these years was of severe drought. The experiments were conducted in three replications but the treatments were not properly randomised. The results of these experiments with *jowar* and *bajri* crops were found to be very promising. The field work was supplemented by laboratory work to determine the soil moisture under different treatments; some of the physical properties of the treated and untreated soils were also studied in the laboratory. The results of the laboratory work were published in the magazine of the Poona Agricultural College, while those of the field experiments during the first three years were published by the Bombay

Department of Agriculture in Bulletin No. 142 of 1927, and also in Leaflet No. 25 of the same year. On the transfer of Mr. V. A. Tamhane to Sind as the Agricultural Chemist and Soil Physicist in 1926, Mr. N. V. Kanitkar, M.Ag., B.Sc., of the Poona College of Agriculture, was appointed as Soil Physicist and it was he who extended the field work. Further additions of several experiments on preparatory tillage, on testing of varieties of *jowar* and *bajri* and field-scale trials of the improved method were made. Preliminary developmental studies were carried out on the *jowar* and the *bajri* plants and water-requirements of these plants on field-scale were also studied for two or three seasons. Fundamental experiments to study the disposal of rain water by run-off, evaporation and drainage were started and carried on for three or four years. Some of the meteorological factors were also studied during the same period.

It was, however, soon realized that the problem under investigation was so vast and complex that the limited resources of men and money at the disposal of the Soil Physicist were absolutely inadequate. It was also realized that the environmental conditions at Manjri were not representative of the vast famine tract in the Bombay-Deccan for which the work was intended. In consultation with the then Director of Agriculture (Dr. W. Burns), a comprehensive scheme for research in dry farming was drawn up and submitted to the Imperial Council of Agricultural Research through the provincial committee of agricultural research, in 1930. The work at the small station at Manjri was, however, continued so as to accumulate more data. In the meanwhile, Mr. N. V. Kanitkar, the Soil Physicist to Government in charge of the work, undertook during 1930-31 an extensive tour in the U. S. A. for a period of eight months, visiting a large number of experiment stations in the dry arid states like Arizona, Utah, Kansas, Nebraska and California where the latest methods of cultivation of dry lands were being applied successfully for raising crops not only on the experiment stations but by the farmers themselves on their own farms.

The Imperial Council of Agricultural Research appointed a small technical committee to go into the details of the scheme submitted. This committee approved of the whole scheme. They further suggested that other provincial Governments who have similar dry areas should come forward with their schemes for similar work. Although the Advisory Board of the Imperial Council of Agricultural Research passed the scheme in 1931, on account of financial stringency, funds could not be made available till 1933, and hence the work of the small station at Manjri continued with its limited resources.

As a result of this work carried on from 1924 to 1932 at Manjri by the Bombay Agricultural Department, the following tentative conclusions were drawn.

(1) By the study of the disposal of rain water it was found that

(*a*) when the lands were sloping, a very large proportion of the heavy showers was lost by surface run-off, causing a serious loss of soil by erosion ; (*b*) that a very large proportion of rain water absorbed by the soil was also lost subsequently by evaporation into air ; and finally (*c*) when the lands were shallow, say less than 18 in. deep, a large proportion of rainfall absorbed by the soil was lost by underground drainage. If the soils were more than 3 ft. deep,

there would be very little loss of rain water by underground drainage.

(2) The actual quantity of water required by the *jowar* or the *bajri* plant was limited. In order to obtain an average crop of *jowar*, so as to have a ton of dry matter consisting of about 740 lb. of grain and 1,500 lb. of straw of *jowar*, the actual water required would be equivalent to about four to five inches of rain. The *bajri* crop would require even a little less than this quantity.

(3) The soil studies showed that the soils derived from the Deccan trap with a depth of 18 ft. and above had good moisture holding capacity, and also good moisture delivering power. The moisture holding capacity was found to be increased by the addition of farmyard manure or green sann (*Crotalaria juncea*).

(4) As a result of the field work carried on for eight or nine years, a tentative method of cultivation was evolved under the title of the Bombay dry farming method and consists of the following important items :

(*a*) Deep ploughing of the land every year with a turn-rest plough.

(*b*) Placing small bunds 9 in. to 18 in. high at suitable distances depending on the slope, and then dividing the field into compartments.

(*c*) Four or five harrowings during the period of the south-west monsoon.

(*d*) Sowing of the *jowar* seed at a moderate seed rate of 4 to 6 lb. per acre with a wide-drill, keeping a distance of 18 inches between the rows.

(*e*) Four or five inter-culturings to keep the land free from weeds and to form mulch on the surface which prevents cracking and conserves moisture.

The results obtained at Manjri with the Bombay dry farming method and with the one followed by the cultivator are summarized in the following table, as the average of seven years.

Comparative yields of jowar *in lb. per acre, by the Bombay dry farming method and the cultivators' method*

(*Average of seven years from 1927-28 to 1933-34*)

Rain in inches	Cultivators' method		Bombay dry farming method	
	Grain	Straw	Grain	Straw
23·70	741	2,444	1,260	2,543

Owing to its superiority, the Bombay dry farming method was handed over to the propaganda staff in the district for trials on cultivators' fields. The

conditions in the north-eastern part of the Poona district were very similar to those of Manjri and hence this method was very successfully tried on cultivators' fields, covering greater and greater area every year. In 1931-32, the total area under the improved method was 350 acres ; in 1932-33, it was 2,500 acres ; and in 1933-34, it rose to 4,060 acres. In all these years, the increase in yield varied from 20 to 50 per cent over the yield obtained by the local cultivators' method.

MADRAS. In 1927, the Madras Agricultural Department started experiments on dry farming under the name of moisture conservation experiments. They were done partly at Coimbatore but mostly at Hagari near Bellary. The layout was systematic though in replicated series and included the cultivation of crops of *jowar* or *cholam* and cotton in rotation. Effect of shallow and deep ploughing, effect of farmyard manure, effect of bunds, etc. were studied by determining the soil-moistures in differently treated plots and also by obtaining the yields of *jowar* and cotton.

The results of moisture conservation experiments carried at Hagari from 1927 to 1932 may be summarized as follows :

(1) Ploughing gave on the whole increased yields as compared to control, but frequent ploughing had no advantage over occasional ploughing.
(2) Bunding gave increased yield on the whole but the increase was not obtained every year, owing possibly to the difference in the nature of rainfall and its distribution in different years.
(3) Cattle manure generally gave increased yields but the dose of five tons per acre proved excessive in a year of scanty rainfall in later years, possibly as a result of cumulative effect of the large doses applied in successive years.
(4) Compacting the soil or the removal of stubbles of crop had no beneficial effect on the yield.
(5) These effects were noticeable on the *jowar* crop and to less extent on the cotton crop.

This experimental work gave sufficient preliminary experience to the workers to prepare a comprehensive scheme for research on dry farming more or less on the same lines as those of the Bombay scheme, as suggested by the Imperial Council of Agricultural Research.

The Hyderabad Government had also a similar problem in a vast area comprising four districts adjoining the Bombay and the Madras drought areas. The Government of H. E. H. the Nizam also submitted a scheme for starting mostly field work on dry farming at their newly established agricultural station at Raichur.

The Bombay, Hyderabad, and Madras schemes for research on dry farming were approved and sanctioned by the Imperial Council of Agricultural Research in 1932 but actually they commenced their work in October 1933, in December 1933 and in April 1934 respectively. The work of the Bombay dry farming scheme was transferred to Sholapur and Bijapur in the heart of the famine area where these two new experiment stations were established to carry on the

proposed and approved programme of research. The Hyderabad work was started on a part of the area of the newly established experiment station at Raichur. The Madras work on dry farming research was also started on the well established station of Hagari near Bellary.

Prior to the commencement of the work under the auspices of the Imperial Council of Agricultural Research the programmes of work for the three stations were discussed and approved at the first meeting of the Dry Farming Coordination Committee held in August 1933 in Bombay. The committee consisted of the representatives of the three Governments and the representative of the Imperial Council of Agricultural Research.

Later on, the Punjab Government also prepared a similar scheme and sent it to the Imperial Council of Agricultural Research for grants in aid. The Punjab scheme started its work on the 1st of July 1935, on the old Rohtak farm which was being rented out to cultivators.

Thus the research on dry farming was started at five stations for the benefit of the vast areas in Bombay, Madras, Hyderabad and the Punjab, which are mostly dependent on precarious rainfall. This became possible only on account of the generous grants given by the Imperial Council of Agricultural Research from 1933 to 1935, for a period of five years. The period of these schemes has recently been extended.

I. *The Bombay dry farming scheme*

The work under this scheme was started on the 1st of October 1933, at the two stations, viz. Sholapur and Bijapur. The work of the scheme falls into three main divisions, viz. the soil, the plant, and the field or agronomy. All items of work included in the original programme and approved by the first Dry Farming Coordination Committee were taken up for investigation during the period of five years and a half. It is proposed to mention briefly the most important items of work and to indicate the findings in a general manner.

(*a*) *Work on the soil*

The soil types existing on the two experiment stations, i.e. Sholapur and Bijapur, have been critically investigated and classified into six distinct types. The same types are found in the major portion of the dry farming areas of Ahmednagar, Sholapur and Bijapur districts surveyed so far. The parent rock of all these types is the Deccan trap. The tract is undulating and hence the soils are subject to heavy erosion. The Sholapur soils are comparatively shallow, while the Bijapur soils are deep. All the soil types are very clayey, with a clay-content varying from 32 to 71 per cent. The Bijapur soils contain an excess of lime. All the deeper soils crack heavily during hot weather and get compacted by heavy showers, and sometimes harden by quick drying after heavy rains. They are all alkaline, having a *p*H value varying from eight to nine. They have a high moisture-equivalent and a high wilting coefficient. Chemically, they are poor in nitrogen and organic matter; other plant food ingredients being present in adequate amounts.

(b) Work on the plant

The *jowar* plant (*Andropogon Sorghum*) has been intensively studied from germination to maturity. The development of the plant with regard to neight, weight, number of leaves, the inflorescence and the root-system, has been studied for several seasons and its relation to several meteorological factors investigated.

The water-requirements of the *jowar* plant or the transpiration coefficient has been determined with a standard soil. This has been found to vary from 400 to 500 in different seasons ; farmyard manure and fertilizers have been found to effect an economy in the use of water. Different strains have behaved almost alike without any significant differences, although an early maturing strain gave a somewhat low transpiration coefficient. The intake of the plant-food has also been studied at different stages of the plant growth. The formation and emergence of inflorenscence seems to be the most important stage when the intake of mineral plant-food as well as that of water is the greatest.

Comparative field trials of *jowar* and *setaria* strains have been made during the five years. Morphological observations at the important stages of growth have been recorded according to a draft-set of instructions prescribed for all stations by the Coordination Committee.

Studies in the disposal of rain water formed important items of investigation. It has been found that nearly 30 to 40 per cent of the heavy rains (more than half an inch received in 24 hours during the monsoon months) is lost by surface run-off from soils with moderate slope of 1·25 per cent. The amount of the soil lost with the run-off water is colossal in years of heavy rain and amounted to 133 tons per acre in a single season of 1937-38. The soil moisture lost by evaporation is also very high and the loss is sometimes so rapid from the top soil that the young seedlings may get dried up by rapid desiccation.

When the rainfall is concentrated in a short period, it results in the loss of much water by underground drainage, leading to a depletion of the soil of its nitrates. The soil and the plant studies have shown the extremely complex nature of the problems involved in growing crops in this tract.

Meteorological observations have been recorded by means of standardized instruments for correlating them with plant growth and soil studies.

(c) Agronomic work

The object of the agronomic work at Sholapur and Bijapur has been to devise a system of farming which includes preparatory tillage, bunding, manuring, inter-culturings, rotation, fallowing and the cultivation of suitable varieties. The tentative system known as the Bombay dry farming method evolved as a result of previous work was tried on a field-scale on areas varying from 15 to 25 acres at both stations during the last five years. For comparison, the local cultivators' method was also tried on areas varying from 5 to 7·5 acres at the two stations. Bunding of the field and division of the area into compartments, which forms a part of the improved method, was done in the first year. The remaining treatments were given in all years.

The yields obtained during the five years at Sholapur show that the average grain yield for five years by the improved method is double that obtained by the cultivators' method, while the straw yield is higher by 33 per cent only. It must, however, be mentioned that the level of yield of grain and straw at Sholapur is very low both for the improved method as well as for the cultivators' method. The actual average grain yields per acre by the two methods are 134 and 66 lb. respectively. The low level of yield is mainly due to the fact that 40 per cent of the area consists of eroded land, having only a thin layer of 4 in. to 5 in. of soil.

At Bijapur, where the soils are deep, the average grain yield by the improved method for five years is about 90 per cent higher than that obtained by the cultivators' method, while the straw yield is only 33 per cent higher. The average yield of grain per acre by the improved method at Bijapur is 507 lb. in comparison with 263 lb. by the cultivators' method.

In order to assess the value of different factors involved in cultivation, five to six intensive experiments have been carried out in replicated and randomised layout, which allow statistical interpretation. Owing to the vagaries of climatic factors in different seasons, many of these have not given significant results in all years. In general, it may, however, be stated that at Sholapur ploughing is advantageous on the deeper soil in some years but it is deleterious on the light shallow soil in all years.

Mulching is advantageous, on the whole, on both the medium deep and light shallow soils. Farmyard manuring and green manuring give 11 to 12 per cent higher yield on medium deep soil. But on the light shallow soil, sann green manuring is far more beneficial than the farmyard manure.

At Bijapur less frequent ploughing is more advantageous than annual ploughing on both soil types, viz. the deep black and the limy. Mulching is also advantageous on both soils. But, the effect of five cartloads of farmyard manure on both types is decidedly beneficial, in all years, including years of scarcity. Sann green manuring is significantly superior both to no-manuring and manuring with farmyard manure on limy soil. Fallowing and rotation are both found to be superior on the two types of soil, the treatments being significant in some years.

II. *The Madras dry farming scheme*

The work at this station also consisted of investigations on three aspects, viz. the soil, the plant and the agronomy. It was suggested by the first Coordination Committee that the soils under moisture conservation experiments in the past seven years be examined physically and chemically. It was also suggested that this station should work on *setaria* or the Italian millet and should try the Bombay dry farming method on a large scale. The work done by this station during the first period of five years till April 1939 is summarized below.

(*a*) *Soil work*

The soil of the tract is the black cotton type which varies in depth from 1 ft. to 10 ft. and is derived from granite and gneiss. It contains about 50 per cent of clay and is highly retentive of moisture. It cracks

freely in hot weather and becomes sticky by rains. It is alkaline in character, having a *p*H value of 8·5 to 9·0. It is poor in nitrogen as well as in organic matter. It is subject to serious erosion on account of its undulating character. The results available only for one season indicated that nearly 50 per cent of the rain from July to September was lost by run-off and the amount of soil lost by erosion amounted to nearly ten tons. Various physical and chemical determinations have been made on the soil samples of the old moisture conservation experiments. No change of a fundamental nature, as the effect of seven years' treatment, is noticeable except some increase in nitrogen content in the manured plots. Soil moistures have been studied from differently treated plots at several stages of the growth of crops. There is a greater loss of moisture from the surface 2 ft. layer than from the third foot.

Meteorological observations have been recorded by means of standardized instruments, set up at the station.

(*b*) *Plant work*

Setaria or the Italian millet is receiving more attention at this station. Developmental studies of *setaria* and *jowar* have been carried out only for one or two seasons.

The root-systems of different crop plants have been studied at this station on a very elaborate scale for the last two seasons. Observations on root grown under field and pot conditions have been recorded. Effects on root growth of such treatments as soil moisture, organic matter, bunds, crop mixtures, fallowing, etc. are being studied very intensively. The protective effect of different root-systems on soil erosion is being studied by an empirical method. Observations on six *setaria* strains and ten *jowar* strains as a common programme for all dry farming stations have been recorded in all years.

(*c*) *Agronomic work at Hagari*

Several selections have been made for high yields in *setaria* and *Sorghums*. Some of the Bombay strains seem to be promising on account of their early maturity, and of bold and lustrous grain.

Intensive, replicated and randomized experiments have shown as a result of five years' trial that bunding is advantageous especially in years of scanty rain. The effect of bunds is increased by ploughing the bunded plots, also in years of low rainfall. Mulching by four or five stirrings gives increased yields of *jowar* and cotton in some years but not every year.

Manuring with farmyard manure or compost is seen to be effective in increasing the yields of *setaria* or *Sorghum* in years of good rains, but it may be pointed out that the dose of 10,000 lb. proves to be too high for years of low rainfall. The adverse effect is seen especially on grain yields. The practice of fallowing, viz. taking a crop in alternate years, has been found to give promising results. The extra yields are likely to compensate the loss, in the fallow year.

III. *Hyderabad dry farming scheme*

The soil type on which *rabi* crops are grown is the black cotton type and is derived from the granite. It is extremely clayey, containing 45 to

61 per cent of clay and has a high moisture retentivity. Its depth may vary from 3 ft. to 10 ft. It is fairly fertile. It cracks heavily during hot weather months and becomes sticky after rains. The tract is undulating and hence is subject to erosion.

There is another soil type also derived from granite which is red and shallow. It contains less clay than the former type and is used for growing early or *kharif* crops.

The *rabi* experiments are being carried on the black soil. The Bombay dry farming method has been tried for three years but only two years' results are available. Out of these two years, it is only in one year that the treatments were given in time. During this year, the increase in grain yield was about 96 lb. per acre, viz. 18 per cent more than the control. Fallowing resulted in doubling the grain yield and in increasing the yield of straw by 90 per cent.

Bunding and mulching experiments have been tried only for two seasons but the results of one year are available. The differences in yields are not significant.

The *setaria* and *jowar* strains have been tried as a common programme for all dry farming schemes. Some of the Bombay *jowar* strains have been found to be outstanding in grain yields. *Setaria* strains have given very much higher yields of grain and straw when tried as *kharif* crop, but as *rabi* crop they either failed or gave very low yields.

There are two lysimeters at the station, which have 18 in. layer of soil filled in. In 1937, the uncropped lysimeter lost 8·91 in. of rain by drainage, while the cropped one lost only 3·74 in. The total rainfall that year was 20·76 inches.

IV. *The Punjab dry farming scheme*

The problem of the four or five districts lying to the south-east of the Punjab is somewhat different from that of the dry districts in peninsular India, containing the famine areas of Bombay, Madras, and Hyderabad. The rain is mostly received during *kharif* from the south-west monsoon, by which the *kharif* crop of *bajri* is grown. The soils belong to the Indo-Gangetic plain which are sandy or silty in character and have great depths. Erosion though present is not as serious as in southern India. With adequate rains, a second crop during the *rabi* season can also be taken.

During the three seasons of the working of the scheme, the rains failed completely in 1938 and hence no crops could be sown. The rainfalls during 1936 and 1937 were below the average for the station.

(*a*) *Soil work*

The soils on the station have been very intensively surveyed and a large number of profiles up to ten feet depth have been carefully described and studied. It is found that though the surface layer shows great uniformity in texture, the sub-soil manifests great heterogeneity. Lime concretions or finely divided lime accumulations are found at varying depths. In some cases, heavy clay is found forming a sub-soil. These variations in the sub-soil material reflect on the growth and yield of the crop and bring on great variations in yields from plot to plot.

The physical characters show that the soils have comparatively low water holding capacity, greater porosity and a very low wilting coefficient. Chemically, the soils are fairly rich in essential plant foods except phosphoric acid and lime in some fields. Organic matter is also deficient in general.

The movement of soil moisture under cropped and uncropped conditions has been studied and the observations show that the rain water penetrates to greater depths, say up to six feet in contrast to the low penetration in the deep black soils of the south. The percolation is facilitated by cultivation. Mulches have been found to conserve more moisture in the lower layers. The moisture is utilized by the crops from greater depths, as the root-systems of plants are deep and extensive.

The effects of different methods of cultivation on the texture of the soil are also being investigated. Changes in nitrate content by inter-cultivation have been studied for two seasons.

(*b*) *Plant work*

(1) Water requirements of two *bajra* strains have been determined at two moisture levels. The water requirement at a lower moisture level is somewhat lower. The transpiration coefficients have varied from 330 to 550 in the three seasons during which they were determined. The coefficient varied with the type of soil used. There is a slightly lower water requirement by the addition of farmyard manure.

Similar determinations have been made for *jowar* and gram. The *jowar* used is a fodder variety and gives lower figures as compared to grain varieties of southern India, tested at Sholapur.

(2) Wilting coefficients of three soils were determined by growing four different crops. They were found to vary from 2·9 to 5·2 per cent according to soil type, with all crops.

(3) Developmental studies of *bajri* including the root-system have been made during two seasons.

(4) Germination tests have shown that the range of soil moisture for good germination is from 8 to 12 per cent. The germination is affected at 15 per cent of soil moisture.

(*c*) *Agronomic work*

An extensive programme of experiments on tillage, bunding, manuring, fallowing, crop varieties, and a number of rotations has been drawn up and carried out for two or three seasons. As the seasons have varied so greatly, the results are not found to be consistent.

But it may be said that bunding shows a great advantage by stopping run-off of rain water. Manuring also gave increased yields in one season. Fallowing increased the yields of the succeeding crop. Inter-culturing resulted in increasing yields by the removal of weeds, by conserving more moisture, and by increasing the nitrates in the soil.

CHAPTER V

RESEARCH IN CROP PRODUCTION *

1. Soils and fertilizers

THE increased contact of research workers promoted by meetings of the Imperial Council of Agricultural Research, Society of Soil Science (India), Society of Biological Chemists and the Indian Science Congress Association is reflected in the lines of research under review. The overlapping of work, badly planned experiments and non-productive problems have been greatly reduced. The uniformity of various estimations for soil survey work, laying down of long-term soil fertility and manurial experiments on similar basis in different provinces and the close collaboration of research workers in different localities working on similar problems is becoming evident.

The importance of the physical relationship of the soil in elucidating the problems relating to erosion, drainage, irrigation and soil alkalinity is now fully recognized. Manuring of major crops has become more systematic due to large numbers of special research schemes devoted to special crops. The officers of the Forest Department have become alive to the importance of studying the problems of soil erosion.

Thus the year under review, while forming a continuation of the researches of previous years, marks an advance in so far as new lines of researches are being introduced.

Soil classification

At the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, the work on soil consisted of the collation of existing data, preparation of a preliminary soil map of India and the genetic studies on typical soil profiles. Pending further information the soil maps were prepared on climatic and other available data. Using the ratio of mean annual rainfall to saturation deficit of air, the whole of the country could be divided into four longitudinal zones, arid, semi-arid, humid and wet. Each of these zones runs from north to south and includes many soil types. These zones also coincide with the geographical

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distribution of the major crops of the country. Another soil map based on colour classifications such as black, red, brown and laterite soils also shows certain significance in regard to specific characteristics and agricultural practices. All the black soils so far analysed, although differing in their geological origin, are characterized by their high clay content, with high values for aluminium silicates. Under the influence of large diurnal differences in temperature and high saturation deficit, the black soils have developed profiles with such common characteristics as high silica alumina ratio and, high base exchange capacity, with relatively high exchangeable sodium and magnesium in lower depths. The red, brown and laterite soils irrespective of their origin are characterized by low clay content, low exchange capacity and lower SiO_2/Al_2O_3 ratio. The soils of Indus basins and valleys, which are probably derived from granitic syenites, show alkalinity in more or less pronounced state. Their profiles indicate varying degrees of decomposition, setting free alkali, and iron and alumina moving to lower layers. The soils from Indus alluvium are rich in alkalis and alkaline earths, those of Ganges alluvium are relatively free from alkalis while those of Brahmaputra alluvium are highly leached. Low rainfall in the Indus area, moderate rainfall in the Ganges area and very heavy rainfall in Brahmaputra area are evidently the chief reasons for this effect although all have their origin in the Himalayan rocks. The profiles of uncultivated soils in places with low and medium rainfall do not exhibit much variation in appearance nor do they show great differences in regard to their exchangeable base content from depth to depth. In the arid and semi-arid regions calcium constitutes 70 to 80 per cent of the total exchangeable bases with magnesium, potassium and sodium together varying between 5 and 15 per cent. In regions with high rainfall the exchangeable calcium is lower at the surface than in deeper layers. The cinchona and clove soil surveys of high elevation show that these soils are mostly ferruginous and in some cases resemble laterite soils, which are highly leached, rich in organic matter and acidic with *p*H values between 4 and 5. As extensive data are being worked out, it would be possible to classify the main soil characteristics of the Indian soils with a greater degree of certainty than under the old system of classification by general soil behaviour.

A study of the physico-chemical properties of some important soil types of the BOMBAY PROVINCE was started at Poona. A few trials made to take soil monoliths proved unsuccessful. The examination at Padegaon of a large number of soil profiles from Nira right bank and Pravara canals indicated that all the normal soils of the tract possessed a well developed crumb structure and exhibited two to three horizons which were differentiated more or less sharply by colour, structure, texture or by the presence or absence of concretions. The first horizon was always loose and granular whereas the second horizon was in some cases very compact and interfered with proper root development and drainage. The degradation of soil types occurred with impeded drainage or nearness of sub-soil water where the profile developed a hard and compact horizon, which came in the way of cultivation and irrigation. In very shallow soils, horizon development was rarely observed and an immature or skeletal soil type resulted. The colour of soil was more related to the moisture relationship of soils than with the actual amounts of organic matter present. The black coloured soils were usually found on low lying situations where soil remained moist over a considerable part of the year. The soils on high levels were brown.

The brown colour indicated some breakdown of the clay complex due to high temperature and extreme desiccation in the summer. Evidence of tropical weathering was found in certain soils where aluviation of clay, silica, and sesquioxides had taken place. This was due to breakdown of clay complex and subsequent mobilization of the products by torrential showers during monsoon. The distribution of rainfall induced a steppe type of vegetation, whereas wide fluctuation in temperature and moisture conditions of the soil caused rapid weathering. The soil climate is, however, greatly modified by topography and the soil formation differs widely under different elements of relief. These have given rise to wide differences in the soil types existing in the canal tracts of the Deccan.

The examination at DACCA of some of the soils collected from typical laterite tracts was made. There is a general tendency of *p*H to increase with the depth of the profile. The data of chemical analyses of the lay fractions of most of the soils examined have their SiO_2/Al_2O_3 ratios higher than 2·33. For this reason doubt has been expressed on the value for SiO_2/Al_2O_3 ratio as an index for laterite and of lateritic soils. It is also possible that the so-called laterites are not laterites. The C/N ratios decrease as the depths of the profile increase. The saturation capacities of soils from Dacca, Suri, Bidar, Himayatsagar, Nagpur, Raipur, Alisagar and Guntur increase as the depths of the profile increase. The profiles from Cannanore, Gorantha Hill and Comorin show opposite behaviour. The profile from Nilgiri Hills show a minimum saturation capacity at intermediate layers. The variation of total exchangeable bases down the profile do not show any regularity. A tendency to an increase in total exchangeable bases with increase in depth is noticed. Almost all buffer curves indicate a definite inflexion at *p*H 9·8 and frequently at 2·9 or at 4·6. In general, the ratio of exchangeable calcium to the total exchangeable bases decreases down the profile. These ratios are often quite low which show that exchangeable bases other than calcium predominate.

Typical soil monoliths and soil samples of red soils were collected from various districts of Chota Nagpur which show that they were all very similar and of one general type. The nature of laterite soil in Orissa varies from place to place and the soils are mainly divisible into two types, viz. lateritic murrum and lateritic hard rocks.

Samples were selected from different groups into which the soils of the agricultural station at Chaubattia have been classified on the basis of appearance were analysed for soil survey data. All soils were acidic in reaction and the acidity increased with depth. There was a very wide variation in the total nitrogen content. The total nitrogen decreased with depth. There was a very wide fluctuation in C/N ratio. The ratio was higher for soils rich in organic matter and lower for soil poor in organic matter. The silica to sesquioxide ratio varied inversely with the maturity of the soil. CaO/MgO ratio was uniformly low. CaO was found mostly in the organic top soils and the percentage of MgO seemed to be dependent directly on clay and organic matter contents. The main source of MgO was obviously the Parent biotite rock.

Mechanical analysis of rice soils at Raipur in the CENTRAL PROVINCES showed that the percentage of clay increased with depth and that there was no particular relationship between the clay content and the percentage of loss on ignition. Chemical analysis showed that the lime content of the heavier

soils was higher than that of the lighter ones. There was very little reserve of calcium in these soils as most of the calcium was present in an exchangeable form. The percentages of available and total phosphoric acid were not correlated with depth or any texture characteristic. The results of leaching experiments indicated that the chief constituents lost from the soil were ammonia, nitrite, nitrate and calcium. When the soil was treated with ammonium sulphate a greater quantity of calcium was leached out.

In BIHAR the work during the year was mainly confined to a survey and analysis of soils in order to locate the areas containing poor soils for adequate manuring of these soils.

A preliminary investigation of soil samples and soil monoliths was carried out in the PUNJAB. The distribution of water soluble salts, *p*H, etc. were correlated with rainfall and irrigation.

Physical properties of soils

At the IRRIGATION RESEARCH INSTITUTE, LAHORE, various problems of soil physics were tackled. It is found that when ethyl acetate or sucrose is treated with soil acidoids the course of hydrolysis is similar to that obtained by the action of buffers consisting of true acids. Thus the soil acidoids are shown to be similar in their hydrogen-ion activity to weak acids. The titration curves of soil acidoids closely resemble those of weak dibasic acids. The point of inflexion is noticeable at approximately 4 *p*H units above the initial *p*H of the acidoid and corresponds to the neutralization of the first hydrogen. The dissociation constants of soil acidoids could be determined from their titration curves. The *p*H value is a special characteristic of each soil, measuring the reactivity of its acidoid fraction. The smaller the *p*H value, the stronger is the acidoid. Another point of similarity between the soil acidoid and true acids lies in their behaviour towards carbonates. A trial has been made to determine the isohydric *p*H value of soils by bringing the soil into contact with buffers of different *p*H values and noting the buffer which show no change of *p*H due to the treatment. A comparison of the isohydric *p*H values and the ordinary values determined by quinhydrone and antimony electrode methods, shows great divergence in several cases between the values obtained by all the three methods. The *p*H value of the soil is influenced by the soil-water ratio and it has been found that the salts present in the soil, which are brought into solution on the addition of water, exert a depressing effect on the *p*H. The depression in *p*H varies with the concentration of salts and hence is greater at narrower soil : water ratios.

The absorption of ammonia by the soil when soil suspensions are saturated with ammonia and which is not given off even when the soil suspensions are boiled down to half their volume is held by the soil acidoid in chemical combination. The quantity of ammonia so retained is dependant on the degree of saturation of the soil acidoid and hence on the *p*H value of the soil.

It has been put forward that oxidation of soil organic matter with alkaline permanganate give better and more uniform results than the oxidation by H_2O_2 and the results so obtained are comparable with those obtained by the International (A) method. The total neutralizable acid of a hydrogen clay solution calculated from its titration curves is a variable quantity. It is largely

determined by 'cation effects'. Both regular and specific cation effects have been observed. The bearing of these cation effects in the estimation of the lime requirements and the base binding capacity of soil by routine methods has been pointed out. The total acidities or the base combining capacities by hydrogen clays and 'hydrogen soils' calculated from their electrometric titration curves as obtained in this work have been compared with their base binding capacities obtained by same routine methods. With the system studied, titration with Baryta in presence of $BaCl_2$(N) has been found to yield results in agreement with those obtained by Parker's barium acetate method. The study of the electrodialysis of soils show that the rate of electrodialysis of different cations is not governed by the state of aggregation of the soil. There is a proportionality between the decrease in conductivity of the soil suspension and the amount of base removed by electrodialysis. Hence the differences in the rates of electrodialysis of different cations are supposed to be due to their different ionic activity especially in association with insoluble acids such as alumino-silicates. The marked fall of *p*H which occurs when carbon dioxide is bubbled through a soil suspension is attributed to the increased amount of salt brought into solution thereby and it is inferred that the carbon dioxide plays a significant role in the reclamation of alkaline soils.

Soil fertility and management

Soil uniformity trials at Rawalpindi (PUNJAB) showed that soil heterogeneity as revealed by any one crop cannot be a true index of the subsequent behaviour of that area with respect to the same or other crop. Two forms of soil heterogeneity were recognized, viz. casual and permanent. The casual fertility varied with crop and season while permanent fertility was independent of such factors.

Experiments conducted at Lyallpur show that in dry climate where weeds are easily kept in check, furrow turning ploughs and improved implements are not required to the same extent as in areas of heavier rainfall or where weeds are more abundant.

The Punjab soils suffer considerable losses in the quantity of organic matter which if not replenished periodically results in impoverishment of the soil. Experiments in progress at Gurdaspur and Rawalpindi with farmyard manures, green manure and composts indicate the value of application of organic manures. It was found at Gurdaspur that during one year sann-hemp as green manure gave better results than farmyard manure. But the position was reversed in the following year. Similarly at Rawalpindi farmyard manure gave higher yields than sann-hemp compost but the latter showed greater residual effect.

Movements of soil moisture were studied in detail. The experiments show that there is a gradual increase of moisture content in the lower layers and attains maximum at 2 ft. or so. The influence of lime on red laterite soils as represented by Dacca farm with special reference to the retention and evaporation of moisture were studied. It was found that continuous liming in heavy doses resulted in deleterious effects.

Experiments in SIND indicate that a good *kharif* crop is depressing to the following *rabi* crop. Even legume crops do not help the following *rabi* crop if the time intervening between cutting of the *kharif* or legumes and the sowing of the *rabi* crop is small, because the remains of the legumes have not the time

and favourable condition to become available to the *rabi* crop. Continuous growing of a shallow rooting crop reduces the soil fertility.

Leaching the soil by heavy irrigation of 16·32 in. has been found to be most suitable for reclaiming *kalar* soils in Sind. Intensive rotational cropping by *jowar*, wheat, and cotton improves the reclaimed soil. Reclamation of *kalar* soil has been attempted in the Punjab by treatment with calcium salt followed by an average dose of farmyard manure. Alkali soil can be further improved by rice during *kharif* and berseem as a green manuring crop or fodder crop during *rabi*. The chemical analysis of the soil has shown that there is a marked decrease in the total salt contents of the first four feet column of soil, decrease in *p*H value and increase in exchangeable calcium. The harmful effect of excess of water soluble salts in soil is counterbalanced by higher amounts of water soluble calcium salts.

In an experiment to evaluate the fertility of sugarcane soils in the BOMBAY-DECCAN in terms of soil factors, it was observed that generally the fertile soils seem to be more associated with lower *p*H values, lower calcium carbonate, higher available phosphate contents and higher moisture holding capacities of the soils than the less fertile ones. Studies regarding the management of 'chopan soils' (alkali soil with a large amount of sodium colloids) show that under all treatments with either irrigation or cane growing there has been an actual improvement in the colloids due to partial removal of sodium from the soil complex. Continuous fallow with no irrigation appears to be harmful by way of raising the soil alkalinity. This has been traced to the differential separation of calcium and sodium salts during summer which can be avoided by irrigation.

Study of soil factors in the PUNJAB to elucidate the problem of partial failure of cotton shows the variation of moisture content in 'good' and 'bad' plots. 'Bad' soils had the sub-soils of low water holding capacity, higher amounts of water soluble salts, and higher *p*H.

Since the construction of the irrigation canals from the Lloyd Barrage fears have been expressed that the water-table may be rising in the canal areas. It has been found that a very large area on the right bank of the Indus (about 3,400 sq. miles) has a high sub-soil water-table varying from three feet to thirteen feet below the ground level. The water-table is nearest the surface at the end of the irrigation season that is in October and lowest at the commencement of the irrigation season in June. In other areas commanded by the Barrage, notably on the left bank of the river, the sub-soil water-table is situated at a much lower depth. The problem of probable waterlogging is likely to be urgent on the right bank in the near future.

Soil erosion

The effect of soil erosion in the sub-mountainous districts on the agricultural lands have now been duly recognized. In the Uhl valley, which supplies water for the Mandi hydro-electric scheme, nearly 55 per cent of the 21,000 acre farm belt is eroding seriously as a result of potato farming on unterraced ground and over-stocking of grazing cattle. The amount of soil carried away by rain water in the Punjab sub-mountainous districts has been measured and it has been found that 7 per cent in the case of grassland and 25 per cent in the case of bare soil have been washed down and removed during

one season. At the dry farming station at Sholapur 155 tons of soil per acre per annum have been lost from a gently sloping field of *jowar* while the soil lost from a cultivated field where weeds had been preserved in fallow was only 1/200th of the *jowar* plot and that from a clean fallow of bare and uncultivated ground was about 1/5th of the *jowar* plot. This shows the aggravative effect of cultivation on erosion losses and stresses the need for bunding even slightly sloping lands under cultivation. The above land had a slope of 1 in 80.

Soil nitrogen.

The nitrifying capacities of the cultivated soils from various stations distributed all over India were determined at Delhi. Some soils showed defective nitrifying capacity and could not nitrify more than 25 per cent of the added nitrogen in six weeks. On marking such localities on the map it has been observed that they form a strip running east to west, the entire width of the northern strip of peninsular India and traversing practically all types of soil and climatic regions. The defective nitrification could not be correlated with any soil characteristic so far determined.

Definite evidence has been accumulating which shows that a cereal crop like maize can fix atmospheric nitrogen under favourable circumstances. There has been a significant gain of nitrogen by the soil after a maize crop. The mechanism of the nitrogen fixation is yet obscure.

The study of the mechanism of carbon, nitrogen and phosphorus cycles has been taken up. The energetics of vital processes such as nitrogen fixation, ammonification and nitrification are yet partially understood. Slow atmospheric oxidations are accompanied by activation of nitrogen enabling it to combine with oxygen yielding oxides of nitrogen. The photosynthetic reactions and oxidation reductions occurring in soil in summer months could be easily explained on this basis, as the microbial activities in arid high temperatures would be hardly significant.

It has been reported by workers at the Allahabad University that when carbohydrates and molasses are added to the soil there is a considerable increase in total and available nitrogen content of the soil. Cellulosic materials and cowdung increase the total nitrogen by fixing atmospheric nitrogen but do not increase the available nitrogen. In all the cases where carbohydrate, cellulose or fat was mixed with soil the increase in total nitrogen was much greater in soils exposed to sunlight than in those kept in the dark although total bacteria, azotobacter and fungi numbers were much greater in the soils kept in the dark than those exposed to light. Again when the nitrogenous manures were added to the soil either in fields or in pots or in dishes, there was a considerable loss of nitrogen in the process of nitrification. The loss is greater in soils exposed to sunlight than in those kept in the dark. The amount of nitrate formed in soil is greater in soils exposed to sunlight. The loss is minimized when molasses and other carbonaceous substances are added to the soil along with nitrogenous manures.

In the CENTRAL PROVINCES it has been repeatedly confirmed that no nitrification of added organic or ammoniacal nitrogen takes place in soils containing adequate moisture and exposed to sunlight in thin layers. The absence of nitrification is not due to the death of the nitrifying organisms but is due to their temporary inactivity. It was found that nitrates and nitrites were very

readily decomposed with the evolution of nitrogen gas when they were exposed to sunlight in the presence of carbohydrates. The influence of crop residues and of season on soil nitrogen has been examined and it is found that the increase in soil nitrogen due to growing of leguminous crops is localized in the stratum of the soil in which the plant feeds. Thus the deep rooted legumes confer on the deeper soil layers a higher available nitrogen content than on the surface soil. The amount of available nitrogen in all cases was low in spring, increased in summer, decreased in rains and once again rose with the beginning of October.

Composts

The ash of *mahua* cake being very rich in phosphates and potash acts as a good manure by supplying these ingredients. Cake as such is useless as a manure as it contains deleterious substances. It has been shown that composts prepared from these cakes according to the method evolved at the Imperial Agricultural Research Institute can be used with much benefit. A detailed study of the factors influencing the efficiency of the hot fermentation process for the preparation of composts from town refuse made it possible to control the process to give maximum benefits. A preliminary hot fermentation in brick-lined trenches with proper admixtures produced the temperature of 60°-70°C. when most of the infectious pathogenic organisms were destroyed. After allowing to ferment anaerobically for about a week the mass is pressed down in pits and anaerobically packed by plastering it with mud and soil. The manure is ready in about three months time. Comparison of different methods of composting town refuse, viz. wholly aerobic, wholly anaerobic and hot fermentation methods, shows that the greatest loss of carbon and nitrogen occur under wholly aerobic process and the greatest conservation under wholly anaerobic process. The manure produced by wholly anaerobic process is not very effective as the nitrogen does not nitrify easily.

The best results are obtained by the application of the manure prepared by the hot fermentation method. Manures prepared by aerobic fermentation are poor in their nitrogen contents.

A cheap method of making a good quality manure by composting sugarcane trash with small quantities of cowdung and earth was evolved in Bihar.

Manures and fertilizers

The effect of potash and lime applications to paddy at Nagina was negative. The effect of ammonium sulphate (60 lb. N) was pronounced and was still more so when this quantity was applied in two or three doses as against a single dose. Green manuring with *sanai* of nine or seven weeks growth was more effective than *sanai* of five weeks growth. Molasses applied either at the rate of 100 or 200 mds. per acre gave substantial increase in yield, but the time of application did not appear to affect the yield much. Manurial experiments conducted at Raipur have shown that the application of phosphoric acid at the rate of 20 lb. per acre in form of superphosphate to paddy is most economical, next best being 20 lb. of nitrogen per acre as ammonium sulphate. Application of ammonium sulphate at the rate of 20 lb. of nitrogen per acre to broadcast late paddies at the time of *Benshaning* and a week before flowering has been found to be beneficial at Cuttack. Higher doses of nitrogen are not economical. The experiments in Bihar on the

comparative utility of supplying green manures to the paddy crop with or without phosphate have shown the superiority of green manures with the addition of phosphate over all other treatments. At Raichur application of superphosphate is most economical. In the Kashmir State lentils were used successfully as a green manure for paddy. The yields were significantly increased, the green manures being found superior to ammonium sulphate. At Berhampore manurial experiments indicated that superphosphate, ammophos and green leaf applied heavily to the nursery alone gave no response whereas when applied to transplanted field there was increased yield, irrespective of manuring the nursery. It is, therefore, profitable to manure the transplant fields rather than manure the nurseries heavily. Superphosphate, ammonium sulphate or slaked lime by themselves had very little manurial values. Green leaf from outside or green manure crop raised *in situ* were found to be very beneficial because the soil was deficient in organic matter. The study of the nitrogen distribution in the rice soils reveals that addition of artificial fertilizers increases the nitrogen content of the crop. A small part only of the added nitrogen is ultimately found in the soil. Ammoniacal nitrogen is usually high. Nitrate nitrogen is also present but in smaller quantities. The ratio between ammoniacal nitrogen and the organic nitrogen remains more or less constant.

The changes in numbers and activities of different groups of micro-organisms were studied in soils under conditions similar to those occurring in the rice fields in India. The numbers of bacteria and fungi were markedly reduced after the soils were water-logged. They again increased in the dry period but the level was below normal. In the desiccating period there was considerable reduction in both bacterial and fungal numbers. Nitrifying capacity was considerably reduced during water-logging but later on in the dry period the nitrification was quite vigorous. During the hot desiccating period the nitrifying powers were almost *nil*. Power for fixation of nitrogen was affected by water-logging, but as soon as the water-logged condition ended it revived and remained even during the desiccating period. Even long periods of water-logging had no depressing effect on subsequent development of ammonifying and nitrifying bacteria. For sugarcane in the Punjab it is economical to apply about 140 lb. of nitrogen per acre, half as farmyard manure and the other half as *toria* cake or sulphate of ammonia instead of applying the same dose in farmyard manure alone. *Toria* cake is a better supplement to farmyard manure than sulphate of ammonia. The different doses of nitrogen, i.e. 105, 140, 175 lb. per acre, applied to cane do not show any residual effect on any of the three succeeding crops, namely wheat, gram and cotton.

Liberal watering under Lyallpur conditions does not delay the maturity of sugarcane; on the other hand the sucrose increases with a corresponding decrease in glucose. Nitrogenous fertilizers also do not delay the ripening of the canes under the Punjab conditions. Experiments conducted at Pusa show that nitrate of soda gives higher yields of sugarcane than sulphate of ammonia. Application of the fertilizers in two doses is better than a single application. Further, manuring just before the break of the monsoon is more helpful than at other times in the year. At Jorhat insoluble phosphates have been found to be more beneficial for sugarcane than the soluble phosphates as the soils are acidic. Potash appreciably improved the quality of the juice as well as the

yield. Green manure + cow-dung gave a significant increase over all other treatments. Manurial experiments in North Bihar suggested that the manuring with castor cake and super were better than that with an equivalent dose of nitrogenous artificials. There was no advantage in applying the manure in two doses. Potash manuring did not improve the juice quality while its higher dose depressed cane yields. The beneficial effects of sulphitation molasses and press mud were seen at various places in North Bihar. The beneficial effects of hot weather irrigation in North Bihar were confirmed. This was proportional to the dryness of the pre-monsoon months. Experiments carried out at Lyallpur showed that the addition of molasses, although it improved the moisture-holding capacity of the soil and lowered the *p*H value, actually reduced both the yields and the quality of the cane. No nitrogen was fixed by the application. The sugarcane in the Bombay-Deccan responds considerably to nitrogenous manures and to a slight extent to the phosphatic manures, soluble phosphate being better than insoluble.

The study of the movement of nutrients within the plants following fertilizer application and of the branching habits of the chief commercial varieties of cotton has given indications of the time suitable for the application of fertilizers under the local influences of soil and climate. While the late date of application, viz. during flowering, is found to be the optimum for American cotton in the Punjab, the early application, viz. at the time of sowing or soon after, has been found suitable for Central India. In the United Provinces and Koilpatti district of Madras the influence of the local factor is paramount, the former suffering from severe pink bollworm damage and the latter from fruit-shedding after February rains. In both the cases the date of application must be so timed that the extra bolls from manuring suffer minimum loss from these adverse factors. In the case of cotton it seems to be definitely established that the application of ammonium sulphate does increase the yields significantly to give an economic return in the Punjab. In the case of wheat the results are conflicting. Experiments conducted in Sind show that marginal effects should be eliminated while conducting manurial experiments on cotton, otherwise the significance of the treatment is minimized.

The effects of manurial applications on quality and quantity of tobacco leaves were studied at Guntur. The basal dressing on mineral manure plots encouraged earlier, more rapid and well sustained maturity, similar to farmyard manure plots. No manure, farmyard manure, N+P+K, N+P, P+K, gave mild flavours while N, P, K and N+K gave strong flavours.

The application of a basal dressing of 3 tons per acre of cattle manure in Madras did not affect the yield of groundnuts. Potash and phosphates increased the yields significantly. Nitrogen appeared to depress the yield. The manurial treatments did not affect the oil content of the seeds.

A slight correlation was found between the biological contents of fodders and the amount of available nutrients in soil as determined by the 1 per cent citric acid method. It was found that the protein content of grains varied a good deal according to the locality in which they were grown and that the protein content could be increased by manuring with nitrogenous manures, the increase being very marked when the manures were applied late. The effect of organic manures and fertilizers on the nutritive values of the crop is yet a controversial subject, but the evidence is daily increasing to establish

that the nutritive value is affected by the manuring of the crop. The grains raised with cattle manure had a decidedly higher digestibility coefficient and slightly higher biological value compared to mineral fertilizers and no manure. The total net protein value also established a decided superiority of grain raised with cattle manure to that of other manures.

2. Agricultural meteorology

Sir John Russell, who inspected the Agricultural Meteorology Section in December 1936, expressed approval of the programme of work and of the results achieved by this section in his *Report on the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India.* Sir John's conclusion was that ' the need for investigation in agricultural meteorology is beyond question and Poona is the obvious place for the work. It should now be on a permanent basis.'

In December 1937, the section was visited by Professor R. A. Fisher, F.R.S. Some stimulating discussions on statistical problems in agricultural meteorology were arranged during his visit. Professor Fisher was particularly interested in the work being done on ' Precision observations ' (i.e. observations on the development of crops during the growing season and, finally, the yield) using modern sampling technique. He suggested that such observations should be recorded at selected centres in India and made recommendations to that effect to the Council.

The section maintained its liaison and research activities and devoted considerable attention to the practical or experimental aspects of the subject, as in previous years.

Experimental or biological

With the kind cooperation of the agricultural college at Poona, it was possible to improve the facilities for experimental work at the Central Agricultural Meteorological Observatory by adding an adjacent plot to the grounds. A number of new instruments were added and, besides carrying out the experimental investigations, the observatory served as a training centre for agricultural workers deputed to Poona and for the students of the agricultural college who came in batches.

Amongst new instruments useful for investigations in agricultural meteorology, designed or made during the year under review, may be mentioned : (*a*) a simple percolation gauge (now being manufactured by the Scientific Instrument Company) ; (*b*) a sensitive portable galvanometer for field observations : this instrument which was evolved by the Laboratory Apparatus Works, Poona, at the instance of the section, is proving very useful and convenient for the measurement of plant, soil and air temperature under field conditions ; (*c*) soil evaporimeters with bottom feed, and (*d*) temperature alarm apparatus consisting of a bi-metallic spiral of brass and invar actuating a contact maker which closes an electric circuit through an alarm bell and a dry battery, as soon as the air temperature falls below a previously adjusted temperature, such an alarm tells the farmer when he should begin taking preventive measures against possible frost : there has been demand for a number of these instruments

and attempts are being made by the Laboratory Apparatus Works, Poona, to manufacture them locally.

Recent investigations in the climate of the air layers near the ground have shown how important it is to study the fundamental processes controlling the thermal and moisture balances at the earth's surface in order to understand the more complicated phenomena relating to the influence of environment on the micro-climate. The investigations on the various processes involved in the disposal of solar radiation and rainfall at the surface of the ground were continued at the Central Agricultural Meteorological Observatory. The studies on the interaction between climate and the plant world (i.e. the climates of different crops as controlled by the general weather, and as modified by plant population, density of foliage, intensity of air movements, etc.) were continued by using an Assmann psychrometer for the temperature and humidity measurements and a hot wire anemometer for studying the dependence of crop climate on wind velocity. Among other new investigations, those on the capillary rise of water through the soil from a water table below and subsequent loss by evaporation at the soil surface, transpiration from plants, the exchange of water vapour between soils, plant materials, seeds, etc. and the surrounding air may be mentioned. It is found that like dry soils, dry specimens of plant leaves, stem, grain, etc. give up moisture to the atmosphere by evaporation by day, and re-absorb it from the atmosphere during night.

On the completion of the first stage of the investigations on the effect of surface-'cover' on soil temperatures, the second part of the investigation, viz. the study of the distribution of temperature and of the thermal diffusivity in blocks of typical soils when exposed to identical weather factors at one place, i.e. Poona, was taken up. The data showed that the thermal diffusivity is greater during the wet season than during the dry season, and that an alteration of the surface cover alone does not cause any change in this coefficient as is to be expected.

The investigation of meteorological factors controlling the nocturnal cooling of the air layers near the ground was continued. The cold wave warnings issued by the Meteorological Department are based on the daily weather charts, and the minimum temperatures referred to are those recorded inside the standard Stevenson screen. For practical purposes in agriculture it is necessary to find out the corresponding (radiation) minimum temperatures outside in the open and at different levels above ground. This experiment was taken on hand during the year. During all the months of the year the radiation minimum temperature increases with height, the depression below the screen minimum being less at 4 ft. level than at 1 in. above ground. The depressions of the radiation minimum temperatures below that of the screen are greater during the clear season than during the monsoon.

The measurements of solar, sky and night sky radiations were continued regularly, as also those of evaporation from different types of evaporimeters. The loss of water by evaporation at the upper surface of a soil column with a water table below was studied with the help of a series of soil evaporimeters referred to earlier. Working with different depths of Poona soil, it was found that actual wetting of the soil surface did not take place even after the lapse of several months when the sub-soil water was more than 1½ ft. below the surface. The mean daily evaporation from soil surface decreased rapidly with increase

in the depth of sub-soil water, being of the order of 0·5 in. of water per day when the depth was 6 in., but only 0·04 in., when the depth was 36 in. These experiments are being repeated with different soil types. The weekly measurements of the seasonal variation of soil moisture at different depths were made regularly during the year.

The Central Agricultural Meteorological Observatory provides opportunities for the study of allied or borderland problems in plant physiology, e.g. transpiration, photosynthesis, nitrogen fixation, etc., which require for their proper understanding a comprehensive scheme of related meteorological observations. Some preliminary experiments were made during the year.

Statistical

On the statistical side special attention was devoted to the sampling studies on the growth and yield of crops at Poona and a few other centres with the kind cooperation of the agricultural officers concerned. The analysis of the daily rainfall in May and June over a number of areas along the west coast of the peninsula during the past 60 years was continued in connection with study of the mode of onset of the south-west monsoon. A note on the prediction of low temperatures during cold waves from a knowledge of prior meteorological conditions by using statistical methods was published and another on the frequency of days with hail-storms in India was completed. Further work was done on the computation of the frequency of heat waves. The investigations of the frequency of phenomena like floods and droughts in India and of yield of cotton in the experimental farms at Akola and Jalgaon in relation to weather were completed.

The question whether cold waves are increasing in frequency in Gujarat was raised by the Government of Bombay. To examine this a detailed study of all available temperature records of the meteorological stations in Gujarat, during the winter season (November to February) was made. On computing the frequencies of occasions when the minimum temperature in the open was below freezing, it was found that there is no foundation for the belief among farmers that the climate of Gujarat is undergoing any permanent changes with the commencement of irrigation on a large scale in Sind. Cold waves have been more frequent in some years consecutively than during a number of years before or after, but there is neither any regularity in the occurrences of these spells nor any permanent trends. A few other enquiries involving careful examination of past records were also taken up.

General—Agricultural meteorological observatories

Barring a few exceptions, most of the experimental farms in India had very meagre meteorological equipment. The creation of the Agricultural Meteorology Section in 1932 coincided with the initiation, by the Imperial Council of Agricultural Research, of a number of other schemes like locust, sugarcane, dry farming, cereal rust, etc., research in which weather plays an important part. As a result of the general awakening in agricultural research in recent years, most of the provinces and states have begun to take considerable interest in meteorology and have arranged or are beginning to arrange to equip selected

farms with standard meteorological equipment in consultation with the Agricultural Meteorology Section of the Meteorological Office at Poona. The map facing page one indicates the positions and types of farm observatories started or improved during the period 1932-38. The observatories number about 40, of which those at Poona, Lyallpur, Shahjahanpur, Cawnpore and Coimbatore have first-order equipment. The stations at Chaubattia, Muzaffarpur, Sabour, Gwalior, Padegaon, Raichur, Hagari and Pasni are of the second-order type. The remaining stations marked with full circles, or crosses are of the third-order type. The farm observatories are gradually increasing in number and in efficiency and will, in course of time, serve as centres not only for crop-weather observations, but also for supplementing the existing network of meteorological stations in India.

3. Plant-breeding and genetics

Information of a general nature on plant-breeding in various crops is given in Chapter II dealing with ' Economic work on crops '. Only points of genetical interest are reviewed here.

Cotton

The replicated progeny row technique evolved at the INSTITUTE OF PLANT INDUSTRY, INDORE, is now being extensively used to exploit the genetical variability in several crops including cotton with very encouraging results. In the case of cotton the adoption of the method has been successful in breeding a sub-strain from Malvi 9 (Malvi 9-20), which is just as good as Malvi 9 in all respects and at the same time has a finer lint with a 20 per cent improvement in spinning value over Malvi 9. Similarly with strains giving a 50 per cent mortality (mean) due to wilt under field conditions, sub-strains have been obtained with a 80 to 90 per cent mean survival value. The genetic variability in three intraspecies crosses among Malvi, Cwn 520 and Bani has been under study in specially designed experiments. There was sufficient heterosis in all the above crosses in yield and halo-length, but only in certain of the crosses with regard to ginning percentage, plant height, node number and final stand. Reciprocal F_1s failed to give significant differences anywhere except in final stand and yield in the Malvi × Bani cross, whereas the F_1 in which Bani was used as the male parent gave higher values. The inclusion of the back-crosses along with F_2s gave a method for distinguishing between dominance and epistasy as the cause of the heterosis effects.

The value of an F_2 for selection in plant-breeding work is proportional to its mean and genetic variance and since this can be estimated from the mean value and heterosis of the F_1, the actual comparison of the F_1s from different crosses should give a good indication of the most profitable combination for selection. This was actually put to the test by comparing F_1s of several *arboreum* crosses carried out in connexion with the improvement of Bengal cotton in Bikaner and indications were obtained as to what particular crosses were likely to be of value for selection purposes.

The interspecies cross, *G. arboreum* × *G. anomalum*, back-crossed to *G. arboreum* twice has given some economically useful types and the hardness of the seed coat associated with *G. anomalum* has been entirely got over in these back-crosses.

On the purely scientific side the following results were obtained. A chlorophyll deficient type isolated from the cross Malvi 9 × *cernuum* has proved a simple recessive. A search made in the types of *G. arboreum* var. *neglectum* for intermediate types of the leaf shape multiple allelomorph series resulted in the obtaining of two such types which belong to the same series. These are the 1090 type and the 'Dacca Narrow' and have been designated L^N and L^D. The chief difference between these types and narrow L is in the leaf index A and it would appear that index A (sinus length) and index B (lobe width) are controlled by independent portions of the gene. The linkage studies with the sterile mutant isolated from Million Dollar have shown that the gene is independent of anthocyanin, petal colour and leaf shape genes. A 'crinkled' mutant was obtained in one of the local *hirsutum* types which proved a simple recessive. Crossed with the Egyptian 'wrinkled leaf' this mutant gave a strongly crinkled F_1 and a wide range of forms in F_2 from normal to heavily crinkled. The results indicated that the Indore crinkled was due to a mutation at the same locus as in Egyptian 'wrinkled leaf' and Sea Island 'crinkled'.

In MADRAS in connexion with the improvement of *G. hirsutum* (Co 2), where simple direct crossing with different types had not led to any promising results, resort was taken to multiple and complex hybridization. It was found that different types had different potentialities of giving valuable combinations. It was noticed that even among the progenies of sibs of the same crosses, some cultures hardly contained any useful breeding material while in others all the plants were characteristically sturdy, productive and free from leaf curl. Since most of the promising biotypes of the crosses between Co 2 and the S. American varieties to get pempheres resistant types were late, an attempt is being made to combine earliness in them by further suitable crossings.

Anatomical work undertaken at Coimbatore having proved that all the cultiivated cottons could be grouped into five classes on the basis of the variations in the pattern of disposition of the vessels in the thalamus, crosses were undertaken to study the inheritance of the anatomical character. *G. arboreum typicum* pattern gave monohybrid ratios when crossed with *G. herbaceum frutescens* pattern; but when the former was crossed with *G. herbaceum typicum*, the F_2 segregated in the ratio of nine *arboreum*, three *herbaceum frutescens*, and four *herbaceum typicum*. In *herbaceums, frutescens* was dominant over the *typicum* pattern. It was clear that the *arboreum typicum* represented the double dominant, and the *herbaceum typicum* the double recessive. In the American group *G. barbadense* behaved as a simple Mendelian dominant over *G. hirsutum*. When Asiatic and American cottons were crossed, the F_1 plants showed an intermediate type of anatomy. It was also observed that the wild types were dominant over the cultivated. *G. Harkensii* and *G. tomentosum* were dominant over *barbadense* and *hirsutum*. It was further noticed that the anatomical patterns were inherited independently of the external morphological characters peculiar to each species.

A mutant with practically no ovary or bolls and with fewer petals obtained from Million Dollar proved a simple recessive to the normal and the gene responsible for it was found to be independent of leaf shape and flower colour genes. The heterozygotes of the two chlorophyll mutants in *arboreum* and *herbaceum* when crossed gave normal F_1s. A female sterile mutant that was isolated in *G. herbaceum* at Hagari station proved a simple recessive to the

normal. Another interesting investigation that has been carried on in Coimbatore is with reference to the origin of lint and fuzz hairs in cotton which has proved the independence of origin and development of the two kinds. Histological studies on the several linted and lintless mutant types have led to the finding that the mode of development of lint could be grouped under six categories. It was also observed that the production of lint was influenced by more than one pair of complementary factors.

In BOMBAY further progress was made with regard to the problem of breeding for wilt resistance. The research work of the Plant Pathologist at Poona on selection of highly resistant strains under controlled optimum conditions has led to a useful technique of giving reliable results in a short time. Several resistant strains from BD 8 and hybrids with it have been obtained. Since the useful Jarilla strain though fairly resistant to wilt under field conditions is not so under optimum conditions, it has been crossed to immune Million Dollar type.

In addition to interspecies hybrids already obtained, another ten Asiatic-American hybrids are reported from Surat (Bombay). Using *G. hirsutum* as the pollen parent 20 back-cross hybrids have also been obtained ; while pollinating American cotton with hybrid pollen one back-cross hybrid was produced and this has given rise to 12 plants in the next generation.

In the CENTRAL PROVINCES AND BERAR, besides the Verum 434, and the promising selections from *G. indicum*, certain derivatives from the cross Bani × *cernuum* have been obtained with an average yield of more than 1,000 lb. of seed cotton per acre and with fibre suitable for spinning 30 H. S. W. C. A natural interspecific hybrid between *G. arboreum* and *G. hirsutum* proved sterile but during the year a boll with five seeds was obtained by using the pollen of the hybrid on Buri, a local *hirsutum* type.

In SIND, out of the four cross progenies 4F-18 × Meade mentioned last year, two were found to be of the same duration as Sind Sudhar, with a higher ginning and a longer staple. Selection work for jassid resistance was continued in the progenies of Sind Sudhar × Co 2.

In the PUNJAB, while the newly developed hybrid strain, Jubilee cotton, proved just as good as P4F in quality, there is still some difference of opinion with regard to its yield, and trials are in progress. An early high ginning *desi* type with good yield (Sanguineum 119) has been evolved suitable for the Multan tract.

In MYSORE seeds of Co 2, which had been X-rayed for 7½ minutes, have now in the third generation given plants with a ginning percentage of 38-40 and a lint length of 25-28 mm. as compared to 33-35 ginning and 20-23 mm. of unexposed seed. The plants are also reported to be almost free from red-leaf.

Wheat

In the PUNJAB among the hybrids, besides C 409 which has given satisfactory yields under *barani* conditions, a new strain, C 228, promises to give under late sown conditions better results than any wheat hitherto available. The oft-repeated experiment of separating grains into small and big in an established strain and determining their cropping power was tried with Punjab 8A wheat which showed there was no difference between the two.

In the CENTRAL PROVINCES AND BERAR the hybrids between A 115 and the Australian and Palestine wheats have maintained their reputation for yield

and rust resistance. In order to get rust resistance from Khapli wheat (*T. dicoccum*) F_1s of *T. vulgare*×*T. durum* and *T. durum*×*T. dicoccum* (Khapli) were grown and the first one crossed with *T. dicoccum* and the second with *T. vulgare*. Success was also achieved during the year in crossing directly *T. vulgare* with *T. dicoccum*. The amphidiploid *Aegelotricum* containing 56 chromosomes was crossed with *T. vulgare* and with the F_1 of *T. vulgare*×*T. dicoccum*. A cytological explanation has been offered for the breaking down of rust immunity in *sharbati* hybrids which, if correct, should mean that the hybrids did not have a stable chromosome complement.

Breeding work for rust resistance was continued by the Imperial Economic Botanist at SIMLA sub-station. Study of the F_1 populations of a number of crosses showed that susceptibility to rust was dominant in all cases. During the year, F_3 populations of a number of crosses after being tested for resistance at the seedling stage at Dr. Mehta's laboratory were studied in the field and selections made on the basis of rust resistance and other desirable characters. The hybrid populations were thoroughly studied with a view to finding out if there existed any correlation between resistance to rusts and any other obvious and easily determinable morphological character. The influence of certain external factors such as different dates and times of sowing, different depths of sowing and different conditions of spacing on the manifestation of heterosis in wheat was investigated at the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI. It was found that hybrid vigour as shown by the rate of formation of the first four foliage leaves and first tiller was affected by all the factors under study. The difference in tillering between parents and F_1 was more striking in the earlier than in the later sowings.

Rice

In MADRAS it has been demonstrated very clearly that by the growing of improved strains and suitably manuring the fields the average yields can be increased to the high figure of 5,000 lb. per acre. Extensive trials with two hybrid strains (Co 3×Burma) have proved their suitability more to the swamp conditions rather than to purely rain-fed conditions. Similarly the hybrid strains evolved for *piricularia* resistance have done remarkably well in centres where the locals were subject to the disease. Of the six X-ray mutant strains of GEB 24 with dwarfish habit, which were tried under heavy manuring conditions, four lodged earlier than GEB 24 and two have given higher yields than 24. One of the selections from the interspecies hybrid (*O. sativa*×*O. longistaminata*) showed a remarkable power to withstand drought conditions.

The erect habit of the cultivated rices and the prostrate habit of the wild rices behaved as a simple pair of allelomorphs, the F_1 being intermediate in habit. The purple colour of the lemma and palea behaved a simple dominant in one case and in another case was due to the presence of two complementary factors. The scent in rice was found to be inherited in a Mendelian fashion, there being obtained in some families an approach to the ratio of 9 scented to 7 non-scented. A genetical association was also detected between scent and the factor *r* for white rice. Certain families showing segregation for asynopsis revealed the presence of duplicate genes governing its inheritance. Forty families derived from *trisomics* originally isolated from a triploid and a tetraploid showed the

trisomics appearing in each of them to the extent of 29 to 36 per cent, and while the normals bred true, the *trisomics* repeated the performance. Simple recessive mutations for male sterility and dwarf stumpy plants (with spikelets enclosing proliferated floral organs) were isolated. Further studies on the ageotropic mutant obtained from the X-rayed material have shown that it may be a recessive but there is indication to the effect that the gene can be unstable and capable of giving distorted ratios making the mutant appear dominant. The semi-sterile mutants giving a 1 : 1 ratio of fertiles to steriles have been shown to be due to segmental interchange of non-homologous chromosomes. Several mutations from somatic tissues were noticed to occur in the vegetatively propagated plants. Some of these mutations that have been examined show simple gene changes, duplication of single chromosomes and chromosome sets. Planting out the individual tillers separated from the stubbles of a previous crop appear to be a very fruitful source of inducing such somatic mutations. Extensive cytogenetical studies in the *oryzae* carried out by Dr. Ramanujam in London have advanced our knowledge of this important crop considerably and he has also worked out the phylogeny and the taxonomical relationship of the genus *oryzae* in the tribe and shown the basic number of chromosomes in *oryzae* to be five.

Total and partial correlation and multiple regression equations between yield on one hand and number of tillers per plant, mean length of ear and number of grains per ear on the other were calculated in four varieties. Number of tillers per plant was found to bear the highest correlation with yield, both total and partial, followed by number of grains per ear and length of ear. Once again it was proved that there was no advantage in separating the seed of an established strain into heavy, medium and light.

The chromosomes and chromosome behaviour of a number of rice varieties differing widely in morphological characters were studied in the United Provinces and although the number of chromosomes was the same in all, the complements of different varieties showed variations in chromosome morphology and it is considered that 'chromosome constitution' is responsible for the varietal differences exhibited. Studies on the inheritance of awning have led to the conclusion that the length of awns was governed by three or more genes acting cumulatively. The presence of colour in the awn, however, proved a simple dominant to its absence. In connexion with studies on awning it was found that environment had a pronounced effect on the development of awns ; for instance closer spacing of the plants increased the length of the awns.

In BOMBAY, by crossing different dwarf forms of rice, it has been found that there are five different genes for dwarfness. One of them occurred in seven varieties, the others only one in each. Studies on hybrid vigour in five crosses showed no evidence of heterosis except in respect of yield where, in two crosses, the F_1 was significantly better than the higher yielding parent. In Coimbatore, where this question has been investigated more extensively involving 26 sets of crosses, there was manifestation of heterosis in six cases with regard to flowering duration, in seven cases with regard to number of ears per plant and in four cases for plant height.

In the CENTRAL PROVINCES AND BERAR genetical studies have shown that the green colour of the leaf blade was found to behave as a monogenic character in two crosses and as a digenic character in others, green being dominant to

purple. The behaviour of the same character studied in Bombay has been explained on the basis of an inhibitory factor hypothesis. Studies on the inheritance of coarse, medium and fine rice based on the width of the grain have led to the inference that coarse was dominant to medium, and medium dominant to fine. While previous reports from here had shown that there was no natural crossing occurring in rice, it would appear from more recent investigations that it does occur to the extent of 1·75 per cent.

In BIHAR the inheritance of full purple colour of the plant is found to be governed by three independent Mendelian characters, one of which is inhibitory in its nature of action. The inheritance of the long outer glume is stated to involve the interaction of four independent factors two of which may be inhibitory in its action.

The inheritance of the colour of the lemma and palea such as ripening black, ripening brown, ripening straw, etc. has been extensively studied in ASSAM and the results have been explained on the basis of three independent factors thus confirming the results previously obtained in Coimbatore. Anatomical studies on the flood resistant types have shown the presence of a sclerenchymatic tissue around each of the cortical lacunae not found in ordinary varieties.

Comparative studies on the distribution of mechanical tissues in different species of rice carried out in BENGAL have shown that wild species were mechanically more strongly constituted than the cultivated rice. Extensive correlation studies between yield and several measurable morphological characters, both within a strain and between strains, are in progress in one of the rice substations in Bengal.

Millets

In Coimbatore (MADRAS) two recessive and lethal types of chlorophyll deficiency, Xantha and patchy albino, have been recorded in *jowar*. The factor responsible for the brown colour in the mechanical tissue of the sorghum plant and the factor for the juiciness of stalk have been found to be independent in their inheritance. A new factor which is responsible for producing purple pigment on the glumes immediately on emergence of the head from the boot has been identified and it is a simple recessive to the factor which produces pigment on the glume at the dough stage. This factor is independent of the factor which determines the nature of the purple pigment, whether reddish purple or blackish purple. Studies on the flowering phases of related species of sorghum have shown that the time and period of anthesis vary with the different species. While typical Indian grain sorghums have green seedlings many wild species and African sorghums have blue green seedlings and when the two types are crossed the blue green is a simple dominant over green.

In BOMBAY, in connexion with the breeding of striga resistant *jowars*, several varieties of *jowar* both local and African were tried in the field to test their susceptibility to the three species of striga, *S. lutea*, *S. densiflora* and *S. euphrasioides*, and it was found that the attack varied according to the variety of *jowar* and the species of striga.

Sugarcane

In Coimbatore (MADRAS) some of the sugarcane-bamboo hybrids (F_1s) proved fertile and set seed freely which has enabled the hybridization to be

taken to the F_2 generation in the second year. Over 1,000 F_2 plants are now growing in the field. About 20 per cent of the progeny is found to show in a marked degree the central cavity of the bamboo parent. The F_2 progeny includes economically useful types with tall, straight and erect canes with very profuse tillering. Some of the F_2s crossed to POJ 213 have given seedlings which are distinctly superior to the standard canes of Coimbatore such as Co 213, Co 281 in vegetative characters. The examination of the sugar contents determined by the refractometer is also very encouraging.

The cytological studies of the intergeneric crosses have been continued. Whereas in the sugarcane × bamboo hybrids examined the chromosome counts approximated to the sum of the haploid counts of the parents, in the sugarcane × *imperata* hybrids the full diploid complement of sugarcane is present. Further evidence of tetraploid inheritance in *saccharum* was provided by analysis of the 'synthetic' Kassoers made in 1936. It has been possible to synthesise a trigeneric *saccharum* hybrid by crossing POJ 2725 × *Imperata* with sorghum. 'Triploid' hybrids between *S. spontaneum* and sorghum are found to be more fertile than the diploid. Giant 'triploids' found amongst selfed seedlings and intraspecific hybrids of *S. spontaneum* are found to be morphologically and cytologically intermediate between the wild *spontaneum* and the indigenous canes of India. This has thrown some light on the evolution of this polyploid species by hybridization and the probable origin of *S. barberi* from *S. spontaneum* by the formation of giant 'triploids' arising from the fertilisation of unreduced eggs. There is an indication that occasional triploids may have been the starting point in the evolution of indigenous canes of India.

The mutants obtained by X-raying sugarcane buds in MYSORE have been found to be far superior to the parent in vigour and growth without appreciable reduction in sucrose contents.

Twenty-two cane varieties were tested at the DELHI institute for their relative resistance and susceptibility to mosaic, red-rot, wilt and smut. Some varieties showed comparatively greater resistance to mosaic, red-rot and wilt but the results of smut resistance were not conclusive. It is observed that there are various physiologic forms in existence in red-rot and wilt organisms which though morphologically alike greatly vary in their power of pathogenicity.

Potato

About 50 cultures from Indian collection after eliminating duplicates, 276 samples of Chilean *tuberosums*, 22 species of tuber-bearing solanums and a large number of interspecific hybrids were under study by the Imperial Economic Botanist. Attention was primarily devoted to the study of disease resistance and the relative susceptibility of the varieties and hybrids to late blight. A large number of resistant plants were found in progenies of crosses between *tuberosum* and *andigenum* and more especially between *tuberosum* and *demissum*. Data regarding sterility and compatibility were collected from a large number of crosses involving several interspecific combinations. In certain crosses, resistance to late blight appears to be definitely dominant to susceptibility. Leaf index, a distinguishing character of varieties, was determined in crosses between *S. demissum* and *S. tuberosum* and the higher leaf index appeared to be dominant over low leaf index. Preliminary observations on cold resistance were also taken. Analysis of six species of potatoes for starch contents has

shown that there is ample variation in starch content and it is possible to breed for high starch content.

Tobacco

Attempts were made at the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, to induce doubling of chromosomes in the sterile *Tabacum plumbaginifolia* hybrids by the use of Colchicine. The available material of *N. rustica* was studied with a view to the production of strains combining heavy yield with a high nicotine content as such strains would be of value for the commercial production of nicotine for insecticidal purposes. Five different kinds of leaf-curl were differentiated ; the first four were due to distinct viruses, A to D, and the fifth due to a mixture of two or more of the above in different combinations. Breeding of resistant varieties offered the most satisfactory method of control. An experiment conducted during the year to see whether by protecting seedlings until transplanting time the subsequent incidence of leaf-curl could be diminished failed to give any significant difference.

Oil-seeds

Linseed. The yellow-tipped mutant observed previously at the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, proved a simple recessive. Oil content in Pusa linseed hybrids is found to be negatively correlated with the intensity of seed colour, the dark seeded types, brown and grey, having a lower oil content than the lighter coloured types, fawn and yellow. Seed size is positively correlated with seed colour intensity. In a cross between a Pusa type and a flax variety the height of the F_1 was intermediate but in seed size and seed weight the F_1 had the bold seed of Pusa type and had a heavier seed weight than that of the heavier seeded Pusa type. With regard to breeding for rust resistance, while none of the existing strains was free from rust, only very few plants showed the rust in the F_4 cultures of the crosses specially made for the purpose. In BOMBAY 18 strains superior for yield, higher oil content and also drying quality of the oil have been obtained which would be tried in the districts. Preliminary studies at Indore would appear to show that the general higher oil content of the white seeded linseed as compared to brown might be partly due to the thinness of the seed coat in the former. In the CENTRAL PROVINCES several foreign flax varieties and linseed strains from other provinces were tried and none was found to be of any special merit.

***Brassica* sp.** Pollen germination and the biology of the flower were studied in *toria* at the DELHI institute. Crosses were again made to study the inheritance of self-sterility in Brassicas and the material so obtained has been classified into self-compatible, self-incompatible and cross-compatible groups. Pseudofertility was observed in certain of the types. In the PUNJAB a new method of group breeding in which selected plants can be made to cross amongst themselves with the help of bees under controlled conditions has been tried with success. In crosses between self-fertile forms of yellow *sarson* (*B. campestris*) and sterile forms of *toria* (*B. napus* var. *dichotoma*) and brown *sarson*, hairiness of leaves was a simple dominant over smoothness and entrose

position of suture of anthers dominant over introse and the two characters were independent. Inheritance of seed colour, however, proved too complicated. Self-sterility (pod setting 30 per cent and less) was dominant to self-fertility 70 per cent and more and this was independent of seed colour and position of suture of anthers. Crossings among different species have shown that (i) brown and yellow *sarson*, *toria*, and turnip (*B. rapa*) cross readily among themselves and give good setting of pods, (ii) *raya* (*B. juncea*) does not cross readily with any of the remaining species, and (iii) cauliflower (*B. oleracea*) will not cross with yellow *sarson*, *toria* and turnip but give a few pods and seeds when crossed with brown *sarson* and *raya*.

Groundnut. In MADRAS among crosses between bunch and spreading types there was a marked tendency for the pods to germinate in the field after the ripening of the pods and attempts are being made to get types without this tendency. A white flowered mutant was isolated in BOMBAY and is found to breed true for this character.

Castor. In MADRAS a hybrid selection No. 5G-2-1-1 has been obtained which gives a 30 per cent more yield than the local and is about six weeks earlier in duration. Genetical studies with castor in BOMBAY have shown that the stem colour and spine on capsules give a monohybrid segregation while the bloom character proved complex. A preliminary cytological study of the castor made in the CENTRAL PROVINCES showed considerable secondary association of chromosomes and it is inferred that *Ricinus communis* is a secondary balanced polyploid. A successful cross has been made between sesamum and the wild weed *Martynia diandra* to see if it would be possible to build up an ideal type of sesamum plant with all the hardy characters of *Martynia*.

Coconut. In MADRAS studies of seedlings from nuts obtained by self, cross and natural pollination were continued. 'Crosses' and 'naturals' were found superior to 'self' in respect of height and girth of seedlings and number of leaves but the 'crosses' were much more vigorous than the 'naturals'. No differences were observed either in germination or production of leaves when seedlings were raised from nuts collected from young, middle-aged and old trees. Girth and height are found to be the important criterion in selection of seedlings but the girth is even more important than height. The artificial pollination of female flower significantly reduces setting by about 6 per cent and it proves that shedding of 'buttons' is not due to the scarcity of pollen. Anatomical examination of the buttons would show that 50 per cent of the shed buttons are fertilized and the remaining 50 are either unfertilized or ineffectively fertilized.

Barley. Two Pusa types of barley, one with a weak straw and the other with a strong straw, which showed differences in the arrangement and development of the mechanical tissue of the culms, were crossed, and the F_2 was studied genetically. Four phenotypes were distinguished, two like the parental types and two intermediate between them. The results indicated the interaction of two factors, one main and another supplementary and less potent in its effects, lodging associated with the weak development of sclerenchyma being dominant to nonlodging. The results of the inheritance studies on fertility of the lateral floret, awn development and the nature of the outer glume showed that single factors were found to determine the inheritance of all these charac-

ters and simple segregations were obtained in F_2. There was complete linkage between two-rowed fertility and the lack of development of awns on the lateral florets, between intermediate fertility and the development of pointed or tipped awns on the lateral florets, and between six-rowed fertility and the development of full awns on the lateral florets; the inheritance of fertility of the lateral florets and the development of the awns may, therefore, be controlled by the same factor pair.

The inheritance of rust resistance was studied in a cross between a foreign resistant (Alpha) variety and a local susceptible type and the F_2 showed that the reaction to rust was inherited on a digenic basis. The resistant parent, Alpha, has a greater number of epidermal cells in a unit area of leaf surface and a larger number of stomata of smaller size than in the susceptible variety. Transgressive segregation occurred for the inheritance of epidermal and stomatal tissue and there was apparently no correlation between epidermal characters and reaction to rust.

A virescent mutant was obtained in barley which in breeding proved a simple recessive to normal green.

In oats the black colour of the seed proved a simple dominant to yellow seed.

Gram (*Cicer arietinum*). In MADRAS confirmatory evidences were obtained with regard to association between seed coat colour and size of seeds. Experiments with the mixture of black, mottled and cinnamon coloured seeds obtained from the same plant proved that factors other than genetical were concerned with such variation in seed colours. A cross between two types of gram, one with branches forming from the ground level upwards and another with no branches up to the ninth node from ground level, showed that the former habit was a simple dominant to the latter. In BOMBAY a highly wilt resistant strain (No. 18) has been obtained which showed only 3·2 per cent wilting of plants as against 95 per cent in the local. In BERAR a cross between Kabuli gram and one of the local strains showed that the pink colour of the flower, the spreading habit of the plant, brown colour of the seed are dominant over white flower colour, semi-trailing habit and white seed. In the PUNJAB continuous selection to get a pure strain with two pods per peduncle has in the course of four years been so effective to raise it from 7·6 per cent in the original material to about 46 per cent.

Pigeon-pea (*Cajanus indicus* Spreng). At PUSA simple monogenic and digenic ratios were obtained in the F_2 with regard to characters such as plant habit, flower colour, pod colour, pod shape and seed coat colour. The work in connexion with breeding of varieties combining wilt resistance with other economic characters was continued. In MADRAS where the inheritance of the seed coat colour in pigeon-pea is in progress it was found that cultures with yellow petals had lighter coloured seed coat. In the CENTRAL PROVINCES AND BERAR, when the simple leaved mutant was crossed with normal trifoliate plants, it was found that seeds set only when the normal plant was kept as the female parent, the reciprocal cross proving always sterile.

Sunn-hemp. Extensive studies on the biology of the flower in sunn-hemp has been made in Nagpur and it has been found that the percentage of seed setting can be increased to 65 if in addition to rubbing the stigma, which alone

produces only a 50 per cent setting, a drop of glucose solution (0·5 per cent) is applied to the stigma after rubbing it with the brush.

4. Plant Physiology

Cotton

With regard to the Sind physiological scheme that had been in progress for ten years, a special officer was appointed by the Indian Central Cotton Committee to revise and re-write the report in a form suitable for publication. The work on the incidence of red-leaf was, however, continued with a single assistant and indications were obtained that soil and time of sowing were the most important factors controlling the disease. It was found that all varieties of cotton were affected if the available nitrogen in the soil was deficient and, by correcting this deficiency, it was possible to counteract the trouble.

In the PUNJAB the investigations in connection with the partial failures of American cotton were continued and it was found that there were two kinds of failures, '*Tirak*', one due to the high concentration of alkali salts in the sub-soil and the other due to the deficiency of nutrients in the soil. The two types of *Tirak* can be easily distinguished from the sequence of characteristic symptoms produced on the growing plant, particularly in the leaves. Certain ameliorative measures were tried during the year to counteract the adverse soil conditions. To overcome the trouble due to alkali salts in the sub-soil, late sowing (middle of June) had the effect of saving the crop from the onslaught of the disease. Late sowing suppresses vegetative growth so that water deficit is avoided at a time when the loss of water from plants is greatest. In the early sown crop the symptoms of the disease appeared by the first week of August. In soils where nutrients are deficient, application of nutrients containing nitrogen, potash and phosphorus produced beneficial effect on the growth of plants. The treated plots showed no symptoms of the disease while all the symptoms appeared in the untreated plots. The number and position of motes in the locks of three important *desi* cottons were determined in the Punjab. It was found that the total number of motes was far less in *desi* than in American cotton but the disposition of the motes in the various seed positions was very similar. The number of motes was least in the centre of locks and early and late pickings had a greater number than the season pickings.

The physiological work in MADRAS to get a strain with a lower shedding index than K 1 has resulted in the isolation of four strains and these will have to be tried in the districts. The work of the year also showed that sowing the cotton thick is more remunerative to the cultivators of Tinnevellies tract and that mixing cotton with coriander gives better results. Observations on the water requirements of Cambodia cotton indicated once again that the demand for water was the greatest during the flowering phase and that up to that period it was necessary to maintain a fairly high level of moisture in the soil. Studies on the variations in the water contents of the leaves point that irrigations in the mornings were more beneficial than at any other time of the day. The final results of the Madras fodder *jowar* scheme have pointed out that the injurious after effects of *jowar* on cotton could be offset by sowing cotton thick, adopting a higher seed rate for *jowar* with a view to inhibit grain setting and by not ploughing in the *jowar* stubbles until the commencement of the north-east monsoon.

At the INSTITUTE OF PLANT INDUSTRY, INDORE, the quality of certain American cottons grown under *barani* (rain-fed) conditions and in *adhan* (well manured and rich) lands have been compared and it has been found that the produce from the latter is finer, longer in staple length and gives a higher spinning value than the produce from the former. Experiments have been in progress to determine the effects of competition when the *desi* cotton (*G. arboreum*) is grown in different degrees of association with the American cotton (*G. hirsutum*). It has been found that the American type is found to suffer significantly less both from red-leaf and leaf-roll with increasing association with *desi* and has a significantly higher number of bolls per plant. There was a definite indication that the American type gains at the expense of the *desi*. As a further step in this line of investigation a *desi* strain (Malvi 9) was grown mixed with three other better quality cottons, one of them being a selected strain of American cottons. It was found that in no case was the mixture significantly inferior to the higher yielding component in the mixture. Experiments to determine the changes from year to year in the proportion of the two components, *desi* and American, starting with three varying proportions artificially made, have shown that the proportion of the two types in the mixture at the end of the season more or less depends upon the initial germination and stand of the two types, the post germination mortality being similar for both the types. Experiments in progress to find a physiological explanation for the differential survival of the four genotypes, Malvensi, Verum, Cutchicum and Roseum, constituting the *desi* types in different tracts showed that the Malvensi type had the greatest leaf area and dry weight and hence physiologically most suited to Malwa conditions. For the Nimar tract, however, the Malvensi and the Roseum types were equally suitable and the preponderance of the latter type in the tract must be due to the human preference for it because of its higher ginning quality. To test the quality of cottons, samples were handspun on the *takli* and *charkha* and the count and strength of yarns estimated. The results, however, when compared with the spinning tests of the technological laboratory, failed to give any agreement indicating that handspinning was of no value in estimating the quality of cotton for mill use.

The application of varying doses of farmyard manure for the *jowar* crop followed by cotton was tested for its effect on the quality of cotton in Bombay (Dharwar). It was found that five tons of manure per acre was an optimum dose and lighter or heavier doses than this quantity brought about a decline in quality in one respect or another. The ginning percentage in cotton showed a decreasing trend with increasing rate of manure application. This last finding agrees with the results obtained at the Indore Institute where the same cotton grown under rich manured land showed a lower ginning percentage than when grown in unmanured *barani* land.

Sugarcane

In BOMBAY (Padegaon) investigations into the bioclimatic have shown a detrimental effect of heavy rains in September on the growth of cane especially in non-flowering varieties resulting in early maturity due to leaching down of nitrates. Experiments on the contribution of the sub-soil water table to the water requirements of the crop have revealed it to be as high as 50 per cent

in case of its proximity at a depth of 2½ ft. They have further indicated that the water requirements of the crop within the irrigation interval of ten days can be satisfied if the dose is just sufficient to keep the soil saturated to the surface two feet. The system of ten-day waterings during summer is definitely better than eight-day rotation as it leads to economy of water without in any way affecting the yield or maturity. In connection with the problem of interrelationship of water and manure it has been observed that while there is a stimulation of vegetative growth with increasing doses of nitrogen resulting in delayed flowering, the reverse is the case with higher doses. The wilting coefficient experiments which have been concluded after a thorough trial have conclusively proved that leading the crop to the stage of permanent wilting in summer does not in any way affect the yield although it may show a temporary bad effect. Experiments on improved methods of the distribution and proportion of manurial top dressings have been continued and the optimum mineral nutrition of the crop is being elucidated. Although the initial application of 100 lb. of P_2O_5 is conducive to better performance of the crop, an additional dose of 15 lb. of P_2O_5 at earthing up time is found to be of no advantage from the standpoint of growth, but on the other hand, leads to the reduction in the absorption of nitrogen by the crop. The after effect of cane varieties on a succeeding crop of cotton has shown that cotton yields best after the variety EK 28 and lowest after Co 413.

In BIHAR, for the fifth year in succession, the beneficial effects of hot weather irrigation in North Bihar were confirmed, the value of such irrigation being proportional to the dryness of the hot weather. Arrowed canes in general were found to give lower and delayed germination. From growth studies it was found that any improvement sought to be effected in the cane crop could have the maximum advantage when it was attempted upon and proved to be of benefit to the hot weather shoots. In root studies, organic manures gave a higher root/shoot ratio as compared to artificial fertilizers and the total shoot weight was proportional to this ratio. Study of the relative efficiency of water requirements of varieties under different moisture and manurial schedules showed that (1) plants grown under limited water supply were more extravagant than those growing under normal water supply, (2) application of manure in one dose at planting time was more economical than application made in two doses, (3) application of Niciphos II was less economical from the point of view of water expenditure than an equivalent dose of castor cake and (4) potash fertilization reduced the water expenditure per unit weight of dry matter produced.

In the UNITED PROVINCES (Shajahanpur) in an experiment to determine the physiological relation between spacing and nitrogen, it was seen that tillering and yield of individual plants increased with increased spacings between plants at all levels of nitrogen. The yield per acre on the other hand, decreased consistently as spacing between plants increased from 13 in. to 26 in. at all levels of nitrogen. Studies on the interrelationship of nitrogenous manures, water duty and sowing date with growth and yield of cane showed that maximum germination was attained at the same time irrespective of the date of sowing and was distinctly poorer in early sown canes. At all sowing dates ammonium sulphate lowered germination appreciably. The adverse effect of ammonium sulphate on germination appears to decrease with increase of moisture in the soil becoming negligible under wet planted conditions. Tillering was

maximum in early planted canes decreasing with later plantings. Increased spacings at all levels of nitrogen increased tillering and additional nitrogen at all levels of irrigation and sowing dates was beneficial to tillering. Increase in irrigations from three to six (each at 80,000 gallons per acre) increased tillering appreciably, but further increase beyond six had no effect on tillering. Even in the large-scale trials additional winter irrigations beyond five or six had no effect on yield but yet would appear to be useful in keeping down the fibre percentage in later harvested canes. Earthing up in lodging varieties improved yield and quality. There is, however, experimental evidence in Padegaon to indicate that earthing up of cane is not essential from the physiological point of view. Irrigation during or before frost saves the crop from injurious effects while smoking did not have any effect. The most economical dose of nitrogen for the cane crop is 100 lb. per acre and higher doses appear to have an adverse effect on quality and a pronounced delaying effect on maturity.

In the PUNJAB liberal watering under Lyallpur conditions does not delay maturity ; on the other hand the sucrose increases with a corresponding decrease of glucose. Even the higher doses of nitrogen, 175 lb. per acre at Rawalpindi and 200 lb. per acre at Jullundur have not delayed ripening to any appreciable extent. The comparison of irrigations after 7, 14 and 21 days' intervals suggests that frequent irrigations (7 days) are effective in lowering the mineral matter in the juice at Risalewala.

In MADRAS (Anakapalle) a study of the water requirements of the sugarcane crop has shown that a variety like J 247 requires 77 acre inches. Eperiments conducted at this place on ripeness of the cane have shown that arrowing was not an indication of attainment of maturity. There was even a steady increase in sucrose content even after 2 to 2½ months after arrowing. Under Ankapalle conditions canes did grow even after arrowing to a slight extent and deterioration started only 2½ months after arrowing, arrowed canes showing a higher, sucrose content than the non-arrowed canes for about 2½ months. Arrowed canes gave a higher percentage of extraction, longer millable cane and greater weight, diameter and girth.

At the Imperial Sugarcane Station the effect of extra illumination by means of lamps on certain varieties was tried with the result that the majority of clumps failed to flower.

Sugarcane on an area of four acres in the Punjab was sprayed with 0·1 per cent ferrous sulphate solution against chlorosis and normal condition was restored.

Rice

The DACCA UNIVERSITY scheme of research on the nutrition of rice plants had, during the year, been mainly devoted to researches on the rice soils, agents responsible for the fixation of nitrogen and the identification and isolation of such agents, the nature of the process leading to the evolution of elementary nitrogen from water-logged soils, etc. A bacteriological examination of the rice leaf has revealed the occurrence of one or more nitrogen fixing bacteria within the tissue of the leaf and the results would seem to indicate that the rice plants can assimilate elementary nitrogen after the manner of legumes.

The effect of nitrogenous fertilizers like ammonium sulphate on rice and the time of applying them has been under investigation at several centres and it

would appear that the best results are obtained when the manure is applied a few weeks after transplanting, which varies from two weeks to a month according to the locality and variety, later applications not giving a response in yield but improving only the nitrogen content of the grain.

The physiological investigation in BIHAR would point out that drought-resistant strains have a low transpiration ratio, that the maximum requirements of the plant for water occur two to three weeks before flowering and that when once the transplanted crop has established itself standing water is unnecessary for the optimum growth of the crop. At the same place it has been established that the rice plant can be made to tolerate a certain degree of salinity in the soil by pretreating the seeds with minute doses of common salt. Such pretreated seeds have given 30 to 40 per cent more yield than untreated seed grown under similar conditions.

Studies on the deep water rices in ASSAM indicated that quick water rise due to flooding resulted in long internodes. If the water level becomes stationary, growth in the height of plants ceases and the plant's energy appears to get diverted towards nodal branching, which is characteristic of deep water rices, such nodal tillers producing ears and contributing to the total yield unlike in the case of ordinary varieties. Maximum root development in deep water rices appears to synchronize with periods of slow water rise or of constant water level. The primary and secondary nodal roots characteristic of these rices have a nutritional function and supplement the food supply during the active growth period. It has also been found that sprouted seeds cannot grow through more than 4 in. height of water and that early varieties respond quicker to water rise than the late ones. The growth rate in response to water rise increases with the age of the plants up to four weeks. An experiment to determine the best time of maturity of rice grains in Assam has shown that grains attain full maturity five weeks after flowering and the produce harvested 35-42 days after flowering gave the best milling results.

In the UNITED PROVINCES rice seeds after a preliminary soaking and irradiated with quartz mercury lamp for different periods from a few minutes to a few hours showed different mortality but longer exposures appear to have some effect in inducing vigour in the surviving plants.

In BENGAL smoking the seeds two hours daily for two or three successive days was found to be the most successful and an easy method of breaking the dormancy period.

In MADRAS in the ' quality ' investigation conducted at Coimbatore it has been definitely established that grain from a green manured plot had thicker bran layers than the grain from an unmanured plot. The milling tests have shown that while in hand pounding only a fraction of the bran layer is lost as compared to what is removed in mill polishing, such hand pounded rices do not cook properly on account of the uneven removal of the bran layer. A uniform removal of the same amount of bran as is removed by hand pounding by an improvised polisher has given very satisfactory results.

Dry Farming Scheme

In BOMBAY measurements of heights of *jowar* plants at Sholapur showed that growth continues even during the night while transpiration was restricted

to the day time only. Tissue temperature of *jowar* leaves showed that it fluctuated with the temperature of the surrounding air. An early maturing selection has been found which on testing is noticed to be more efficient, requiring 15 per cent less water. The lysimeter studies recorded a loss of 11 in. and 8 in. of water in the uncropped and cropped lysimeter respectively, both having 18 in. layer of medium deep soil.

MADRAS. The root-system of the *jowar* plant examined at Hagari was 37 per cent greater in bulk, 111 per cent better in lateral spread in the ploughed and bunded plot than in the control. Similarly *jowar* plants in plots which were fallow in the previous season had roots double that of the plants in previously cropped plots. This importance of fallow in dry farming practices was also clearly brought out in experiments conducted at Rohtak (Punjab).

PUNJAB. At Rohtak, with moisture content of the soil ranging between 7 to 15 per cent, *jowar* and *bajra* gave cent per cent germination in both heavy and medium soils. It was also found that for *jowar* and *bajra* soil drought was more harmful when it occurred before earing than after, as grain yield is considerably lowered in the former case without any economy in the use of water. By vernalizing *jowar* seeds it was possible to shorten the vegetative period by about ten days.

Miscellaneous physiological investigations

Several investigations of general physiological importance such as influence of light on plant growth, rate of transpiration at different periods of growth, photo-synthetic rates in different plant species, physiology of stored fruits, etc. were carried on at the BENARES HINDU UNIVERSITY but they are not reviewed here. The one investigation relating to wheat, namely, the growth and protein content of wheat as affected by variations in soil moisture and soil nitrogen, is alone dealt with. For better protein formation and accumulation in wheat both nitrogenous and phosphatic fertilizers are found essential. The later the application of fertilizers, the better is the protein content of the grain, though this may not be most conducive from the yield point of view. Increase in soil moisture up to 35 per cent of the moisture holding capacity of the soil increases the yield of both straw and grain in wheat, any increase beyond this limit being detrimental. The optimum moisture content in soil for protein formation is also in the vicinity of 35 per cent of the moisture holding capacity.

In the PUNJAB trials with barley types have shown that barleys grown on clayey soils had lower nitrogen content both with two and four irrigations and that the number of irrigations given to a crop had more or less pronounced effect on nitrogen content and brewers' extract. Nitrogen content decreases and brewers' extract increases with increase in irrigation.

In MADRAS it has been found that the maximum rate of plant growth takes place during the first fortnight after the first flowering in the spreading varieties of groundnut and during the second fortnight in the bunch types. Most of the flower production takes place during the fortnight immediately following the commencement of flowering in the bunch varieties and during the third and fourth fortnights in the spreading varieties.

In addition to his studies on the living protoplasm Dr. Boshi Sen has obtained successful results in vernalizing seeds. In mustard which has been the first

crop under trial, the maximum earliness that has been observed in opening of first flowers in plants from dried unsplit vernalized seeds is 18 days. It has also been found that unsplit vernalized seeds can be dried over 15 weeks (the maximum period so far studied) under Almora climatic conditions without being completely devernalized. Vernalization experiments with other plants like linseed, peas, garden peas, etc. have been started.

5. Plant diseases

Soil-borne diseases and root diseases

Some progress has been made in studying the root disease of coconuts in Southern India. Two hundred and eighty isolations yielded 78 cultures of *Botryodiplodia theobromæ* Pat., which has been suspected as the cause of the disease by Butler and by Stockdale, and which also causes the internal root-rot of tea and die-back of rubber. Of the four plants inoculated with pure cultures of this fungus two have so far shown symptoms of the disease and one has died of wilt. One seedling inoculated with *Rhizoctonia* also showed symptoms of the disease. Soil analyses showed marked deficiencies, notably of potash and nitrogen, and the belief is held that these deficiencies, if not the cause of root disease, are at least predisposing factors.

It has been found in the PUNJAB that low temperature and high humidity are unfavourable for active attack of cotton roots by *Macrophomina phaseoli* (Maubl.) Ashby, explaining why the incidence of disease is reduced in the late sown crops, and also why plants at Ambala and Rohtak, which carried the fungus on the roots, showed no damage. At these places the humidity is much higher than in the irrigated districts of West Punjab, where the disease is severe.

The wilt disease of gram, which causes severe damage in many parts of India, was under study at the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE. A number of isolates of *Fusarium* were obtained, of which one, a non-colour-forming species of the sub-group *Orthocera*, was predominant. This caused severe wilting in artificially infested soil. Certain other species caused severe seed-rooting or pre-emergence blight, and the remainder were non-pathogenic.

Attempts were made in MADRAS to control wilt of red gram (pigeon-pea, *Cajanus Cajan*) by inducing biological antagonism of the casual organism (*Fusarium vasinfectum* Atk.) by common soil organisms through addition of farmyard manure at the rate of 15 tons per acre or green manure at 30 tons per acre. The efforts were unsuccessful.

It was found in Madras that the strain of *Fusarium vasinfectum* causing cotton wilt is physiologically distinct from that causing pigeon-pea (*Cajanus Cajan*) wilt, no cross-infection taking place, thus confirming previous conclusions reached elsewhere.

A new disease of citrus trees, described as ' bark rot ', has been found doing severe damage in the Kistna delta, Madras. Although a species of *Diplodia* and two other fungi were found constantly associated with the disease, it was believed to be primarily due to unfavourable soil conditions resulting in water-logging, the water table having been found only about seven feet from the surface at the beginning of the rains. Control measures were based on amelioration of soil conditions ; it was recommended that dead trees should be dug out and destroyed, and that the cankered bark of diseased trees should be scraped away,

the stained wood excised, and the wounds disinfected by application of Bordeaux paste.

A species of *Fusarium* isolated from wilted citrus trees in the PUNJAB was found to be capable of causing infection when artificially inoculated into citrus trees. The fungus is one with a high optimal temperature (about 30°C.) for growth.

The root-rot disease of areca-palms in MYSORE, caused by *Ganoderma lucidum* (Leyss.) Karst, responded satisfactorily to soil treatment with sulphur. A large block of diseased trees has now been treated as an experiment.

Foliage diseases

Citrus anthracnose caused by *Colletotrichum glœosporioides* Penz. has been found to cause five distinct types of damage :—

(1) Withering of the branches from the tip downwards.
(2) Blighting and falling of the flowers.
(3) Rotting of the stem ends of the fruits.
(4) Spotting of the leaves.
(5) Dying of newly budded plants.

Of a varied collection of fungi isolated from coconut plants infected with the leaf disease, *Helminthosporium*, *Glœosporium* and *Pestalozzia* all reproduced rotting on inoculation.

It was found that the main cause of spotting on *Hevea brasiliensis* leaves in the Mundakayam Valley Rubber Plantation was *Oidium hevœ* Steinman, a disease which causes severe damage in certain rubber-growing countries, but not previously recorded in India.

A new disease of chilli was found to be common in the neighbourhood of DELHI. The symptoms are the production of spots of a greyish or greyish-brown colour, oval, roundish or irregular in appearance, with concentric rings, on leaves, twigs and fruits of chilli. It is caused by a species of *Alternaria*.

The effect of nitrogenous manures on susceptibility of paddy to 'blast', caused by *Piricularia oryzæ* Cav., was studied in MADRAS in a pot culture experiment. Forty pounds of nitrogen per acre in the form of ammonium sulphate or sodium nitrate increased the disease in susceptible varieties, but did not cause infection of the highly resistant variety Co 4. Sodium nitrate induced greater susceptibility than ammonium sulphate.

An interesting and important discovery about *Phytophthora arecæ* (Colem.) Pethybridge, the cause of Koleroga disease of betel-nut, has been made in BOMBAY. It was known that the fungus does not normally produce oospores in nature, and the mode of its survival from year to year and the origin of primary infection was a mystery. It has now been found that the fungus hibernates in the dead portions of the crowns of infected trees as mycelium, but oospores are not found in these portions.

Fruit spoilage

The host range of the fungus *Colletotrichum lagenarium* (Pass. Ell. & Halst.) was studied on fruits of *Cucumis sativus*, *Cucurbita maschata*, *Lagenaria vulgaris*,

Cucumis melo var. *utilissimus*, *Momordica charantia*, *Cucurbita pepo*, *Citrullus vulgaris*, and *Trichosanthes dioica*. The only fruits which became infested were *Lagenaria vulgaris* and *Cucumis melo* var. *utilissimus*.

A study of seasonal effects on development of rotting in fruits and vegetables is being made by paying fortnightly visits to the Delhi wholesale market. During the first year, apples, coming mainly from the North-West Frontier Province and Kashmir, showed rotting of 5 to 20 per cent of the fruits. In November most of the damage was due to *Aspergillus* and *Penicillium*, but after December the cause appeared to be almost exclusively the latter fungus. Oranges from Nagpur showed marked variation in the amount of rotting. From November to February the cause was chiefly *Penicillium digitatum* Sacc., but during the hot weather damage was less and was mostly caused by bacteria. Pears were frequently damaged by *Aspergillus japonicus* Saito, which appears to attack only fruits with slightly damaged skins.

Botrytis rot of grapes, which causes severe damage in South Africa, has been found to be fairly wide-spread in Baluchistan.

Breeding resistant varieties of crops

Twenty-two varieties of cane were tested for susceptibility to red-rot and wilt, namely varieties Co 213, 214, 223, 244, 281, 285, 290, 299, 312, 313, 331, 352, 354, 360, 362, 402, 411, 412, 413, 417, 419 and 421. The varieties most susceptible to red-rot were Co 213, 223, 244, 281, 290, 299, 331, 354, 362, 402, 411, 412, and 417 ; those most susceptible to wilt were Co 213, 223, 290, 352, 360, 362, 402, 419 and 421.

Tests of resistance of sugarcane varieties to mosaic were made at MADRAS. The varieties Co 215, 335, 355, 434 and 511 were found completely free, others varying from 2 per cent to 86 per cent infection.

Testing of F_3 generations of nine wheat crosses against a mixture of the six physiologic forms of stem rust in India were carried out. None of the Indian *vulgare* wheats had shown a satisfactory degree of resistance to any of the rusts except Pusa 120, which showed high resistance to yellow rust. Consequently exotic varieties were used as parents for crossing with the Indian varieties. Out of a total of 4,521 F_3 plants thus tested with a mixture of physiologic forms, 1,631 fell in the infection classes 0 to 2, indicating resistance, while the others ranged in the higher susceptibility classes.

In addition to the above, tests were carried out on F_1 plants from crosses made the previous year. In eight such crosses, all the F_1 plants showed high susceptibility to infection with the mixture of six physiologic forms, indicating the dominance of susceptibility over resistance.

Extensive testing of varieties of wheat and oats for resistance to smuts have been conducted for several years and results are now becoming available. Of the 40 Indian wheat varieties tested seven appeared to be immune and nine more highly resistant to loose smut. Selections of resistant plants were made for testing next year. Resistance to flag smut was tested with 97 varieties, of which 25 showed no infection, 15 showed less than 10 per cent, and four more less than 25 per cent. The remainder ranged from 30 to 89 per cent infection.

Seed of the sann-hemp (*Crotalaria juncea*) variety D-IX, a strain immune to *Fusarium* wilt, is being multiplied in Bombay for distribution. All the F_1

plants in a cross between immune and susceptible individuals showed wilt symptoms, indicating that susceptibility is dominant over resistance.

Marked progress has been made in breeding wilt-resistant cottons in BOMBAY. In the Broach section, seeds from nine highly resistant plants of BD 8 have been retained. Seed from 19 selected plants of NS 12 all gave rise to some disease, but a number of cultures showed a high degree of resistance. Crosses have been made of BD 8 with Goghari and NS 12. In the Jalgaon section seeds of 103 selected plants of Million Dollar variety were tested, and 76 of the resulting cultures showed no mortality. Promising selections are also being retained from Chinese R_1 Spotless and New Million Dollar.

So far no cotton resistant to *Macrophomina* root-rot has been found in the PUNJAB in the Indian varieties tested, but foreign cottons show more promise of giving a resistant type. In Baroda certain KS strains show promise and selections are being made.

Owing to the failure of cultivators to adopt the practice of cleaning up debris in gram (*Cicer arietinum*) fields in the Punjab for control of blight caused by *Mycosphœrella rabiei* Kovachevsky efforts were directed towards producing a resistant variety, and this has been found in F_8 which is being multiplied for distribution.

Fungicides

Attempts to work out a cheaper spraying programme for 'Mahali' disease of areca palms caused by *Phytophthora arecæ* (Colem.) Pethybridge were made in MADRAS. It was found that two sprayings with Bordeaux mixture were necessary for satisfactory control, and that 2 per cent Bordeaux mixture is more efficacious than a 1 per cent mixture, but the possibility of replacing the 2 per cent mixture by a 1 per cent mixture for the pre-monsoon spray is to be investigated. Oils and casein were found to be better spreaders than resin, and also easier to manipulate, but good results were obtained with plain Bordeaux mixture, suggesting the possibility of dispensing entirely with spreaders and adhesives. Cuprous oxide was found to be a poor substitute for Bordeaux mixture.

In BOMBAY work has been done on the control of the newly-discovered powdery mildew disease of betel vines, caused by *Oidium piperis* Uppal and Kamat. It has been found that a single application of 200-mesh sulphur gives effective control in new gardens, but a second dusting must be given in older gardens.

It was found that Sulsol of strength 2 or 2½ parts in 100 parts of water gave good control of fig rust in Bombay. The infection, however, was mild. The object of the test is to replace Bordeaux mixture which though effective leaves a disfiguring spray-deposit on the fruit.

In the CENTRAL PROVINCES it was found that treatment of cotton seeds, before sowing with the mercurial dressings Agrosan G, Hortosan B, Abavit B and Ceresan and with copper carbonate, sulphur or sulphuric acid increased the yield. The use of Agrosan G, Ceresan, sulphur and copper carbonate also increased the yield of grain and straw of *jowar*.

The largest outlet for fungicides continues to be in the control of Koleroga disease of areca palms. In Mysore alone 15,500 acres of palms were sprayed

during the year, the total value of spraying materials sold being Rs. 41,500. For the Koleroga disease of betel-nut palms in Bombay the area sprayed was 3,487 acres. A large amount of spraying is also done annually in Madras and Travancore.

In MYSORE a new sprayer of German make, capable of spraying nearly 1,500 trees a day instead of about 250, trees has been introduced.

Nutritional disorders

Mosambi citrus suffering from ' mottle leaf ', a serious disease in Bombay, have been found to respond readily to spraying twice with a zinc sulphate lime mixture of 5-2½-50 composition.

In Mysore orange trees suffering from chlorosis responded well to spraying with zinc lime mixture, as in Bombay, but it was noticed that trees in which the yellow leaves had become thick failed to respond.

Virus diseases

As in the previous year the thick cane variety Surkha Saharanpuri suffered severe loss (18·8 per cent) in yield of cane as a result of mosaic in a yield trial at Karnal using naturally infected and healthy sets ; in contrast to this the thin cane variety Co 313 grown at Shahjahanpur suffered practically no loss of yield from mosaic.

Among the most interesting and important findings which have come out of the sugarcane mosaic investigation have been those relating to natural transmission and recovery from mosaic. In some areas there appears to be practically no natural transmission of the disease (e.g. at Delhi). Recovery is the phenomenon of production of healthy canes, entirely free from mosaic, from sets cut from mosaic-infected clumps. It seems to be a factor of the district of origin of the sets, and supports the conclusion that there are more than one strain of mosaic virus. Mosaic-affected Co 313 material from Pusa gave 15 to 20 per cent recovery at Pusa, Delhi and Karnal, but when sets of the same variety were obtained from Shahjahanpur instead of Pusa they showed no recovery at the same three stations. It is not a question of masking of symptoms—the ' recovered ' canes are quite free of the virus. The two factors, natural transmission and recovery, must set the level of infection with mosaic in any particular district.

Further attempts to transmit the leaf-curl disease of tobacco by white-flies fed on extracted juice of diseased plants have not met with much success. Out of 110 plants carrying flies fed on leaf-curl plant juice extracts, only two showed anything strongly reminiscent of leaf-curl.

Phanerogamic parasites

Striga on sugarcane was found at Risalewala in the Punjab for the first time in 1936, and it was also found at Delhi. It is suspected that to both places the seed of the parasite was carried by irrigation water. This troublesome pest is wonderfully adapted for distribution and multiplication, and is difficult to eradicate.

6. Entomology—Insect pests

(a) Locusts

Locust survey work

Surveys of the various habitats of the desert locust in Sind, Rajputana and Baluchistan were periodically made to note seasonal peculiarities of its distribution and breeding as in previous years. Ecological studies of the solitary phase of the locust in typical centres were also continued.

Experimental work

Experiments to determine the relative preferences shown by young and adult locusts for various natural food plants were carried out, as also, observations under controlled conditions in regard to the influence exerted by different food plants on expediting the sex-maturation of the adult locust and on quickening the growth of the hoppers. Certain experiments were also conducted to determine the effect of the action of sun-light in the production of mauve or rosy tinge in the hindwings of locusts.

Biometrical studies of collections of *Schistocerca gregaria* and *Locusta migratoria* were in progress during the year and the relative proportion of the different phases in both species at different seasons and places was carefully worked out.

Surveys of outbreak areas in Mekran

In the course of the year careful surveys were made all over Mekran and maps were prepared to show the distribution of sandy areas and of cultivated patches where the formation of incipient swarms was likely to occur. These maps would be valuable in case the suppression of incipient outbreaks should be decided to be carried out.

Study of old records

Considerable progress was made in the correlation of locust activity with meteorological data. Maps showing the movements of locust swarms, month by month, were prepared for the last two locust cycles (1912-19 and 1926-31).

Observations on the breeding of solitary phase locusts in their natural habitats during 1937-38.

(a) *Schistocerca gregaria*

1. *Winter-spring breeding 1936-37.* Along the Mekran coast, winter rainfall was very scanty and consequently there was no locust breeding in these areas. On the other hand, normal rain was received in the interior valleys of Mekran, as well as in Kachhi and Upper Baluchistan. A certain amount of breeding occurred in the interior of Mekran. In Kachhi, good numbers of solitary hoppers were noted all over the area, while in the Bolan valley fairly concentrated breeding occurred in favourable situations. There was also some concentrated breeding in the Sheh Lakhra area of Lasbela in April-June 1937.

2. *Summer breeding in 1937.* By June most of the adults of the new generation were found to have disappeared from Kachhi, Bolan, Mekran and Lasbela.

In July somewhat large concentrations of adult locusts were found in parts of East Bikaner and Western Jaipur States, where fairly early and good rainfall had occurred in June, and in this area considerable breeding was observed in July-August. Breeding also occurred in parts of Thar, Mallani and Southern Jaisalmer, and to a small extent also in Lasbela.

Owing to the development of a long and persistent drought in August, the large locust population produced in the East Bikaner areas gradually disappeared, and was found by September to have migrated partly into other parts of the Rajputana desert. In southern areas of the desert as around Chachro, a second summer brood appears to have developed with the fall of some rain in the early half of September. By October, most of the locusts had disappeared from the Sind-Rajputana area, and it is presumed that they had migrated westwards into Baluchistan since the locust population in the Lasbela Pasni and Gwadar areas was found to have increased very considerably in October-November.

3. *Spring breeding in 1938.* A fair quantity of winter rainfall in 1937-38 occurred during the months of December 1937 and February 1938, but was on the whole below the average both on the coast and in the interior. There was little rain in spring in Kachhi. Consequently only light locust breeding occurred on the coastal reks in March-April, as also to some extent in the interior. Unlike the previous year there was no breeding whatever in Kachhi, but light breeding was noted in the Bolan valley in March-April.

(*b*) *Locusta migratoria* ph. *solitaria*

(1) *Spring breeding in 1937.* Concentrated breeding of *Locusta* was observable in the Bolan area in May-June, as also light breeding in Kachhi.

(2) *Summer breeding in 1937.* By July, however, very few locusts were noticeable in Bolan and Kachhi, but in the East Bikaner-West Jaipur areas, very large concentrations of *Locusta migratoria* were noticeable in July. Considerable breeding occurred in this region during July-August. During August, however, a pronounced drought developed, and in its wake, the greater part of the *Locusta* population was found disappearing from these areas.

(3) *Autumn breeding in 1937.* During October-November 1937, heavy infestation of cereal crops by hoppers of *Locusta migratoria* were reported from the Sirohi and Mehsana areas, and similar attacks were detected in the adjoining areas of Palanpur, Idar and Kaira. Considerable damage to crops such as *jowar*, *bajri*, paddy, sugarcane and millets was caused in some of the attacked fields. By November, the new generation of locusts produced was found disappearing. As good concentrations of winged locusts were found in parts of the Karachi district and Lasbela State in November, and in Kathiawar and Cutch in December-January, it is presumed that migration of the locusts into these areas had occurred.

Spring breeding in 1938. Stray hoppers of *Locusta* were noted in parts of Lasbela State in February 1938. In March, fairly good numbers of *Locusta* adults were found present in irrigated wheat fields in the Bolan valley, and by May, large numbers of hoppers were detected in the fields after wheat harvest. Some damage to sugarcane was also noted at Harnai in May-June. By the middle of June, however, very few specimens of *Locusta* were observable in the Bolan-Harnai area.

The observations made during 1937-38 show that, just like the desert locust, the migratory locust is capable, in its solitary phase, of making long distance migrations from one rain-zone to another with the change of seasons, possibly as a result of certain combinations of meteorological conditions.

Work on the desert Locust at lyallpur

Hoppers of the desert locust breed ' crowded ', in an atmosphere containing excess of oxygen, develop patterns of black pigment typical of *gregaria* hoppers bred in normal atmosphere. Atmosphere containing more than 66 per cent of oxygen was not congenial to the normal life of the hoppers.

It has been determined that in a starving desert locust, the death is primarily due to moisture deficiency in its body. It has been found that a thirsty locust may drink water, and in one particular case a male locust drank 225 mgm. of water at a stretch.

The influence of atmospheric pressure on the life-cycle and the colouration of the desert locust has been studied. An addition or reduction of 2 in. of mercury pressure does not seem to have any effect.

The size of the gonads as also the amount of fatty deposits in the body of the locust are influenced by atmospheric temperature.

(*b*) OTHER INSECT PESTS*

Cotton

In the laboratory of the Imperial Entomologist at NEW DELHI, the ecological work on the spotted bollworms of cotton and their parasites, *Microbracon lefroyi* and *Melcha nursei*, yielded some interesting results. The fecundity and rate of development of the bollworm (*Earias fabia*) were found to be profoundly influenced by temperature and humidity. During pre-imaginal period high temperatures increased the fecundity and low temperatures decreased it. Moist conditions, within certain limits, increased the reproductive power, while dry conditions retarded it. The threshold of development was found to lie between 10° and 13°C. and the rate of development at any constant temperature was quickest at a saturation deficiency of 3 mm. The parasite (*M. lefroyi*) developed much more quickly than its host and on an average, a female parasite killed five to seven host larvæ. This parasite developed best in an atmosphere with a saturation deficiency of 0 mm., as against one of 3 mm. for the host. The rate of development of *Melcha nursei* was found to be comparatively slower than that of the bollworms. It oviposits preferably on prepupæ and paralyses a far greater number of hosts (56-150) than it actually lays its eggs on.

In the PUNJAB research work on the spotted and pink bollworms, under a scheme of the Imperial Council of Agricultural Research, came to an end. The work showed that protection with mosquito-net covers of crops from the attack of spotted bollworms resulted in the triple advantage of high yield, early crop and clean *kapas*. Another scheme was, therefore, initiated to demonstrate the value of this finding to the cultivators. Since the most important source of carry-over of the bollworms from one crop to another is through the ratoon cotton sprouts, the demonstration has taken the form of cleaning up

* Excludes insect pests on sugarcane, for which see Chapter III.

an experimental area of 500 sq. miles of all cotton stubbles and also other weeds which harbour the pest. As the Surat plant-puller did not work well in the hard soils of the colony areas of the Punjab, an implement called *kudali* which cuts the cotton plants 2 in. below ground level was substituted. Preliminary work on the cotton jassid, started under another scheme of the Imperial Council of Agricultural Research, confirmed some already known conclusions, viz. that this pest mainly attacks the American varieties of cotton and even among these, exhibits varying degrees of preference, that resistance of *desi* and other cotton varieties results from the inability of the jassid females to oviposit freely on them and that hairiness is not necessarily an important factor in anti-jassid resistance.

In the CENTRAL PROVINCES the American bollworm, *Heliothis obsoleta* and the spotted bollworm, *Earias fabia*, were shown to be serious pests of cotton but not the pink bollworm, *Platyedra gossypiella*.

In MADRAS the alternative host plants of spotted and pink bollworms were studied. The incidence of spotted bollworms on the Cambodia cotton was much higher (48-55 per cent in mid-December and 4-7 per cent in mid-January) than that of the pink bollworms which never exceeded 1·5 per cent.

In BENGAL the cotton leaf roller, *Sylepta derogata* and the red cotton bug, *Dysdercus cingulatus* were moderately serious as pests and were kept in check by regular hand picking. Aphids on young cotton plants were controlled by spraying with crude oil emulsion (4 oz. to 4 gallons of water).

Paddy

In MADRAS light trap trials against the paddy stem borer, *Schœnobius incertellus*, showed that the effect of light is felt most at a range between 60 and 130 yards from the source. Seasonal studies of fortnightly plantings at the Paddy Breeding Station were also made with a view to finding the relationship, if any, between weather conditions and the degree of incidence at different stages of the crop. The army worm of paddy, *Spodoptera mauritia*, was studied to note its peculiarities, if any, during larval or pupal period under natural conditions at different times of the year.

In BENGAL the stem borer, *Schœnobius bipunctifer*, attacking transplanted paddy plants, was controlled by letting the water out of the plots and also by destroying the moths by light traps.

In ASSAM the paddy case-worm, the paddy swarming caterpillar, the paddy stem borer and the paddy hispa were serious. In addition to these, a Chrysomelid beetle, a Limacodid caterpillar and *Nephotettix bipunctatus* were recorded for the first time as pests in this province.

In the CENTRAL PROVINCES *Pachydiplosis oryzæ* was under investigation. It was found that the damage by this pest could be avoided if the crop could be sown earlier than the normal time.

In MYSORE two serious pests of rice were the swarming caterpillar and the stem borer. In working out the life-history of the former, attention was chiefly directed towards finding out the means by which the pest tides over the interval between succeeding crops. In addition to the usual remedies of flooding, sweeping and applying kerosine, dusting with Paris Green was found fairly effective against the swarming caterpillar. About the only method of controlling the stem borer seemed to be to weed out infected seedlings from

the nursery. This method was successfully applied over 300 acres of paddy nurseries.

In COCHIN the important pests of paddy included a species of *Spodoptera* and species of *Nymphula* (rice case-worm).

Fruits

The survey of the codling moth by the Imperial Entomologist in BALUCHISTAN disclosed it as a serious pest of apple, pear, quince, etc. in that province. Larvæ of another moth, *Euzophera punicella*, sometimes occurred in large numbers inside the fruits along with the larvæ of the codling moth, but they did not seem to attack sound fruit and were, therefore, of secondary importance. Larvæ of yet another moth, *Spilonota ocellana*, attacked chiefly the leaves and flower buds of apple. The Imperial Entomologist also found the pest, codling moth, in the Parachinar district (Kuram valley) near the Indo-Afghan border. With regard to the pest it was considered probable that it had been and was being introduced into India by being carried inside infested apples imported from Afghanistan.

In the NORTH-WEST FRONTIER PROVINCE the incidence and bionomics of the fruit fly, *Chætodacus ferrugineous* Fb., a serious pest of fruits, was further investigated by the Imperial Entomologist. The fly damages pear, peach, guava and other fruits in Peshawar, Kohat and Parachinar districts, the attack varying from 50 to 80 per cent depending upon the time of the year. In Kohat the fly was observed to make as many as 15 punctures on a fruit and the maggots hatched out in 24-48 hours. Large-scale experiments at Kohat for testing the effect of various baits and poison sprays on the fruit fly showed that (1) Citronella oil attracted the largest number of flies, but the majority of them were males, (2) Pollard and Clensel were found almost equally useful as attractants, but the former was more economical. Sodium fluocilicate bait proved ineffective.

The biology of the apricot chalcid, *Eurytoma samsonovi*, a serious pest in the North-West Frontier Province, was closely studied by the Imperial Entomologist in the field at Haripur, Peshawar and Parachinar, and in the laboratory at New Delhi. The grubs were usually found from May up to the middle of the following February in the infested fruits which were attracted to the extent of 60-80 per cent in the *kori* variety. The grubs pupate inside the seeds and the adult emerges by making a hole in the testa and then boring a fine hole in the woody wall of the fruit. It was found that the grub stage might last for two to three years.

The fruit growing areas of the North-West Frontier Province and the Punjab were surveyed for San Jose scale and other insect pests of fruits under a scheme of the Imperial Council of Agricultural Research in charge of the Entomologist to Government, Punjab. The San Jose scale was found in Simla, Kulu valley, Mandi State, Dalhousie, Kurram, Abbotabad and other places on a large variety of host plants including almond, apricot, quince, walnut, rose, etc. Other pests distributed in both the provinces and fairly serious were *Chrysomphalus aurantii* and *Diaphorina citri* on citrus, *Monophlebus stebbingi* var. *octocauda* on apple, mango and plum, *Idiocerus* sp. on mango, *Schizoneura lanigera* on apple.

At the Chaubattia Fruit Research Station in the UNITED PROVINCES the study of the apple root borer, *Lophsteronus hugelli*, was continued. In confinement the grubs fed on roots of almost all kinds of fruit trees, e.g. apple, chestnut, walnut, etc., although in nature, usually, roots of apple and dead oak stumps were found infested. The hatching of the eggs, which were laid preferably in sandy soil, seemed to depend on the moisture of the soil, that with 20-40 per cent moisture proving the most suitable. Tests with para-dichlorbenzene and carbon bisulphide showed that the former is effective up to a depth of 6 in. if applied at the rate of 1 oz. to a running foot and the latter effective to 3 in. at the rate of $\frac{2}{3}$ oz. to a running foot. Observations on the woolly aphis, *Eriosoma lanigera*, brought to light several new forms not hitherto noted in Kumaun. The migration of the aphids from root to shoot and *vice versâ* continued throughout the year except for two months in winter. Some varieties, such as Merton 729 and 793 and *Pyrus baccatâ* remained immune from attack in all types of soils at Chaubattia. There seemed, however, no interaction between stock and scion and a susceptible scion remained so on a resistant stock without being changed by the latter. Sprays of nicotine sulphate and soap were very effective against the wooly aphis.

Different results about the efficacy of different sprays against the woolly aphis are, however, reported from the Punjab. In the Kulu valley, spraying the trees attacked by the pest, with rosin soap was found very successful but nicotine sulphate gave very low mortality. A parasite of the woolly aphis, imported from England and introduced into the Kulu orchards, is reputed to have done good work. Some other important fruit pests in the Kulu valley were the walnut weevil, the cherry and apple tree borer and the walnut tree borer.

In BOMBAY the citrus scale, *Chrysomphalus aonidum*, was effectively controlled by spraying with fish oil rosin soap. The common species of fruit flies in the province are *Chætodacus ferrugineous*, *C. zonalus* and *C. cucurbitæ*, damaging mango, guava, citrus, chikoo and cucurbits, the first two being most seriously attacked. Clensel was found to give good results as a trapping agent.

In MADRAS studies on two fruit flies, *Carpomyia vesuviana* and *Dacus correctus*, showed that the former did not feed on any host other than *ber* and was also not attracted by any lures, while the latter had a range of food plants which included sandal fruits, pumpkin flowers, guava and oranges. Raking up the soil to expose pupæ and spraying poisoned molasses were found effective as control measures. Experiments against *Virachola isocrates*, pest of pomegranate, indicated that spraying lead arsenate, crude oil emulsion and cutting away calyx cups, were partially effective in reducing infestation. This insect was also noted to breed in guava fruits and soap nuts.

A survey of fruit-growing areas in KASHMIR showed that San José scale was more serious in areas of high humidity than in those which are dry and well drained. The warmer climate of Jammu seemed unsuitable for this pest. Observations on the woolly aphis showed that during the winter season, the aphids hibernated chiefly in the crevices of trees and on the summer galls. The winged forms of this insect were seen moving about towards the end of summer. Winter spraying with Diesel oil emulsion controlled both the woolly aphis as well as the San José scale.

Vegetables

At the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, the *ak* grasshopper, *Pœcilocerus pictus*, which was found attacking cultivated crops for the first time, was closely studied. Previously known to feed only on wild *Calotropis* plants, this insect was found to damage leaves and fruits of brinjal and tomato and leaves and seedlings of gourd, etc. at Delhi. A test of the range of food plant showed that *P. pictus*, in addition to the above plants, could feed well on leaves of cowpea, soya bean, castor, cabbage, radish, *bhindi*, maize and oleander and to a lesser extent, on cotton and *Dolichos lablab*. The eggs of this insect, which are laid in the soil from June to August, overwinter and hatch in the next spring, the nymphs taking seven to nine weeks to become adults. The usual grasshopper baits, which are laid on ground, did not prove successful as the pest seldom leaves the plants. The spray with sodium arsenate gave the best results.

At Coimbatore (MADRAS) the life-cycle of the diamond back moth, *Plutella maculipennis*, a pest of cabbage, was found to last 15 to 18 days. Two parasites of this moth, *Brachymeria excarinata* and *Tetrastichus sokolowskii*, were also studied. In Madras sulphur and tobacco dustings were tried to control thrips damaging chillies.

Although the results have yet to be confirmed indications are that tobacco dusting gave better yields.

In ASSAM the life-history of *Heliothis obsoleta*, the caterpillars of which were found to bore into tomato fruits, was under study.

In COCHIN the brinjal shoot borer, *Leucinodes orbonalis*, was under study. It was found that each dead shoot generally harboured only one caterpillar.

In BOMBAY spraying experiments were carried out to control aphids on cabbage but the results were not conclusive.

Tobacco

Some interesting results were obtained by the Imperial Entomologist from experiments on insect vectors of leaf curl of tobacco carried out at PUSA. It appears that in nature, the alternate hosts, sann-hemp and *Ageratum conyzoides* and not diseased tobacco are the main sources of infection for healthy tobacco. The most susceptible period for tobacco plants for receiving infection is when they are about eight weeks old, provided the infection occurs during autumn or in February. It was also found that the white fly, *Bemisia gossypiperda*, can transmit the leaf curl virus after five to six hours' feeding and the minimum number of white flies tested and found successful for the transmission of the disease from sann-hemp to tobacco was five, from tobacco to sann-hemp and sann-hemp to sann-hemp two and from *Ageratum* to tobacco only one. The number of infected individuals used did not seem to alter the incubation period of the disease, provided they all fed for the same time. The white fly was observed to have a wide range of host plants some of which are affected with a leaf curl disease, very closely allied to, if not identical with, tobacco leaf curl. This would seem to reduce the chances of controlling the disease by the removal of the alternate hosts of its insect vector.

In MADRAS *ragi* (*Eleusine coracana*), raised in long narrow strips on the edges of tobacco plots, was found successful as a trap crop for *Laphygma exigua*.

Additional control measures found useful were handpicking of egg masses and caterpillars and spraying of arsenical poisons against caterpillars which escaped to tobacco seedlings.

In MYSORE the most serious insect pest of tobacco was the tobacco stem borer, *Phthorimœa* (*Gnorimoschema*) *heliopa* Low., which was kept under control by spraying the nursery beds with calcium arsenate, discarding all borer attacked seedlings in the nursery and splitting open the borer galls on the plants in the field.

In the CENTRAL PROVINCES *Prodenia litura* caterpillars on tobacco seedlings were successfully controlled by spraying with lead arsenate ($\frac{1}{2}$ oz. in 4 gallons of water).

Coffee

In MYSORE the coffee borer, *Xylotrechus quadripes* Chevr., became a serious pest owing to the neglect of some planters to systematically remove and destroy in time coffee plants badly affected by the borers. A tar distillate was very effective against the eggs and larvæ but proved costly. Other distillates were under trial with a view to reducing the cost consistently with efficiency.

Tea

Further work in respect of control of *Helopeltis theivora* was carried out in South Travancore using various insecticides. Fish-oil insecticidal soap, lime-sulphur, " Hillo " and " H. G. Ionised " (proprietory products) and ordinary bar soap were the wet sprays tested while " Helopellicide ", " Nico-sect" and Pyrethrum alone as well as in combination with diluents such as lime, sulphur and wood ash in varying proportions were the dusting trials made. The results distinctly indicated the superior value of dusting as compared with spraying as a means of *Helopeltis* control.

The study of the life-history and bionomics of *Laspeyresia leucostoma* (leaf-roller) was continued. The eggs were discovered for the first time in the field. They are laid on older leaves further down the branch. This is important from the control view point, as, in the course of normal plucking, the old leaves are not removed from the bush.

Gracilaria theivora, another leaf-roller occurring along with *Laspeyresia*, was under further study. *Xyleborus fornicatus* (shot-hole borer) is believed to be gradually extending its range of distribution in Travancore. A beginning was made to study the various types of gallery formation of this pest and their relation to the thickness of branches.

The termites *Kalotermes* sp. and *Coptotermes* sp. were definitely found attacking living tea bushes. Regarding *Toxoptera aurantii* (tea aphis) it was found that in the case of pruned tea, the bushes that were slow to recover from the effect of pruning were the worst to suffer from this aphid. Climatic factors and the presence of parasites and predators were found to exert considerable influence on the growth and dispersal of these insects.

Coconut

In MADRAS the maximum attack by the coconut beetle, *Oryctes rhinoceros*, on palms was noticed during March and April. Control methods

tried included, first, systematic hooking out and removal of beetles from palms and filling the holes with sand to prevent further entry of beetle and secondly, use of the parasitic Green Muscardine fungus against the beetle grubs. As could be expected, the activity of the fungus in infecting the grubs, was slow in drier areas.

In TRAVANCORE the coconut leaf roller, *Nephantis serinopa*, continued to be a serious pest, against which large numbers of Eulophid parasites were released in the field in certain areas.

Moringa

In MADRAS *Stictodiplosis moringæ*, a cecidomyid pest of moringa, was under study. Usually buds, 4-10 mm. long, are selected for oviposition and the maggots feed on the internal tissues, as a result of which the bud shrivels and falls down. Pupation occurs in the soil. Another major pest of moringa is the moth *Noorda moringæ*, the caterpillars of which first feed on the anthers and later, on the other parts of the buds. After the buds have fallen down, the catepillars come out and pupate in the soil. In the case of both the pests, raking up the soil underneath the trees to destroy the pupæ was found to be useful.

Castor

In MADRAS a study of the life-history of the red spider, *Tetranychus telarius*, showed that the life-cycle of this pest was completed in 10-12 days and a female could lay as many as 75 eggs. Dusting with flowers of sulphur and spraying with lime sulphur, were both found effective, the former giving slightly better results. The other serious pest was *Achoca melicerte*, the various stages of which, as also its natural enemy, *Microplitis maculipennis*, were studied.

Betel vine

In BENGAL the betel vine mealywing, a regular pest of betel vine on some farms at Dacca, was controlled by a proprietory insecticide called " Whiz ".

In ASSAM an ant, *Pseudolasius binghami*, was for the first time noted boring into the nodes and internodes of betel vines.

Stored grain

At the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, studies on the life-histories of the rice moth, *Corcyra cephalonica* Stn. and the rice weevil, *Calandra oryzæ* were continued. In the case of the former, oviposition started in April and a single female laid 100-200 eggs which hatched in three to six days during April, May and September. The larvæ hibernated in winter and the adults emergerd in spring. For the rice weevil, a temperature of 20°C. and a relative humidity of 87 per cent was found to be the most favourable for development, while relative humidities 36 per cent and 56 per cent proved very unsuitable. Similarly temperatures, below 16°C. seemed to be very unfavourable, irrespective of the relative humidity.

Laboratory experiments at COIMBATORE for the preservation of *cholam* from the attack of *Calandra* beetles showed that grains mixed with borax

and copper carbonate act as a repellent, while lime *plus* creosote, copper carbonate and sodium fluosilicate appeared to check their multiplication. The leaves of *Acorus* and *neem* also seemed to have repellent action.

In the PUNJAB mercury placed in small quantities in grain bins was found most effective in repelling and also checking the multiplication of insect pests.

The fecundity and duration of life of some species of *Bruchus* attacking pulses, both in field and in storage, were studied in COCHIN.

7. Useful insects

Lac and Shellac

Butea frondosa (*palas*) × *Ficus infectoria* (*pakaur*), *Zizyphus Jujuba* (*ber*) × *Ougeina dalbergioides* (*panjan*) and *Albizzia lucida* × *Albizzia lucida* infections gave promising results during the *Baisakhi* crop. *Glycine hispida* (soya bean), *Tephrosia candida* (bogammeddalor), *Panicum maximum* (Guinea grass) and *Pollindium angustifolium* (sabai grass) are found to be valuable in preventing erosion and for the production of a revenue crop subsidiary to lac.

Lac host trees were damaged by *Aspidiotus orientalis*, against which a completely refined low boiling paraffin distillate was found to be effective, and by the *Pentatomid Tessaratoma javanica* which was controlled by hand picking. Petrol was found to be the most effective fumigant for Termitaria.

The damage to lac crops by parasites remained small, being 7·5 per cent, and the predators, *Eublemma amabilis* and *Holcocera pulverea*, continued to damage 30-35 per cent of the lac cells. The effect of water immersion of stick-lac as a control against insect enemies was further investigated ; the immersion is undoubtedly effective against lac enemies, but has certain effects on the chemical and physical properties of the resulting shellac which are being examined.

Microbracon greeni, parasitic on the larvæ of *E. amabilis* and *M. hebetor*, parasitic on the larvæ of both *E. amabilis* and *H. pulverea* are likely to be of major importance in the biological control of lac enemies. *M. greeni* is indigenous and it would appear that the periodic release of laboratory-bred adults would grealty increase its efficacy. *M. hebetor* is an introduced parasite and results indicate that laboratory-bred adults are able to colonise in the field.

Two *Trichogrammid* parasites of the eggs of *E. amabilis* and *H. pulverea* recently identified as *Trichogramma toideanana* and *Trichogramma minutum* were observed for the first time during the year and are under investigation. Their potential value in the control of these enemies appears to be great.

On the chemical side, further progress has been made in the investigations on the possibility of modifying shellac and shellac constituents with various chemicals to give better products than the original shellac.

Further studies have been made in regard to the effect of various factors on the bleaching of seed-lac and shellac and a technical note on the bleaching of seed-lac on a semi-large scale has been published for the information of shellac manufacturers and industrialists.

The manufacture of garnet lac from seed-lac and by-products of lac manufacture, especially *kiri*, by solvent extraction has been worked out and the process has been successfully demonstrated with the aid of a Pilot Plant on a semi-

large scale. The quality of lac obtained from *kiri* by this process has been shown to be quite comparable in properties with the garnet lac of commerce.

The seed-lac obtained by refining stick-lac by the centrifuge process worked out by the Indian Lac Research Institute, Namkum, Ranchi has been found to be of very good quality and the possibilities of the commercial application of the process are being worked out on a fairly-large scale.

Improved shellac varnishes, coloured with alcohol-soluble dyes and giving finish like enamel, have been prepared suitable for brushing or spraying and favourable interim reports have been received, especially in regard to their application for cane furniture.

Considerable progress has been made in the moulding of articles from shellac and using a hydraulic press, it has been found possible to reduce the time-cycle to 2 min. with comparatively small articles. Greater rapidity of production is being tried with an injection moulding press and the possibilities of starting a shellac moulding industry have been indicated to the Government departments and industrialists in this country.

CHAPTER VI

AGRICULTURAL MARKETING*

DURING 1937-38 greater emphasis was laid on the work of immediate practical value and efforts were made to put into effect the results obtained in the course of the marketing surveys which had been completed. It was realized that the surveys, though forming the essential foundation for any system of organized marketing, should, as far as possible, be followed up by effective demonstrations of the methods of improved marketing. Accordingly, it was decided at the Marketing Officers' Conference held in September 1937 that new surveys should be taken up only in respect of fish and cashewnuts so that the central and provincial marketing staffs could devote more time to development work.

The central marketing staff was thus engaged throughout the year in the two-fold task of compiling the all-India survey reports on various commodities and of giving a practical lead to the provinces and states in the matter of development work. The all-India reports on linseed, eggs, tobacco and grapes were in the press and several others under preparation. A special report, *Cold Storage and Transport of Perishable Produce in Delhi Province*, was also published. It outlined the economic possibilities and advantages of applying improved methods of cold storage to perishable commodities like fruits, fish, etc. Besides, short and simple summaries of the *All-India Wheat Report* were published in English, Hindi and Urdu for the benefit of the general reader and the cultivator. The annual report of the Agricultural Marketing Adviser for the year ending 31 December 1937 was also issued as a priced publication.

The survey work and the compilation of reports on lac, sugar and coffee was continued by the special staffs working under the Agricultural Marketing Adviser.

The experimental grading and marking stations, run during the previous year, having indicated possibilities of development along the lines of defined standards and systematic grading, it was felt necessary not merely to continue the experiments but to extend them to cover fresh commodities and to other centres. With this end in view, the funds of the Agricultural Marketing Adviser were augmented by a special grant of Rs. 31,000 made by the Imperial Council of Agricultural Research.

Such grading operations assumed further importance when it was decided to attempt the grading of ghee which is one of the most widely consumed articles of food in the country. A scheme for the testing, grading and marking of ghee was formulated in consultation with the trade and the remarkable progress achieved may be judged from the fact that within nine months from the date of inauguration of the scheme ghee grading and packing stations were functioning successfully at Calcutta, Cawnpore, Okara, Khurja, Aligarh, Hathras, Jaswantnagar, Etawah, Firozabad, Shikohabad, Sirsaganj, etc. The task of checking the quality of ghee collected at these stations was entrusted to a

* The assistance of Mr. A. M. Livingstone, Agricultural Marketing Adviser to the Government of India, in the preparation of this Chapter is gratefully acknowledged.

central ghee control laboratory specially established for the purpose at the Harcourt Butler Technological Institute, Cawnpore.

The adoption of uniform grade specifications for ghee was rendered difficult by the existence in certain areas, like Kathiawar, of genuine ghee having physical and chemical characteristics different from those prescribed originally by the conference held at Simla. Hence, the claims to special exemptions advanced by the Kathiawar ghee interests were considered at a special meeting in Bombay and suitable provision was made in the Agricultural Produce (Grading and Marking) (Ghee) Rules, 1938, to admit of the grading and marking of genuine ghee of particular localities and in particular seasons having peculiar physical and chemical characteristics.

The experimental hide grading stations at Agra and Delhi were continued and new stations were opened at Tangra and Garden Reach Slaughter Houses in Calcutta. The working of the hide grading stations was reviewed by an informal conference held at Cawnpore in February 1938 and certain modifications, found necessary in the light of the experience gained, were incorporated in the hide grading rules. The conference recommended that the possibilities of introducing mechanical flaying should be investigated. It also authorized the Agricultural Marketing Adviser to open a hide improvement fund for the purpose of encouraging proper and careful flaying by paying small premia on well flayed hides.

The egg grading stations at Pabbi (Peshawar), Chenganoor (Travancore) and at Delhi were continued and eight more stations were opened at Calcutta, Mardan, Havelian, Quilon, Lucknow, Bareilly, Bombay and Chinnaganjam (Madras Presidency). The fact that the egg merchants were willing to take to grading without any financial aid testified to the practical success of grading. The grading experiments in respect of fruits were also continued—oranges at Nagpur and Sylhet, grapes at Sheikh Mohammadi in the North-West Frontier Province, apples in Kashmir, mosambis at Rahuri and mangoes at Bulsar in Bombay and Digha in Bihar. An experiment for the manufacture and sale of graded *ata* from conditioned wheat similar to the one previously tried at Delhi was conducted at Lahore and proved popular. Concurrently with the grading of commodities for the internal trade, it was decided to apply the grading system to tabacco exported from the Madras Presidency to the United Kingdom, and the Indian Tobacco Association, Guntur, shipped several hundred bales of tobacco, graded according to the specifications laid in the Agricultural Produce (Grading and Marking) (Tobacco) Rules.

In addition to revising the rules for grading tobacco, eggs, oranges, hides and grapes in the light of experience, new rules in respect of commodities like ghee, plums, mangoes and apples were promulgated. The results obtained in the course of the grading operations outlined above, encouraged the authorities concerned to consider the question of widening the Schedule to the Agricultural Produce (Grading and Marking) Act, so as to include fruit products, cotton of specified varieties, *ata*, rice of specified varieties, oil-seeds and edible oils and wheat of specified varieties. With a view to securing wide support in this connexion contact was established with the main interests affected.

Since public cooperation and appreciation were essential for the success of such a new line of work, advantage was taken of the various agricultural exhibitions in provinces and states to give public demonstrations of the technique of

grading and these evoked general interest, particularly that of the cultivators. The various provincial Governments also gave wide publicity to the Agricultural Produce (Grading and Marking) Act, by translating it into twelve major languages.

As in the case of commodities previously surveyed, many representative samples of rapeseed, mustard seed, market wool, ghee, sugar and butter were collected and analysed in different centres with a view to defining their quality characteristics and to finding their prevalent defects. The market wool samples were also examined from the point of view of their commercial utility by a leading firm of wool manufacturers.

The weekly broadcast bulletin was made more comprehensive by the inclusion of an estimate of wheat stocks at Karachi and wider publicity was given to this bulletin through newspapers and journals. The daily broadcast service in respect of Hapur was enlarged by the inclusion of quotations for gram, barley, peas and *arhar*. Besides, arrangements were made to broadcast twice a week, along with the Hapur quotations, the latest available quotations for jute bags (f.o.r. Calcutta). As a preliminary step towards the introduction of a market intelligence service designed to benefit and connect the buying and selling centres for she-buffaloes, statistics of their daily prices and arrivals into Bombay were collected and a weekly bulletin compiled therefrom was published every Wednesday.

Experiments on cold storage transport continued to receive the attention of the Cold Storage Committee, consisting of representatives of the Finance, Defence, the Railway Board and Imperial Council of Agricultural Research Departments, of which the Agricultural Marketing Adviser was the liaison officer. Closely linked with the question of transport is that of proper containers for perishables like fruits and eggs. An improved type of light container was designed for eggs and was subjected to several examinations. Other problems such as the standardization of weights and measures also continued to engage the attention of the Agricultural Marketing Adviser.

The long series of negotiations with the grain and oil-seeds trading interests were brought to a successful close when, as a result of a third grain conference held in April 1938, the trade accepted with certain modifications the standard contract terms for white wheat and for 'small' and 'bold' linseed. Consideration of the final terms of the contract for groundnuts had, however, to be postponed to a later date.

While the central staff was busy tackling these several problems, similar progress was maintained by the marketing staffs in the provinces and states. The provincial officers examined the possibilities of opening new grading stations and supervised the working of the existing ones. As a result of their efforts, several railways reduced the freight rates on many commodities and thereby encouraged a greater flow of traffic between centres of demand and supply.

The formation of an organic and closely knit marketing structure was further facilitated by the decision of several major Indian states to pass legislation similar to that of the Agricultural Produce (Grading and Marking) Act. Sikkim was the first state to pass such an act and others like Travancore, Kashmir, Hyderabad, Mysore, Patiala, Porbandar and Nawanagar have taken the preliminary steps. The all-India nature of the activities and the progress already

achieved lead one to hope that the Indian agriculturist will soon be enabled to market his produce in a more economical and scientific manner.

Progress report

The fourth annual report of the Agricultural Marketing Adviser to the Government of India (published elsewhere) includes the summarized reports of the marketing staffs in provinces and states and shows the progress of the scheme in detail. It may be recalled, however, that the Office of the Agricultural Marketing Adviser with a central marketing staff was established by the Government of India in 1935 as a result of the Report of the Royal Commission on Agriculture (1928) presided over by Lord Linlithgow, now His Excellency the Viceroy. The report embodied many recommendations for the improvement of agricultural marketing and it will be useful at this stage to take stock and see how far the main proposals of the Commission have been carried out.

Marketing officers

The Commission recommended the appointment of a whole-time marketing officer of the status of Deputy Director of Agriculture in each of the major provinces. This has been done and three assistants provided by the help of a grant from the central Government through the Imperial Council of Agricultural Research. Provincial Governments have, in some cases, added to their staff to meet the growing demand for development work of a practical nature. Special marketing staffs have been appointed for jute, sugar, lac and coffee. Ten leading Indian states, at their own expense, have engaged full-time marketing officers. There are, therefore, now altogether 100 full-time marketing officers in India and in addition over 200 minor Indian states have nominated persons to carry out marketing enquiries so that marketing work is receiving attention practically throughout the whole length and breadth of India. The marketing staff in Burma also cooperates.

Surveys

The Commission's report pointed out the need for the collection and study of exact information in the form of marketing surveys as an essential preliminary to the formulation of an effective policy for the improvement of marketing.

By the end of March 1939 four all-India marketing survey reports had been published (wheat, linseed, tobacco and eggs). Abbreviated editions in Indian languages were issued for wheat. Those for linseed were in press and also the report on grapes. Survey work was completed and reports were being compiled in respect of seven commodities (rice, groundnuts, coffee, potatoes, milk, cattle and hides and skins) as well as on cooperative marketing. Twenty-one other commodities were under survey and altogether well over 300 commodity survey reports were received in the course of the year from the marketing officers in provinces and states, for being examined and compiled into all-India survey reports by the central marketing staff.

Grading and standardization

In the view of the Commission there was considerable room for improvement in the quality of much of the Indian produce as marketed. In discussing

steps which might be taken to improve the general level of quality and assist the cultivator in obtaining the full premium for quality, the Commission thought that organized trade associations in India could give great assistance in applying effective pressure to secure improved quality from the producer.

This view was fully borne out by the preliminary marketing surveys and two general lines of action were decided upon. First, the physical grading and packing of commodities such as fruit, eggs, etc., on the basis of statutory standards and second, the standardization of contract terms for staples such as cereals and oil-seeds.

The former involved legislation and the Agricultural Produce (Grading and Marking) Act was passed in 1937 for defining standards of quality and methods of marking in respect of prescribed grade designations applied to scheduled products. As a result of consultation with the provincial Governments and with the representative trade and manufacturing interests, the original products in the schedule were later added to and by March 1939 included fruit, vegetables, eggs, dairy produce, tobacco, coffee, hides and skins, fruit products, *ata*, oil-seeds, vegetable oils (including hydrogenated oils and vegetable fats), cotton and rice. Rules in respect of most of these commodities had been duly prepared and notified.

Further, experimental grading stations were opened or established by packers authorized in accordance with the rules under the act. Altogether produce valued at about half a crore of rupees was graded and packed at 134 centres and sold under the AGMARK—the emblem used to distinguish the standard products. The number of grading stations is rapidly increasing. Up to the end of March 1939 the following had been opened, eggs (36), hides (10), *ata* (2), tobacco (3), fruits (27), ghee (53) and rice (3). The results of these grading stations show that there is, in fact, in India a good demand amongst consumers for reliable high-grade produce for which producers can secure a substantial premium. In some cases the AGMARK products sold for 50 per cent more than similar produce ungraded and the average increase ranged from 5 per cent in the case of eggs to 9 per cent for fruit and 12 per cent in the case of ghee.

Consultations and conferences were held with associations of traders and manufacturers with a view to drawing up standard contracts for staples. The terms were designed not only to act as a basis for "futures" trading and improving the system of price quotation generally, but also to provide a premium to producers of good quality through a mutual or reciprocal scale for produce higher or lower than the basis, and at the same time to discourage the putting of dirty produce on the market by reducing the amount of refraction (impurities) allowed in the basis prescribed in the standard contracts.

Considerable progress was made towards the general adoption, throughout the whole trade, of the standard contracts for wheat, linseed and groundnuts both for crushing and edible purposes. Certain interests, however, remained opposed to the standard contracts in Calcutta, for linseed, and in Bombay and Karachi for wheat. At meetings of all the interests concerned held in Calcutta and Bombay during March, the respective Hon'ble Ministers for Agriculture indicated that if voluntary agreement could not be secured they would consider the possibility of applying statutory sanction. In Karachi, however, it was found possible to secure unanimity among all the interests for the adoption of the standard contracts.

There is a need for the formation of stronger representative trade associations in India and as a result of negotiations and discussions initiated by the central marketing staff, the Tanners' Federation of India and an Indian Tobacco Association have been formed. Committees have been set up with a view to constituting a federation of the ghee trade, and an all-India federation of grain and oil-seed trade associations and allied interests. The necessity for the last-named has been particularly felt for carrying out negotiations with the corresponding trade associations in the United Kingdom regarding standard contract terms for produce exported from India.

Regulated markets

Well-regulated markets for all produce were regarded by the Commission as essential and it was recommended that in all provinces local Governments should take the initiative in establishing regulated markets under provincial legislation. This point was again emphasized at a marketing conference of Ministers from provinces and states held in Delhi in November 1938.

The central marketing staff circulated a model bill and before the end of March 1939 an act for the regulation of markets had been passed in the Punjab. Bills suitable for local conditions had been introduced or prepared in the United Provinces, Bihar, and Bengal, and were under preparation in Sind, the North-West Frontier Province, Mysore and Travancore. The Bombay Act was being amended to include produce other than cotton, and in Madras the Commercial Crops Markets Act was extended to tobacco in Guntur district and groundnuts in South Arcot.

Statutory regulation of markets already prevailed in the Central Provinces and in certain states such as Hyderabad, Gwalior and Patiala so that as soon as the recent legislation, either passed or contemplated, is put into effect this recommendation of the Commission will be well on the way to fulfilment throughout most of India.

Standardization of weights

An important recommendation of the Commission was to the effect that the Government of India should again undertake an investigation into the possibility of standardizing weights and measures throughout India.

The investigations carried out in the course of the marketing surveys showed that conditions were chaotic and that producers suffered considerably through the manipulation of weights, measures and scales, and the fact that the comparison of prices was almost impossible owing to the trade practice of buying on the basis of a heavy weight and selling on a light.

Fortunately the surveys also showed a common thread of agreement throughout India in respect of the three cardinal weights, *tola*, seer and maund and as a result the central Government passed the Standards of Weight Act, 1939. Pending the passing of central legislation, proposals were awaiting consideration in most of the provinces. Bills to standardize their weights on the basis of the all-India standards were taken in hand in Hyderabad, Patiala and Travancore, and Mysore had indicated a readiness to follow suit. It is, therefore, reasonable to suppose that uniform standards of weight will be established throughout most of India in the very near future.

In regard to measures the marketing surveys, so far as they have gone, have not shown any common feature prevailing throughout India regarding dry measures and it would, at present, appear that their standardization can only be done on a local basis. So far as liquid measures are concerned the imperial gallon is in very wide-spread use and the marketing survey reports have recommended that local Governments should base their standard measures on it.

Market news service

The Commission recommended that attention should be paid to the form and manner in which market information regarding prices and stocks at the principal marketing centres of the tract, and at the ports and the wholesale and 'futures' prices ruling in major markets should be made available.

Provincial and state marketing staffs have directed their attention to initiating local market news services through the radio and by the issue of bulletins and in other ways, but it will be readily understood that having regard to the amount of other work in hand and the absence of standard weights, most of the efforts so far have been of a tentative and experimental character.

The central marketing staff has arranged the daily broadcast from Delhi of 'ready' and 'futures' prices in Hapur market for a number of cereals, pulses and oil-seeds. The price of jute bags is included in this broadcast twice a week. In addition a weekly market report in English and Hindustani is broadcast every Saturday and issued, at the same time, to over 100 newspapers. This includes information regarding the 'ready' and 'futures' prices and stocks of wheat and linseed at the large ports and certain important up-country centres, as well as information regarding rice and a summary of the position in markets abroad as received from the Indian Trade Commissioner in London.

Since the surveys showed almost a complete absence of market news regarding cattle, a service was opened for the exchange of prices, loadings, etc. between certain producing areas and Bombay and Calcutta. The experience so far gained seems to indicate that it is necessary to have two different types of market news services, one for markets and another for producers, but that it is not possible to lay down any general rules on this subject. Each commodity and each area presents special problems which require study and attention by the local marketing staffs. This is being done and the work is developing.

Transport, cold storage and containers

In recommending the periodical revision and adjustment of railway freights the Commission suggested that Agricultural Departments should interpret to the railway authorities the requirements of producers, and marketing officers should be members of the local railway advisory committees. Only in the case of the Punjab and Madras has the latter recommendation been adopted.

So far as the reduction of freights is concerned, various railways as a result of discussions with the local marketing staffs have so far allowed more than 100 concessional rates on about 30 different commodities. Attempts are being made to maintain closer relation between marketing staffs and the commercial branches of the railways.

The Commission also recommended that the possibilities of cold storage should be investigated under the auspices of the Railway Board and that experiments should be made to devise suitable standard forms of containers.

The Railway Board in collaboration with the Imperial Council of Agricultural Research and the Defence Department constructed an experimental railway refrigerated van and the Agricultural Marketing Adviser carried out test runs of the van with fruits and vegetables. The prices obtained for the produce showed considerable possibilities to be inherent in this form of transport.

Trials of improved containers were carried out for oranges in the Central Provinces and although only done in a small way showed that the produce packed in this way could command a higher price. More success has attended the experiments in devising a small standard container for eggs. This has proved of value in reducing the breakages in transport and the North Western Railway introduced concessional rates on eggs packed in this way and also a special freight on the returned empties.

The work is to some extent still in the experimental stage but the results obtained so far are promising.

Cooperative marketing

Cooperative sale societies should be encouraged in all possible ways according to the Commission and help can best be given in the form of assistance in the grading of produce.

Several of the grading stations for eggs and fruits already referred to were operated on a cooperative basis and secured direct price benefits for the producers. Existing producers' cooperative sale societies for ghee in the United Provinces were brought into direct contact with refiners of AGMARK ghee and not only obtained an extra Re. 1-8 per maund above the bazar price but effected a further saving in market charges and middlemen's profits.

The marketing surveys have shown that in the case of perishables particularly a more rapid collection of village produce and a speeding up of distribution generally is required. The measured loss in the hot weather due to staling of eggs runs as high as 28 per cent and the damage to fruits in some cases even higher. The more rapid assembly of village produce by instituting cooperative societies of small village collectors was, therefore, indicated. The Frontier Cooperative Egg Sale Society of local village collectors, started by the central marketing staff, has amply justified its existence not only by securing more profit for the collectors, but by bringing about a higher general level of prices for producers with a premium on large as compared with small eggs. This has been obtained entirely by the elimination of losses and more efficient distribution and not at the expense of the consumer.

There is a need for further and more rapid expansion of cooperative activities on these lines. For example, in the case of eggs alone there are at least 150 centres in India where more than 50,000 eggs are assembled daily by village collectors.

Hitherto provincial cooperative departments have confined their operations strictly to the formation of producers' cooperative sale societies—frequently with disastrous results. Where producers' cooperative sale societies are formed there is a great need for them to be linked into central cooperative unions which

will operate on business lines in much the same way as a *pakka arhatiya* with the help and guidance of the local marketing staff. The coordination of effort, however, between local cooperative departments and local marketing staffs has been found difficult except in provinces such as the Punjab and Madras where Marketing Advisory Boards or Rural Development Boards exist on which non-officials and all departments (including industries) concerned with agricultural marketing are represented.

The Ministers' Marketing Conference opened by H. E. the Viceroy in November 1938 took note of this fact and subsequently similar bodies had been or were in process of being established in several other provinces and states by the end of March.

Miscellaneous

There were many incidental recommendations of the Commission. For example, that the foreign demand for specially chosen fruits should be tested. Nine tons of mangoes bearing the AGMARK were despatched to London where they met with a mixed reception but enabled useful permanent contacts to be made.

Many major recommendations of the Commission bearing on the marketing of agricultural produce are not dealt with here. For example, their suggestions for the improvement of agricultural statistics and forecasts and for the revision of normal and standard yields of various crops. These recommendations have been fully borne out by the marketing surveys. Further, the report dealt with the development of cultivation, particularly of fruits and vegetables—and matters relating to rural welfare, communications, education and agricultural research all of which make it a useful handbook of reference for marketing officers. These important items apart, it would appear that in spite of the hiatus which occurred between 1928 and 1935, the main recommendations of the Commission specifically relating to agricultural marketing are fairly well on the way to being implemented.

Later developments

With the information then at its disposal the Royal Commission on Agriculture could not be expected to make positive recommendations on many important points which have since arisen.

In regard to the control of exports, for example, they could not have foreseen that the export of cigarette leaf—a trade only then in its infancy—would be disastrously affected by the absence of such control, and that by the end of 1938 practically all the interests concerned were agreed on the need for all shipments being graded and marked in accordance with the prescribed standards.

Conditions were then so rudimentary that problems connected with the wider organization of marketing were not of immediate concern. The partial rationalization of the sugar industry in the United Provinces and Bihar and the recently introduced Lac Control Bill in Bihar have opened up new avenues of approach to the organized marketing of other commodities.

The regulation of production has not so far been attempted except in a tentative way by the voluntary restriction of jute acreage in Bengal. The possibility of central legislation for controlling commodity exchanges dealing

in ' futures '—with a view to the elimination of (*satta*) gambling transactions—was only taken up by the central marketing staff at the instance of the Ministers' Marketing Conference.

For future development reliance must be placed on the marketing surveys which are regularly bringing to light these and many other similar problems which can only be solved by the wit and willingness of the marketing staff so far as Governments and other interests concerned are prepared to make use of their services.

CHAPTER VII

AGRICULTURAL ENGINEERING*

1. Boring and pumping

IN the BOMBAY PROVINCE, 12 boring machines and 15 pumps were given on hire, 12 boring machines were repaired and 282 power plants were inspected through the mechanical assistants in the divisions. Similarly 25 power plants, including 22 pumping, were erected and 15 were repaired. As regards site surveys for pumping, 37 sites were surveyed and 39 estimates supplied for power plants. The receipts for hire of plants and for the sale of spares and machines were Rs. 30,523 and Rs. 97,734 respectively.

In the BARODA STATE, 73 wells were bored, of which 45 were successful, giving an increase of 70 *koses* of water. Similarly 103 wells were dynamited, giving a total increase of 5½ *koses* in 75 wells. Nine tube-wells were bored successfully and of these the one at Makarpura Dairy has the capacity of about 15,000 gallons per hour. The air compressor was used for testing water supply and cleaning bore holes at seven places.

As regards pumping plants, five pumps driven by engines and 10 pumps worked by electric motors were installed. Thirty-five pumping plants were repaired including fourteen electric sets.

In the MADRAS PROVINCE, the total number of borings put down and the depth bored during the year were 971 and 69,840 feet respectively as against 1,034 and 66,369 feet respectively in the previous year. The total number of borings decreased by 63 but the footage bored increased by 3,471 reflecting the tendency for deeper borings. The demand for borings for providing water for drinking purposes is on the increase. The amount expended by the public on the boring operations conducted during the year is estimated at Rs. 1,61,374. Of the 673 successful borings put down, those for agricultural purposes numbered 510. The deepest of the borings completed during the year by a hand boring set was 566 feet and by a power drill 876 feet.

Twenty-four fresh artesian springs were tapped during this year, capable of discharging from 5 to 400 gallons of water per minute at ground level, thus making a total of 150 artesian bore-holes so far put down.

In all 75 sub-artesian borings were made, some in existing wells and some from surface, and water was tapped in all of them. Out of these 75 borings, 65 are for the purpose of supplying drinking water to rural areas, etc., and the remaining 10 for increasing the water supply in wells for irrigation. Bore-holes for supply of drinking water are fitted with hand pumps. The power drills were used for making 10 bore-holes of depths ranging from 82 feet to 561 feet in various places in the province and all of them, with the exception of one, which was to be tested, were successful.

The department maintained 22 pumping plants for hiring out to cultivators and erected for them 54 pumping plants in various divisions resulting in a new area of about 90 acres under irrigation.

* The assistance of Mr. C. G. Paranjpe, Agricultural Engineer to Government, Bombay, in the preparation of this Chapter is gratefully acknowledged.

In BIHAR, 242 open borings of 2½ in. to 4 in. in diameter were sunk with a total footage of 20,297 and out of these, 193 borings were successful. The number of borings in progress was 14. As regards tube-wells of small diameter, 124 wells with diameter varying from 1¼ in. to 5 in. were installed and out of these 116 were found to be successful. In addition to the above, three tube-wells of 10 in. to 12 in. in diameter were also sunk and the total depth sunk in feet was 9,721. The number of tube-wells in progress was seven. The percentage of successful bores in the cases of open borings and tube-wells was 79 and 96 respectively.

In BENGAL, a 6 in. tube-well with a turbine pump driven by a 15 B. H. P. oil engine was installed on the Chinsurah farm. This tube-well yielded, on test, 38,000 gallons of water per hour. An irrigation plant capable of delivering 48,000 to 50,000 gallons of water per hour was also designed and installed at Lakshminarainpur in the Malda district.

In MYSORE, two pumping outfits were worked in two areas of the Mysore Tobacco Company for irrigation and one electrically driven plant consisting of a 10 H. P. motor and 4 in. centrifugal pump was installed at the Hesaraghatta grass farm.

In the CENTRAL PROVINCES, a pumping plant consisting of a 9 B. H. P. crude oil engine and 4 in.×3 in. centrifugal pump was installed for a cultivator. In addition to the above, pumping tests were carried out around Kalmeshwar with a view to finding out the 'pumping level' and the capacity of an average well, for irrigating orange orchards. It was found that the 'pumping level' was between 30 ft. to 33 ft. when discharge of water from the pump was adjusted to 28 to 30 gallons per minute and that an average well of 35 ft. to 40 ft. depth and six ft. to seven ft. in diameter was able to command about three acres of oranges with one *mhote*, provided the layout was well arranged and the distribution of water properly looked after.

In NORTH TRAVANCORE, pumping demonstrations were given and the interested ryots were furnished with details regarding the cost of the machinery as well as the cost of running and upkeep.

In the PUNJAB, Rs. 43,898 were spent on well-boring. It has been noticed that the demand for this work was reduced when the overhead charge of annas twelve per foot was reimposed. The existing rule of prepayment of the estimated cost of the bore was also responsible to some extent in reducing the demand for boring. During the year under report 50 boring machines were at work and they completed 353 bores, out of which 266 were successful. The total footage bored during the year was 37,993. Out of 266 successful bores, strainers were used in 160 wells. The average yield in such wells increased from 617 gallons per hour before boring to 3,288 gallons after boring under an average head of three feet. The total length of strainer used in 160 wells was 3,086 ft., giving an average of about 19 ft. strainer per well. The average cost of each well bored with the strainer was Rs. 240. Three deep trial bores, one at Khanewal of 18 in. in diameter and 590 ft. deep, the other at Rampura of 12 in. in diameter and 284 ft. deep and the third at Jullundur of 7 in. in diameter and 250 ft. deep were made. In addition to above, eight demonstration bores were also made at places such as Jullundur, Amritsar, Lahore, etc. which have attracted a large number of people. As regards tube-wells, 19 power-

operated tube-wells were completed during the year with a total footage of 5,546 and using 1,021 ft. length of strainers of different makes.

In SIND, five tube-wells, out of which one is 6 in. in diameter, were sunk at different places for irrigation purposes and out of these, three including the trial bore taken at Karachi have been found to be unsuccessful, as the quantity of water tapped was insufficient and the quality brackish. The bore at Larkhana and at the Agricultural Research Station, Dokri were very successful, the former yielding 15,000 gallons of water per hour and the latter 12,000 gallons per hour with a drop of eight and eighteen feet respectively. The possibilities for economic utilization of tube-wells for agricultural purposes are being explored in one of the talukas of Karachi district and a boring machine is sent there to take some trial bores. A scheme for an extensive well-boring programme in Sind, including the desert tract, in conjunction with rural reconstruction, is in contemplation.

2. Water-lifts for hand and bullock power

In MADRAS, further minor improvements on the improved circular *mhote* have been carried out and it has been entered for competition, notified by the Imperial Council of Agricultural Research, for improvements in water-lifts, as the provincial research committee considered it as a distinct improvement upon the existing types. Three such lifts have been manufactured and installed at Akkaum, Nagari and Anakapalle and two Persian wheels at Attur and Kabakasti.

In BIHAR, the following water-lifts were made and supplied to different parties :

2 Archimedean screws
7 *Rahat* pumps
16 Hand pumps

3. Bunds and channels for irrigation and erosion control

In BIHAR, 15 irrigation schemes for controlling 20,000 acres were inspected, and levels, plans and estimates were forwarded to the parties for consideration. The biggest of these schemes would irrigate about 5,000 acres. There are yet 54 irrigation schemes which are pending.

In BENGAL, surveys of two irrigation projects, one for Chinsurah and the other for Malda, were made, plotted and estimates submitted.

In BOMBAY, the observations of soil erosion and its control in almost all parts of the province were continued and bunding classes at various centres were held. Similarly, advice on preventive measures was given on inspection of typical areas.

4. Agricultural implements and machinery

In the BOMBAY PROVINCE, further work was continued on improved seed-drills, winnowing fans, the application of ball bearings to country cart wheels, groundnut lifting implement and the soil scooper or basin furrowing implement. Six improved seed-drills were sent to districts for trials and demonstrations and 114 acres were sown by them. Three such improved drills were sold to people outside the province, thus making up the total number to 24 drills.

Out of the 14 winnowing fans made and supplied, the latest model has been greatly appreciated by the people and there has now been a considerable demand for such fans from Khandesh.

A few minor improvements have been effected in the arrangement of fixing the ball bearings into the cart wheels to overcome certain difficulties. The idea has been much appreciated by the public during the shows at Belgaum, Sanand, Broach and Haripura.

In the case of the groundnut digger it was found that stiff soils demand still stronger supports for the blade. Improvements in that direction are taken in hand and the implement given further tests next season.

The soil scooper designed for the Sholapur dry farm worked quite satisfactorily but the one built for Bijapur requires further improvements in order to enable it to deal successfully with the peculiar soil condition there.

Two wooden and steel ridging implements were designed for Gujarat and sent for trials to Surat. It was, however, found that further tests are necessary to form some definite opinion about their usefulness.

In BARODA, six improved wheat threshers were prepared and sent out for trials, five in Mehasana district and one at the model farm. Trials of cultivator and dusting machine were also in hand. The Baroda hoe has been found to be a very useful implement by the agriculturists and there has been a considerable demand for it. The new model A. G. (1938) is a distinct improvement upon the old ones. The total hoes so far sold amount to 653.

Three bullock-power crushers and four engine-power crushers were put to work by the department for demonstration and in all they crushed 71,838 maunds (Baroda) of sugarcane.

In MADRAS, the demand for the light Cooper and Kirloskar ploughs was greater than last year. The new light ridge plough, designed by the section and produced now by all the leading manufacturers, has been well received by the people and 235 ploughs were sold since it was put on the market. Tests were carried out with the Cooper No. 34 plough, Gardner Turnwrest plough, two bar point ploughs from Messrs. Cooper Engineering Works Satara and the five-tyned John Deere cultivator received from Messrs. William Jacks & Co., and amongst them the first and the last two have been found to be satisfactory. The Cooper No. 34 plough is as good as the Ransome's ' Victory ' plough and its cost is only one-fifth of the latter.

The total number of iron ploughs of all descriptions sold throughout the province reached a record figure of 4,339 excluding 918 ploughs sold by private agencies.

The earth scooper with a capacity of 2 c. ft., a basin furrower for moisture conservation and soil erosion control and a disc roller for the incorporation of green manure into the puddle in paddy land cultivation were devised and found to be satisfactory.

The improved seed drill has been tested with highly satisfactory results and will be tested on an extensive scale next season. Trials were continued with wet land puddling implement, chaff-cutters, paddy husking machines and stalk pullers. A hand distributing device for artificial manure has been designed for use in potato cultivation in the Nilgiri hills and has given very satisfactory results.

All the power-driven sugarcane crushing mills were fully engaged on hire during the season with the exception of one mill attached to Tanjore division. One thousand eight hundred and sixteen tons of cane were crushed by these crushers, producing 14,175 maunds of jaggery and 157 maunds of white sugar.

Pneumatic tyred carts have shown complete satisfaction in all respects and they are greatly appreciated by the ryots, even though the cost is $2\frac{1}{4}$ times that of an ordinary country cart. The section has manufactured rubber tyred carts, trolleys and wheel harrows of various descriptions to meet the demand of different officers. The section has also built an improved cotton stalk puller, a corn sieve and a turmeric polisher for hire and demonstration purposes.

In BIHAR, a winnowing machine was designed and tests carried out with it showed satisfactory results. Experiments were carried out with a hand-power maize sheller costing about Rs. 8 and capable of clearing about four maunds of maize cobs per hour. The machine has proved very satisfactory. The department supplied two archimedean screw water-lifts, seven *rahat* pumps, 16 hand pumps and five Norag threshing machines to cultivators.

In BENGAL, Peterson's furnaces, filter battery, oil-seed press for laboratory work, flax breaking machine and the all-steel bullock carts come under the newly invented machines.

The demand for the improved Bengal ploughs is greatly increasing. The all-steel improved type of field cultivator, three types of hand hoes, a strong branding iron and a large and efficient grease gun are an addition to the newly designed implements.

A large char furnace of special design for the economical manufacture of activated char on a commercial scale for use in refining cane juice, in the manufacture of refined white sugar in the departmental type of open pan sugar factories, was designed, made up and installed at Birampur factory and tested. It proved quite satisfactory in every respect. Activated char can be manufactured in these furnaces at Rs. 4-13-9 per maund.

Peterson's improved types of furnaces for *gur* were made and tests on A, B and C types were conducted.

One improved new 25-ton open pan sugar factory of improved departmental type was erected at Mhow, Central India. The flax-breaking machine will be assembled after the parts are manufactured and then tested. It is hoped that it will improve the flax industry to a great extent.

The all-steel tilting and easy running bullock carts of different types were designed in view of economy, long life and reduced maintenance cost.

In MYSORE, experiments with a power attachment in cane milling were carried out for preparing cream jaggery and since they proved successful, a 10 H. P. electric motor and a half-ton horizontal power crusher were purchased for increased production of cream jaggery.

The manufacture of all-steel implements required by the central implement depot was continued at the Hebbal workshop, including the manufacture of ploughs and plough-shares, etc. A few locally made shovelled cultivators were tested and found satisfactory. A cheap fly trap, a groundnut seed drill and a groundnut harvester come under the newly designed machines. The fly trap was found to be very useful and about 50 have been made and supplied.

The Raoeng pulper supplied by Messrs. Krupp Engineering Works was fitted up in the Coffee Experimental Station, Balehonnur, for demonstration to the coffee planters.

In the CENTRAL PROVINCES, two cane crushing plants, one consisting of an 8 H. P. Crossley engine and Kirloskar 8½ in.×10 in. horizontal cane crusher and the other consisting of an 8 B. H. P. Blackstone engine and a Kirloskar crusher of similar size, were erected by the department, the former for the Belul farm and the latter for the Bilaspur farm.

UNITED PROVINCES. In Allahabad, research on implements has been mainly concerned with the development of ploughs suitable for medium-sized and small cultivators and has resulted in the development of three ploughs which are coming into increasingly wide use. The design of a new grain-drill is practically ready and it will be put on the market after one more season of testing.

In TRAVANCORE, demonstrations were given with the improved type of iron ploughs and 'Pallikkal' plough, which is the imitation of improved types, is rapidly gaining favour with the ryots. General demonstrations were also given with the improved type of sugarcane mills to show to the agriculturists the higher percentage of extraction obtained by them than that by the country mill.

In the PUNJAB, a scheme regarding the award of prizes for inventions designed to improve the various implements of cultivation suitable for the need of the province was sanctioned and accordingly a prize of Rs. 3,000 was advertised for the best invention of cheap bullock-driven cultivators.

In SIND, four agricultural implements, viz. (1) threshing machine, (2) universal seed-drill, (3) stalk-cutter and (4) rake, were designed for bullock power. Efforts are being made by the department to introduce the use of a seed-drill in place of broadcasting, which is the common method of sowing crops like wheat, gram, *jowar*, etc. in this province. The four-coultered drill now designed to sow grain crop is universal and is fitted with an arrangement to control the seed rate and the depth. Further, necessary improvements have been made in the already designed implements such as the winnowing machine, standard plough, bullock cart and low-lift water wheel.

At the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, the testing of agricultural implements and machinery was continued and the following implements were tested :

(1) A. G. B. general cultivator and bullock hoe was used for interculture and the defects noticed were communicated to the inventor with suggestions for improvements. A new improved model has been received and will be tried next year.

(2) The Ramchandra water-lift was given an exhaustive trial at two places. The working of the lift is based on sound principles but the tests have revealed that it needs expensive repairs and heavy cost of upkeep.

(3) A mechanical seed-drill received from the Research Engineer, Coimbatore, was found to have certain defects and the inventor has been referred to in the matter.

(4) The Hissar S. 3A plough was worked in comparison with the standard Victory plough and was found hard on the bullocks.

It is noticed that the inventors do not realize the importance of testing their implements by an experienced agriculturist at all stages before the implement is brought out to the public and hence a number of implements had to be returned on account of their obvious defects.

In the HYDERABAD STATE, the Agricultural Department supplied to the public 186 implements and 1,735 spare parts excluding those supplied to cultivators direct by local agencies and village blacksmiths. The demand for spare parts shows that the cultivators are making use of the implements they have purchased.

5. Mechanical cultivation

In BOMBAY, investigation into the cost of tractor ploughing for eradication of *hariali* (*Cynodon Dactylon*) in the Southern division was carried out with a view to arrive at a reasonable rate per acre, at which the proposed tractor-ploughing syndicate might undertake the work. A detailed report in this connexion has been submitted to the Government for consideration.

In BARODA, a high power Diesel tractor was purchased and it ploughed 594 *bighas* for Rs. 2,945-11-6. The cost of ploughing one *bigha*, including working expenses, repairs, interest at 3½ per cent and depreciation calculated on the basis of 10,000 working hours life, comes to Rs. 6-8-0 exclusive of supervision and expert help.

In MYSORE, tractor-ploughing was done in the lands of a landlord at Whitefield through sectional staff.

In SIND, it is estimated that about seven million acres of waste land which is infested with *dabh* grass and other obnoxious weeds will have to be brought under cultivation by the use of tractors. Such lands are now being ploughed by the departmental tractor at the rate of Rs. 6 per acre and there is a great demand for this work from the zamindars. An additional new Diesel caterpillar tractor type R. D. 7 was, therefore, purchased. The old Diesel 35 caterpillar tractor continued to work at the Agricultural Research Station, Dokri. The total area ploughed by both these tractors during the year was 1,423 acres and the quantity of earth removed by them in scraping work amounted to 1,124,312 c. ft.

6. Miscellaneous

In BOMBAY, the agricultural engineering section had to spend much time and energy on the agricultural shows at Belgaum, Sanand, Broach and Bandhan and on the various constructions in connexion with the sheep breeding station at Poona, including paddocks, bore-holes with pumps, shearing machines, etc. The section was also busy with the construction of a glass house and quarters at the College of Agriculture, Poona, and quarters and dutch barn, etc. at the Cereal Breeding Station, Niphad.

In BARODA, the outfit offered out for pneumatic-drilling has been received and experiments were made on farm and neighbouring cultivators' wells at Amreli.

Two gins and one chaff-cutter were installed in Vesma farm. Two flour mills were installed in Kosamba and Sokhda.

In MADRAS, the following miscellaneous articles were prepared by the department as per requirements of different officers :

1. Steel gates
2. Laboratory apparatus
3. Bullock harness
4. V notch plates

The section participated in the exhibition held in connexion with the College Day and implements and machines pertaining to the work carried out by the section were displayed with illustrated charts and diagrams. Improved implements and machinery were also sent to Madras for the All-India Khaddar and Industrial Exhibition held in the Congress House and to the Swadeshi Exhibition held at Coimbatore.

In BIHAR demonstrations of borings, tube-wells, hand and power-lifts and various kinds of agricultural machinery were given at the fairs held annually at Sonepur, Dumka, Sangheswar and Banka. The use of the portable cane crushing plant evolved at the Sabour workshops was demonstrated at Khutia and Sondih in North Bhagalpur.

In BENGAL, a complete set of steel buildings for an improved 25 tons departmental type open pan factory were designed and erected at Mhow in Central India. A factory building with layout of several industrial machines was designed and drawn for Lakshminarainpur and several small buildings for pumping plants were designed and constructed. Practical demonstrations in the use of improved machinery and implements were given repeatedly in different parts of the province.

In MYSORE, an electric motor and a double roller gin were fitted up on the Irwin canal farm for ginning cotton grown in that area. All the constructional steel work and the erection work was carried out on the following items of works :

1. Construction of fowl yards for the Hebbal poultry.
2. Construction of the poultry colony house in steel and cement.
3. Construction of fowl runs and houses for the serum research station.
4. Steel trusses for the buildings on the Irwin canal farm.
5. Steel frame work for the reinforced well curbs on the Hebbal and Hesaraghatta farms.

The special building works carried out during the year are :

1. Erection of necessary structures for housing the poultry on the Hebbal farm, Nagenahally farm and cattle breeding station.
2. Preparation of five sets of portable structures for the five centres of Shimoga, Hassan, Chickmagalur, S. K. V. D. Patasala and Closepet.
3. Construction of structures needed in the investigation of poultry diseases.
4. Construction of activated charcoal furnaces and the structures required in connection with the manufacture of cream jaggery on the Irwin canal farm.
5. A permanent well fitted with reinforced concrete rings was built in the wet area on the Hebbal farm.
6. As desired by the Military Department, wells with reinforced rings were sunk with a power pumping plant capable of lifting water to a height of nearly 120 feet for providing irrigation supply to the grassland on the Hesaraghatta farm.

In TRAVANCORE, general demonstrations with improved cane crushing mills were given for the benefit of the cultivators.

In the CENTRAL PROVINCES, the departmental workshop prepared Akola hoes, feeding troughs and constructed a godown for the horticultural section. All the electrical fittings and equipments of the two new Commer Diesel trucks were completed and the lorries were kept ready for work with the projectors and the generating sets for cinema demonstration outfits.

UNITED PROVINCES. In Allahabad, the department has introduced in the line of building, the method known as reinforced brick work giving a very superior type of construction at a considerably smaller rate than was previously possible. This type of construction has also superior resistance to damage by earthquake.

In SIND, the godown and ginnery of the Government ginning factory have been enlarged and the factory is now capable of dealing with 20,000 maunds of *kapas* in four months. During the year the factory worked for 97 days and during this period 12,459½ maunds of cotton was ginned.

7. Progress in the provinces and states in implementing the recommendations of the Royal Commission on Agriculture

The foregoing paragraphs give in general the progress made by the provinces and states in implementing the recommendations made by the Royal Commission on Agriculture, in paras. 79, 105, 107, 108, 280, 491 and 494. Para. 79 deals with soil erosion. The BOMBAY PROVINCE has been doing extensive experimental work at Poona and at the Dry Farming Stations at Bijapur and Sholapur in this respect, and has put up several thousands of feet of bunds in fields for checking run-off and preventing soil erosion. In BIHAR the work of bunding is on the increase and the bunding staff has inspected nearly 15 schemes.

Para. 105 deals with agricultural implements and paras. 107 and 108 deal with the scope of research work in agricultural implements and machinery including power cultivation with the help of tractors. In this connexion attempts have been made by the following provinces and states as regards the design of new implements and machines useful for agriculture :

Bombay	Mysore State
Baroda State	United Provinces
Madras	Travancore State
Bihar	Punjab
Bengal	Sind

Hyderabad State

No one could, however, concentrate on wooden implements and produce their spares on a large scale presumably because of inadequate demand and want of uniformity in the design, which is an essential feature for mass production. In MADRAS, the research on implements is entrusted to an independent officer but in other provinces and states, the work has not been sufficiently developed in order to entrust it to a separate research officer. As regards mechanical cultivation, investigations have been carried out in BOMBAY and SIND and also in BARODA STATE with a view to find out its economic value in comparison with bullock power.

The Commission lays particular stress on the need for an automatic seed-drill, cheap threshing and winnowing machines, improvement in a country cart, etc. and provinces like Bombay, Sind, Bengal and Madras and Mysore State are the foremost in tackling these problems. There are, however, several points which require investigations and the most important of them are the following :

(*a*) Study of resistance offered by different soils to various implements with an accurate dynamometer as is used at Rothamsted with a view to comparing their efficiency.

(*b*) Whether deep ploughing pays for all *kharif* crops in different tracts ; is conversion of soil necessary, if it is not, would one implement do in place of the plough and the cultivator both.

(*c*) Relation of the capacity of bullocks to the implements they are required to draw.

(*d*) Further improvements in indigenous implements in the light of modern knowledge and to keep their cost within cultivator's means.

Para. 280 deals with tube-wells and pumping and recommends a systematic survey of sub-soil water supplies. The provinces of MADRAS, BIHAR, PUNJAB and the BARODA STATE seem to be foremost in boring, while BENGAL, BOMBAY and SIND stand next to them. Madras stands first in point of footage and has at its credit good many artesian wells, while Punjab stands second and Bihar third.

As regards training the cultivators in the handling of agricultural machinery facilities are afforded in three provinces, viz. Sind, Bombay and Bengal, in partial compliance with the recommendation made, in paras. 491 and 494.

CHAPTER VIII

ANIMAL INDUSTRY

1. General remarks

CATTLE IMPROVEMENT

TWO outstanding events of the year which have contributed considerably towards the cattle improvement drive, initiated by the Imperial Council of Agricultural Research under the guidance of His Excellency the Marquess of Linlithgow, are the Cattle Conference held in Simla in May 1937, and the First All-India Cattle Show organized at the Irwin Amphitheatre, New Delhi, in February 1938.

Cattle conference

Reference was made in the preceding review to the impetus provided by His Excellency the Viceroy's initiative for the improvement of livestock in India. A natural sequel to His Excellency's appeal for the donation of pedigree bulls or money for their purchase and maintenance, and the response thereto, was the further elaboration of the ways and means by which this country-wide awakening and enthusiasm could be harnessed for the purpose of setting livestock improvement on a permanent basis and also to secure that the methods recommended for cattle improvement reach the man in the village and are accepted and utilized by him. With this aim in view, an All-India Cattle Conference, convened by the Government of India at Simla, was opened by the Viceroy and was attended by Ministers from provinces, representatives of the Government of India and of Indian states and distinguished non-officials.

In opening the conference, His Excellency observed : ' The purpose of this gathering is that we may take counsel together upon the question of what may best be done in order to promote an early improvement and development of the livestock industry throughout India—in other words, to consider what practical steps can be taken to secure the better breeding and feeding of Indian cattle.' Further, while pursuing the details of the pressing problems confronting this vast subject, His Excellency observed : ' It is not necessary that I should remind an audience such as this that the ox is the foundation of India's agriculture. Indeed, I am aware of no other single contribution which it lies within our power to make towards the enhancement of the agricultural wealth of this country which, in its potential value, is in any degree comparable with the general improvement of livestock. It has been calculated that the total annual cash value of livestock in India, if we include the annual value of cattle labour, dairy produce, manure and other products, is of the order of 1,300 crores of rupees. That, no doubt, is an approximate figure, but it serves at least to indicate the immense values at issue, and the scope afforded in this direction for the enhancement of the country's wealth.

' And here let me say that, while cattle must be the chief concern of this meeting, many of the proposals which may result from your deliberations will be applicable to other branches of the industry such as sheep and goat

breeding, both, in my opinion, deserving of and certain to repay, in full measures, the early attention of the departments concerned; while wool production, the hides and skin industry, and, in some provinces, horse breeding may well derive benefit as a consequence of your labours.

'It is impossible to overstate the importance to the agriculturists of India of an adequate supply of good working bullocks. For the bullock provides practically the sole source of power available to the cultivator, whether for cultivation, for transport, or for the lifting of irrigation water. Nor need I emphasize the value of cattle manure or the importance of the place which cattle dung used as fuel still holds in the domestic economy of a large proportion of the rural population, much as we may regret that fact.

'The great importance of milk production, whether produced by the cow or the buffalo, from the point of view of the country at large, as well as from that of the cultivator himself, is now widely recognized. The facts as regards the average consumption of milk and milk products per head of the population, so far as these are at present available, go to show that, while there is great variation in this matter as between region and region and between household and household even in the same village, there is no doubt that the average consumption of dairy produce is too low, more particularly when it is remembered that we are dealing with a country in which the diet of human beings is so largely vegetarian, and in which there is therefore a special need for such protective animal foods as milk, ghee and curds.'

His Excellency made many valuable suggestions in regard to various aspects of animal husbandry organization and the lines of improvement which would ensure a speedy realization of the main object, namely the improvement of livestock.

The conference discussed in detail the following agenda and the comprehensive notes prepared on each subject by the Imperial Council of Agricultural Research.

1. The setting up of suitable provincial cattle improvement funds on the lines suggested by the Animal Husbandry Wing of the Board of Agriculture as the best means of following up His Excellency the Viceroy's campaign for providing breeding bulls.
2. The improvement of grass lands and the better utilization of waste and surplus land for fodder production and the initial steps to be taken in that direction by the various appropriate agencies.
3. The need for increased technical personnel required for livestock improvement work throughout India.
4. The possibility of crop planning for increased fodder production with special reference to leguminous fodders.

There was a full and frank exchange of ideas and interchange of experiences and each Minister explained the work that was being done in his province and pointed out the difficulties regarding further extension work due to limited finances. After due deliberation the following resolutions in respect of each of the items of the agenda were adopted:

Subject No. I

Resolution 1. The conference having noted the response to His Excellency the Viceroy's appeal for the provision of funds for the purchase and maintenance

of approved breeding bulls, being convinced of the necessity for a sustained effort to improve Indian livestock and of the importance of continuity of policy in all livestock breeding, considers it desirable

(*a*) that there should be established in each of the provinces represented a provincial livestock improvement fund into which would be paid donations or other monies received for the purchase and maintenance of breeding bulls and for other forms of livestock improvement. It is a sound principle that most of the money should be spent in the district in which it was collected ;

(*b*) that there should be set up in each province either a provincial livestock improvement board with suitable district or local committees or a provincial livestock improvement association with district branches. It would be for each province to decide what form of organization to adopt. It would largely rest with district and local committees or branches to maintain local enthusiasm and raise further funds ; and

(*c*) that there should be the closest possible liaison between the several Ministries of Agriculture and such boards and associations. The precise composition and functions of these bodies is a matter for the provinces to determine, but it is desirable that the Minister should be president except where that position is occupied by the Governor of the province in which event the Minister would be vice-president. It would be an advantage if such bodies include in their membership the permanent officials connected with livestock improvement. Provincial livestock improvement boards would not undertake administrative functions.

The conference noted the unanimous opinion of the provincial Ministers that the central Government should make substantial grants to provincial livestock improvement funds.

Resolution 2. The conference endorses the recommendation of the Cattle Improvement Sub-committee of the Board of Agriculture and Animal Husbandry that adequate and suitable provision should be made for the proper maintenance, in such manner as may best suit local conditions, of all breeding bulls which may be presented in future.

Subject No. II

Resolution 1. With a view to securing systematic and progressive improvement in grazing and grassland areas, and the conversion of waste land into useful grazing, wherever that is possible on an economic basis, the conference recommends

(*a*) that in all provinces standing fodder and grazing committees should be established on the lines recommended by the Board of Agriculture and Animal Husbandry in India ; and

(*b*) that a central committee to coordinate grassland and fodder research and the dissemination of information should be set up by the Imperial Council of Agricultural Research.

Resolution 2. Whilst recognizing that conditions vary greatly in different provinces and localities the conference is agreed upon the following general conclusions:

(*a*) The report of the Special Committee on Forest Grazing shows that contrary to popular belief this is not only a reserved forest problem but even more a problem of waste lands;

(*b*) That great improvement in existing grasslands is possible by controlling the periods during which individual areas are open to grazing and by limiting the number and species admitted. Without such control deterioration is progressive and frequently the poorest cattle are found where grazing is unrestricted;

(*c*) That good grazing is essential for the production of hardy young stock especially of the draught breeds and is, therefore, of special importance in all definite cattle-breeding areas;

(*d*) That it has already been shown by experiment that, under control, several types of waste land can be improved to yield an appreciable amount of grazing and hay; and

(*e*) That there is scope for much useful experimental work on grassland improvement in many parts of India and that definite schemes of experimental work should be initiated by the provincial and central fodder and grazing committees and by the Forest Department in forest lands.

Subject No. III

Resolution 1. The conference is convinced of the need in every province for a livestock division with a separate allotment of funds for livestock improvement work and controlled by a livestock expert whose whole time is devoted to that subject. It is probable that the ultimate solution in each province will be found in the eventual establishment of a unified department under one Minister embracing plant industry, animal industry, the control and prevention of animal diseases, the marketing of crop and animal products and rural cooperation with technical heads for the appropriate divisions.

Resolution 2. Additional staff of all grades is required for livestock work and much can be done by the creation of a class of trained stockmen: provided that the head of the livestock division has an adequate supervising staff.

Resolution 3. It is also suggested for the consideration of provinces that the best possible use should be made of existing staff and, in particular, that in those provinces which have not completely provincialized their veterinary staffs there should be a clear division of responsibility for veterinary work. Local bodies might be responsible for the maintenance of veterinary hospitals for the treatment of ordinary diseases and casualties and should retain control of the veterinary assistant surgeons required for that purpose. The rest of the veterinary assistant surgeons would form a disease control staff at the disposal of the Directors of Veterinary Services and these assistants could render substantial assistance in livestock improvement work.

Subject No. IV

Resolution 1. The conference being convinced of the need for a greater attention to the improvement of fodder and its best use and for deliberate crop-planning directed to the greater production of fodder crops recommends that

such special effort should be made and such planning should form part of the regular propaganda by the agricultural staff in all provinces. Details must vary greatly with local conditions but the fullest advantage should be taken of all favourable opportunities such as are afforded by the spread of high-yielding varieties of cash crops and the development of more intensive cultivation due to new irrigation facilities.

Resolution 2. The conference recommends that the above resolutions be commended to the notice of Indian states for their careful consideration and such action within their own territories as may suit their special conditions.

All-India cattle show

Another important landmark in the history of cattle improvement in India was ushered in by the first All-India cattle show held at New Delhi in February 1938. The value of exhibitions as an effective medium for demonstrating the variety and range of a country's products and for engendering a healthy spirit of competition amongst producers has long been recognized. The important role of shows in the improvement of cattle has also been duly appreciated in India and the holding of periodical cattle shows in selected localities is a regular feature of the activities of the livestock departments in the provinces. The assembling and exhibition of the best stock available in India at a central place is, however, an entirely new event. Experience of the premier livestock producing countries has shown that the results achieved amply repay the vast sums expended. Therefore, apart from adding another attractive item to the pageantry and the social engagements of the Imperial capital during the week, the show, a unique event in this country, rendered an incomparable service in the presentation of a panoramic picture of India's enormous cattle wealth.

The organization of the show was an uphill task. There were no precedents to follow and a considerable amount of scepticism, which is frequently encountered in efforts of this nature, had to be surmounted. In spite of the immense odds, however, Col. Sir Arthur Olver, the Animal Husbandry Expert, who was the Chairman of the show and the moving spirit of the whole organization, ably assisted by the show secretary, Sardar Santokh Singh, managed to make the event a great and an astounding success. The organizers succeeded in enlisting the sympathy and cooperation of high and distinguished personages. The response from provinces and Indian states was very substantial and the corporate efforts of all concerned thus resulted in the representative display of the most important Indian breeds of cattle which, incidentally, India had never witnessed before.

The detailed arrangements connected with the show were entrusted to a small committee whose personnel comprised of persons who could easily be assembled in Simla and Delhi.

The show was confined to cattle only and almost all the important breeds of India, namely Amritmahal, Bhagnari, Deoni, Dhanni, Hissar Hansi, Gir, Hariana, Kankerej Khillari, Hallikar, Krishnavalley, Malvi, Mewati, Nagori, Nimari, Rath, Red Sindhi, Sahiwal and Tharparkar; and Jaffarabadi, Mehsana Murrah and Nili breeds of buffaloes were exhibited.

Despite the time and cost involved in the transport of cattle some representative breeds of the south, e.g. Hallikar, Amritmahal and Deoni, were also exhibited.

Food, water and suitable accommodation, including isolation facilities, were arranged for the animals and their attendants and during the period of the show, the cost of maintenance and other incidental expenses in connexion with the exhibits were borne by the exhibition authorities.

Two separate enclosures were provided—one for cows and heifers and the other for bulls. Each enclosure contained the requisite number of stalls for the exhibits. A spacious open ground on the western side of the wall with necessary enclosures was provided for judging rings. Tents were pitched between the walls for the use of cattle attendants, while officers in charge of the exhibits were provided suitable accommodation outside the cattle yard. A microphone was installed on the hillock near the judging rings with loud-speakers all over the cattle yard and all general directions concerning the assembling of cattle, general parade, milking, etc. were issued over the microphone. In the middle of the cattle yard, two wire-gauze enclosures with weighing machines were provided for milk recording. Milking and recording was done at regular hours everyday and the milk was mostly handed over to local hospitals for charitable purposes.

As the main purpose of the show was to attract the private breeders and to foster a spirit of competition amongst them, each province was requested to fill up the quota of each breed, as far as possible, with private-owned animals. If that was not possible, a certain number of selected animals from Government farms could be sent, but they would not be admitted to compete for money prizes and the number of Government animals was normally limited to three per breed, i.e. one bull, one cow and one heifer.

The Railway Board was approached as regards concession rates for animals coming to Delhi for this show and all railway administrations cooperated in providing cheap and rapid transportation for all animals vouched for by the Animal Husbandry Department of the province or state concerned as *bonâ fide* exhibits for the show.

Systematic arrangements for disease control were also kept handy at the show grounds and no animal not permanently protected against rinderpest was accepted. It was also made obligatory that every animal sent to the show should be inspected for freedom from disease by a Veterinary Officer, immediately before despatch.

Demonstration stands were arranged by the Civil Veterinary Department, Punjab, S. P. C. A. and the Civil Veterinary Department, Mysore, at which pamphlets, brochures, etc. dealing with various aspects of animal husbandry, disease control and treatment were made available to the public.

To enable reasonably good prizes to be given, it was necessary to limit the number of classes in each breed to (*a*) breeding bulls under eight years, (*b*) cows over four years, and (*c*) heifers between three and four years.

In addition a bronze medal was presented to every animal that came to the show having been duly selected by the provincial animal husbandry staff to represent a breed. Twenty-nine magnificent challenge cups were offered for open competition including one presented by His Excellency the Viceroy for the best animal in the show. The show was opened at the Irwin

Amphitheatre on 14th February 1938 by His Excellency the Viceroy, who also presented the prizes.

On the first day of the show, i.e. the 14th February, there was a rehearsal parade followed by a full parade of all exhibits on the afternoon of the second day. His Excellency the Viceroy was a distinguished spectator. There was a running commentary over the loudspeaker by Col. Sir Arthur Olver on each breed as it passed in front of the stadium, wherein he described the origin, home, characteristics, utility, excellence, defects, etc. of each breed. This was very much appreciated by the interested audience who never previously had an opportunity of seeing the different types of Indian cattle.

Arrangements were also made for taking photographs of all the winners of 1st and 2nd prizes, as also their measurements and milk yields. A cinematograph film depicting the various activities of the cattle show was also prepared.

A valuable addition was the special bulletin (No. 17 of the I. C. A. R.) by Col. Sir Arthur Olver entitled *A Brief Survey of Some of the Important Breeds of Cattle in India*, which contained a brief description with photographs of representatives of 25 of the best known breeds. It is a unique publication, the first of its kind in this country, and its issue simultaneously with the opening of the show was appreciated by persons interested in livestock.

A number of the best animals were sold at the show, at prices up to Rs. 500 for a bull and Rs. 325 for a cow. At the conclusion of the show it was the general opinion that this unique event made a very important contribution towards livestock improvement work in this country, particularly in drawing attention to the potentialities of the Indian breeds of cattle. It had encouraged competition between breeders which would help in gradually raising the stock to the highest levels of efficiency for the particular functions they are required to perform and also in stimulating trade in livestock and livestock products.

There was a general desire that the show should be made an annual event and agreeing with this view the Government of India have allotted funds for the continuance of the show for a period of five years.

General health of livestock

It will be clear from the previous year's reviews that the prevention of contagious diseases is one of the major problems facing India. Detailed figures of reported mortality and inoculations are given in Appendix X. The following statistics relating to bovines show the share of the different diseases in the total annual toll levied by these diseases :

*Mortality from contagious diseases 1933-34 to 1937-38**

Year	Total reported mortality among bovines	Mortality from rinderpest		Mortality from hæmorrhagic septicæmia		Mortality from black quarter		Mortality from anthrax		Mortality from other contagious diseases	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
1933-34	289,774	178,301	61·5	60,485	20·9	14,401	5 0	9,377	3 2	27,208	9·4
1934-35	216,756	118,698	54·8	43,156	19 9	10,484	4 8	5,869	2·7	38,549	17·8
1935-36	228,693	135,251	59 1	30,750	13 4	9,498	4 2	7,118	3·1	46,076	20·1
1936-37	279,397	160,055	57·3	43,456	15 6	12,863	4 6	10,478	3·8	52,545	18·9
1937-38	236,177	115,987	49·1	53,446	22·6	19,474	8 2	10,396	4·4	36,874	15·7

* (Since Burma has been separated from India figures relating to that country are not included in the general statistics. For purposes of comparison with previous years, however, Burma has been included in this.)

It will be seen that during 1937-38 mortality in bovines decreased by 43,000 or 15 per cent from the previous year, but it is still greater than that in 1935-36. One noticeable feature is that the share of rinderpest is only 49 per cent which is less than any of the figures for the previous four years. This low rate is probably due to the extended use of the goat virus inoculation which is cheap and at the same time confers satisfactory immunity. Hæmorrhagic septicæmia accounted for 22·6 per cent of the total mortality, black quarter 8·2 per cent and anthrax 4·4 per cent. The proportions due to these are higher than in the four previous years.

It will be seen from Appendix X that the total reported mortality during the year among all kinds of livestock was in round numbers 244,000 in British India as against 282,000 (excluding Burma) in the previous year, which shows a decrease of nearly 38,000. Of this 23,000 is due to decrease in mortality from rinderpest, which again shows the increasing success which is being attained in the control of that disease. The increases and decreases are as under in the various provinces :

Name of Province	*Increase or decrease in mortality from previous year* (In thousands)	
	Total mortality	Mortality from rinderpest
Madras	+9·4	+2·9
Bombay	—16·1	—15·5
Bengal	—30·4	—9·7
United Provinces	—9·6	—3·6
Punjab	+2·6	+9·0
Bihar	—6·3	—4·7
Central Provinces	+3·6	—0·6
Assam	+6·8	+2·7
North-West Frontier Province	—0·5	0
Orissa	—1·1	—1·1
Baluchistan	+0·1	0
Sind	+4·4	—1·6
Ajmer-Mêrwara	—0·9	—0·5
Coorg	+0·1	0
TOTAL	—37·9	—22·7

Increases in total mortality are mainly in Madras, Assam, the Central Provinces and the Punjab and the decreases in Bengal, Bombay, the United Provinces and Bihar. The most striking decrease is in Bengal, but out of the 30,000 only a third is in rinderpest, while almost the whole of the 16,000 decrease in Bombay is due to decrease in mortality from rinderpest. The most notable increase in rinderpest mortality is in the Punjab.

Preventive inoculations. The increasing attention paid to the prevention of diseases is well reflected in the figures of inoculation given in Appendix X. The totals during the year were 4·9 millions as a gainst 4·4 in the preceding year or an increase of about 10 per cent. About 70 per cent of these total

inoculations were against rinderpest, and these are distributed as under among the various methods :

Serum alone	2·8 per cent
S. S.	8·5 „ „
Goat vaccine	88·7 „ „

These figures are definite evidence of the efficiency of goat vaccine.

SLAUGHTER HOUSE STATISTICS

In view of the importance of statistics of slaughter of livestock an attempt was made for collecting figures of animals slaughtered in recognized slaughter houses in India. Assam and the United Provinces were not able to supply these figures. The totals for the remaining provinces in British India for 1937-38 were approximately as under :

Ovines	6,322,367
Bovines	886,114
Pigs	11,979
Others	89,117
Certain unclassified figures	11,404
TOTAL	7,320,981

These figures are provisional, but arrangement has been made for making this return a regular feature of annual reports of provincial and state Veterinary Departments and a detailed table has been laid down for the purpose. It is expected that more accurate and classified figures will be available in the near future.

2. Trade in animals and animal products

Appendix XIII (A, B and C) contains figures of inland and foreign trade in animals and animal products. The total values of imports and exports of livestock and livestock products for the past five years are as under :

	Value in lakhs of rupees	
	Imports	Exports
1933-34	4,27	13,80
1934-35	4,98	11,88
1935-36	4,09	13,60
1936-37	4,22	16,50
1937-38	4,91	17,32

It will be seen that both imports and exports show a tendency to rise. The values of individual products during the year are as under :—

	Imports Rs.	Exports Rs.
Live animals	35,32,524	8,79,133
Hides and skins—		
Raw hides	4,26,259	1,57,01,401
Raw skins	15,44,406	3,36,69,705
Tanned or dressed hides	29,785	3,20,72,727
Tanned or dressed skins	17,47,299	3,24,63,062
Wool	3,35,15,503	3,72,37,394
Dairy products	51,41,843	34,77,389
Other products	32,01,383	1,76,83,179
TOTAL	4,91,39,002	17,31,83,990

Inter-provincial trade

There is a considerable amount of inter-provincial trade in animals and animal products in India. The Director-General of Commercial Intelligence and Statistics has arranged to register the quantities of such trade as is carried by railways and steamers and figures are summarized in Appendix XIII-C. These figures do not include quantities carried by road or by country boats. The total volumes of the trade are as under :

	1937-38	1936-37
	No.	No.
Livestock—		
Cattle	260,615	..
Horses	25,359	..
Sheep and goats	930,513	..
Others	352,188	..
	Maunds	Maunds
Bones	5,036,899	4,672,117
Hides—		
Raw	1,812,422	1,996,383
Skins—		
Raw	1,156,248	1,160,550
Hides and skins—		
Tanned and leather	610,099	586,826
Ghee	762,210	692,237
Wool—		
Raw	573,911	770,426

3. Minor industries

Apiculture

The provinces at present most interested in apiculture are Assam, the Punjab and Madras, and in all these provinces steady progress is being maintained. Apart from ordinary demonstration and propaganda work a 'bee-keeping' film was produced in MADRAS for illustrating better methods in apiculture. During the year, 1,016 colonies were maintained, 419 colonies were hived, 90 demonstrations of better methods of extraction were held and 219 beehives and 2 extractors were supplied to parties. Observations on the behaviour of bees in relation to weather and pasturage conditions were also started at Coimbatore and some interesting information on the fluctuation in the activity of bees as shown by periodical fluctuations in the weight of the colonies under different conditions and on the influence of weather on the secretion of nectar in plants, time of visit of bees to different flowers, etc. was obtained. The biology of a Braconid parasite, *Apanteles galleriæ*, noted for the first time on wax moths, was under study.

In the PUNJAB, a regular survey of the honey and pollen flora round about bee farms was undertaken. A large number of meetings were addressed by the staff of the Entomological Section. Classes in apiculture were held during the year at Raison and Nagrota and 40 students were trained.

Increasing interest is evidenced in ASSAM by the large number of enquiries received by the Agricultural Department, and a few bee-keepers have set good examples by their success in getting pure honey extracted from the colonies supplied by the department. A course of training in systematic and economic entomology was given to students of the agricultural training class at Jorhat. Two important exhibitions were also held.

In TRAVANCORE, bee-keeping is developing into an important subsidiary industry on account of the small initial outlay required and the existence of other natural facilities, particularly pastures. The total cost of a hive and an extractor amounts to Rs. 7 only, while at a modest estimate each hive can be expected to yield honey worth at least Rs. 10 per annum. During the year under report, 59 new apiaries were started and in Trivandrum alone there are now over 200 apiaries. Twenty-nine hives, six honey extractors, seven smokers and three bee-scapes were manufactured and sold to local residents. Further, to popularize this industry in the villages in South Travancore, Government's sanction was obtained during the year for the manufacture and sale of 500 bee-hives among rural families. The timber was supplied free of cost by the Forest Department and the work of manufacturing and distributing the hives was entrusted to the Y. M. C. A. rural demonstration centre at Martandam. These hives are being sold to the villagers at a flat rate of Re. 1-9 each, which is the actual cost of manufacture.

In MYSORE, six apicultural centres were established in different areas to disseminate information about bee-keeping, and a week's practical course in bee-keeping was also given at each of these centres. In COCHIN, honey bees and their predators were under study.

The increased interest in the subject is also evident from the numerous enquiries received by the Imperial Entomologist. As in previous years he gave advice and references to literature and also supplied hives, comb foundation sheets and other appliances.

*Sericulture**

As pointed out in the previous reviews, the effect of the protective tariff has not been completely successful and has not been able to check the imports of raw silk. During the first five months (April to August), the import of raw silk was 645,270 lb. in 1936, 797,813 lb. in 1937 and 712,178 lb. in 1938. Out of the last quantity as much as 613,886 lb. were high-grade and mostly reported to be from China but it is doubtful if this was wholly of Chinese origin. The average declared value per lb. which had gone up to Rs. 3-8-10 in April 1937, fell to Rs. 2-12-11 in April, 1938, to Rs. 2-10-4 in June 1938, and to Rs. 2-9-11 in August, 1938. The imports of silk yarn during the same periods of the same three years were 1,165,785 lb., 988,520 lb. and 413,215 lb. and those of silk piecegoods were 7,933,284 yds., 8,538,998 yds. and 6,534,415 yds. respectively. Artificial silk and artificial silk goods showed decrease to about half and two-sevenths respectively. Staple fibre and yarn were imported to the extent of 705,332 lb. in 1937 and 859,352 lb. in 1938.

BENGAL. The year under review was marked by drought succeeded by heavy rain and floods which adversely affected the cocoon production. The Bengal Sericulture Department undertook work on simultaneous development of all three stages of the silk industry, viz. (1) cocoon raising or sericulture proper, (2) reeling of raw silk, and (3) weaving.

In connexion with the first stage, seven nurseries or seed rearing farms maintained stocks of worms and produced and supplied examined eggs to 423

* The assistance of Mr. C. C. Ghosh, B.A., F.R.C.S., Deputy Director of Sericulture, Berhampore, Bengal, in the preparation of this section is gratefully acknowledged.

selected seed rearers, who produced seed cocoons for general cocoon rearers. The nurseries also supplied seed direct to cocoon rearers.

A propaganda staff for district work, consisting of four inspectors, nine officers of the rank of assistant inspectors and 59 demonstrators, supervised the work of selected seed rearers, dealt with epidemics of diseases among silkworms, with disinfection, improvement of rearing houses, demonstration of improved rearing methods, and issue and realization of agricultural loans among silkworm rearers, and collected statistics.

For the improvement of the sericultural stage (1) new improved fixed hybrid multivoltine races of worms (*Nistid* and *Nismo* evolved in Burma) were found to be better than the indigenous races (*Nistari* and *Chhotopolu*) and were being adopted by general rearers, (2) research was undertaken (*a*) for production of fresh improved fixed hybrid multivoltine races of worms suitable for Bengal conditions, for trials with first cross-races with the local multivoltine races and (*b*) for study of mulberry varieties, their growth and methods of growing them with a view to adoption, on the result of this study, of varieties which prove to be high-yielding and possessed of high nutritive value of worms. Two more research officers, viz. Protozoologist and Agricultural Biochemist, were sanctioned to undertake research on diseases of worms as well as of mulberry and manurial and chemical problems connected with all these items of research. The Calcutta University helped the research work by the free provision of (i) land for mulberry, (ii) laboratory accommodation and (iii) use of costly apparatus and also by permitting the heads of the Departments of Zoology, Botany, Chemistry and Applied Chemistry to afford assistance to the research officers.

For the improvement of the reeling industry the Peddie Silk Reeling Institute was started at Malda in order to try and introduce up-to-date reeling machinery and methods. A raw silk conditioning house was also started in order to test and standardize raw silk and raise the quality of raw silk at present produced.

For the improvement of the silk weaving industry a scheme was sanctioned for the organization of a proper silk technological institute.

A special enquiry undertaken to find out the defects from which the industry was suffering revealed that many of the general cocoon rearers were not using seed-cocoons produced from examined eggs which, therefore, was responsible for the consequent loss due to diseases among worms. Adverse climatic conditions to which bush mulberry succumbed easily caused more loss than diseases. Steps were taken to arrange for seed examination so as to keep all sources of seed supply disease-free and also to have trees and high bushes from grafts which would better withstand the adverse climatic conditions. An enquiry was also made to find out the economics of the three stages of the silk industry as at present carried out and the results are given in the report.

The expenditure incurred by the Government of Bengal on sericulture proper and reeling, i.e. the first two stages of the industry, was Rs. 1,73,579; and Rs. 37,501 and Rs. 4,651 were expended from the grants provided by the Government of India on seed production and research respectively.

MADRAS maintained four silk farms for rearing and maintaining different races of worms and also for trials with mulberry. There were six aided grainages which produced disease-free eggs and supplied them to cocoon rearers. Besides, 14 moth-testers were distributed in different villages.

The department is arranging for first-crosses between pure Mysore race and foreign univoltine races as is done by the Mysore Sericulture Department with very satisfactory results.

The Pathological Assistant confirmed by actual rearing further known modes of contamination by pebrine, through infected cow-dung, with which trays are smeared though the smearing is thoroughly dried in the sun, through leaves stocked in pebrine infected room, through chopping knives and boards used before for feeding pebrinized worms, through infected stands for trays and through the attendant caring for infected as well as uninfected lots at the same time. It was also proved that a pebrine-infected male transmitted disease germs to a disease-free female at the time of fecundation. The germs of the disease in this case, however, adhered to the egg-shells and could be got rid of by washing in formalin water.

This department secured a hybrid of univoltine races (Italian and French) and a pure univoltine race from Kashmir. The rearing, however, was unsuccessful though successful hatching could be secured artificially.

While the existing sericultural industry is confined to Kollegal taluka of Coimbatore district, five demonstrators were stationed in Tinnevelly, Bellary, North Arcot, South Kanara, West Godavari and Kistna districts in order to try sericulture there and Chittoor, Salem, North Arcot and Tinnevelly districts are reported to be promising.

An important event which is expected to benefit the sericultural industry is the starting of Kollegal Silk Filatures Ltd. with an issued capital of Rs. 1,78,500 of which 10 per cent was subscribed by the Government.

Ten thousand silkworm guts were prepared from univoltine worms and sent to London for valuation.

ASSAM maintained two sericultural stations of which Titabar dealt with all the three kinds of silkworms, viz. *Muga*, *Eri* and *Pat* (i.e. mulberry silkworm), and Shillong only *Eri* and *Pat*. Foreign and indigenous races of mulberry silkworms were reared and cross breeds tried.

Besides these stations, there were six permanent demonstrators and 20 temporary demonstrators and seed examiners or a total of 26 demonstrators who were posted in as many circles in the province. They had 127 model rearing houses under them and distributed eggs, food plants of the worms and reeling and other appliances.

The two stations and the district staff distributed a total of 190,979 layings of eggs and 31,232 seed-cocoons.

MYSORE followed a very wise principle of supplying free of cost disease-free eggs to seed rearers, thus keeping the source of seed supply free. Madras, which takes seed-cocoons from the seed rearing areas in Mysore, also benefits by this measure. In Bidadi and Kunigal seed rearing areas, 552 rearers were supplied free with 491,119 layings which yielded 900 lakh seed-cocoons. Besides, 252 foreign race-rearers were provided free with 129,804 layings of foreign races, from which 127 lakh seed-cocoons were utilized for production of first-crosses. All these seed-cocoons were purchased by the Government and aided grainages, sericultural cooperative societies and private cocoon rearers.

The demand for cross-bred eggs is increasing. Government sanctioned an additional grant of Rs. 45,300 during the year for arrangements for increased production of disease-free layings.

During the year 10 Government grainages produced 5,482,026 disease-free layings of which 5,247,355 were supplied to 15,120 cocoon rearers and 33,491 to different farms. The cost of production of 100 layings amounted to 11 as: 5 pies.

In all, 24 aided grainages including four newly started ones worked during the year, and 21 of these were producing cross-bred eggs. The total number of laying produced by them amounted to 3,958,407 of which 3,915,591 were distributed to 5,054 coccoon rearers in 1,522 villages. The cost of production of 100 layings in aided grainages amounted to 14 as. 2·7 pies. The aided grainages incurred an expenditure of Rs. 34,876-10-6 for their work out of which they received from Government Rs. 19,634-14-2 as bonus at the rate of Rs. 5 for 1,000 disease-free layings produced.

Although about 5,000 acres of mulberry were estimated to have been newly started when higher prices were obtained for cocoon and raw silk much of it was neglected when prices went down again, leaving only about 1,175 acres. Towards the end of the year under report there were 26,175 acres under mulberry. Seventy-two cartloads of green mulberry cuttings and 5,000 saplings were supplied free of cost to sericulturists from different farms.

Ten sericultural cooperative societies, of which six were recognized as aided grainages and received bonus, produced and supplied to their members 567,644 disease-free layings. The membership of the societies was 336 and the total subscribed capital was Rs. 2,237-1-9.

Research and experiments, as regards mulberry, consisted of further trials which confirmed the results already obtained that groundnut cake and ammonium sulphate alternated with cow-dung gave the best results as regards yield and quality of leaves. Farmyard manure applied in three instalments gave better results than when applied once. Yield of leaf from male mulberry was slightly better than that of female mulberry. Bush raised from seeds gave better yield than that raised from cuttings. As regards spacing 2 ft.×2 ft. gave the highest yield, 2 ft.×1 ft. came next and 3 ft.×2 ft. third. As regards quality of leaf the third spacing was the best.

As regards worms, trials were continued to find out the best foreign races for hybridization purposes in different seasons. Foreign race worms fed on tree leaf gave better results than when fed on bush leaf. Worms fed on leaves of mulberry grown from seedlings and seedling cuttings gave better results than when fed on bushes grown from ordinary cuttings. Leaves of mulberry manured alternately with farmyard manure and groundnut cake or a mixture of groundnut cake and sulphate of ammonia proved better for worms than mulberry with other kinds of manure. The local variety (*Morus indica*) proved better for worms than Sultani variety. Seed-cocoons of no particular locality had any superiority over others. Chinese races of worms proved better than Japanese. Fresh univoltine races from France and Turkey showed a very high percentage of pebrine, and those continued after a rigid selection and elimination of pebrine, produced good cocoons. A preliminary test showed that worms reared on leaves from rain-fed and partially irrigated gardens with hard soils produced more male moths while those fed with leaves of irrigated gardens with soft soils gave more female moths. The refrigeration experiment with multivoltine worms was completed during the year and similar experiment was continued to find out the most suitable age of the pupa as well as of first-cross eggs when they

could be subjected to cold and the period for which refrigeration could be continued. Experiments for hibernation of imported univoltine and bivoltine eggs and seed-cocoons were arranged to be undertaken in the ensuing year. The Government of India contributed Rs. 5,000 towards these experiments.

The propaganda staff distributed disease-free layings, demonstrated improved methods of rearing worm and growing and manuring of mulberry, encouraged starting of mulberry topes and collected statistics.

As regards sericultural training and education 37 students including one from Assam and one from Bihar were under training in the different silk farms, all of which excepting the Bihar and Assam students, were undergoing the training at their own expense. In the four Government middle schools 263 students took up practical sericulture as optional subject.

With the starting of a new cocoon market at Closepet in October, 1937, three such markets were now working.

Sericultural loans amounting to Rs. 700 were issued and the amount of Rs. 5,884-12-10 out of past issues was realized. A sum of Rs. 132-9-9 was written off as irrecoverable. The ordinary and penal interests were reduced to 4 per cent and 6½ per cent respectively from 6¼ per cent and 9 per cent.

The expenditure on the Department of Sericulture during the year was Rs. 1,99,000 as against 85,000 in 1927-28.

The Government Silk Filature which worked under the control of the Director of Sandalwood Oil Factory was handed over to a joint stock company, called Mysore Silk Filatures, Ltd., which is arranging to start a filature of 200 basins. None of the Mysore domestic basins was worked. Steps were being taken to improve the country *charkhas*.

A joint stock concern called the Mysore Spun Silk Mills, Ltd. which started in 1936 with a capital of Rs. 10 lakhs has erected a factory and started the operation.

The Mysore Silk Association and the Board of Sericulture, Mysore, continued to function.

Fish

For some time past the Imperial Council of Agricultural Research have been interested in the question of the practical measures for the development of the fish industry in India. Information collected from various sources shows that a certain amount of work is already being done in Bombay, Madras and Bengal and that considerable success has been achieved by motor-launches in bringing fish to market in Bombay. By this means the price realized for fish has in some cases been increased from Re. 1 per thousand to Rs. 12 per thousand and further, the available figures indicate that there would be considerable scope for the sale of fish if suitable facilities were available in regard to marketing and transport. Similar attempts had also been made in Bengal to enable Hooghly and estuarian fish to realize better prices in the Calcutta market but their efforts had been frustrated by a ring of middlemen to whom the fishermen are financially indebted.

The matter was discussed in detail by a special fish committee of the Council and the general view expressed was that, in order to effect improvement, it was necessary to carry out (*a*) local surveys of the amount and class of fish

available, and (*b*) systematic experimentation on a small business scale with such improved methods of collection, transportation and handling of fish as are available in the country.

Survey work on fish marketing, under the direction of the Agricultural Marketing Adviser to the Government of India, has already been started in the provinces and states and an all-India report thereon will be published shortly.

The Council has already provided funds for a scheme for the investigation of the life-history of certain fresh-water fishes in Bengal. The result of this investigation will have an important bearing on the economic aspect of the fish industry and, incidentally, work has also been undertaken on this scheme in regard to control of malaria through fishes that feed on mosquito larvæ. It is proposed to correlate the laboratory methods with those practised by fishermen. A study will also be made of the history, development and habits of the common carp, which have been found to breed successfully in fresh-water tanks. During the year under review, experiments were carried out in regard to natural and artificial feeding of fish and relative values of artificial foods for yearlings. The problems of natural and artificial breeding have also been investigated.

Another important scheme relating to the development of the fishing industry in Madras has also been approved by the Council but so far funds have not been available for putting it into operation.

The urgent need for developing fisheries as an important food industry in India was emphasized in the Zoology Section of the Jubilee Session of the Indian Science Congress held in Calcutta, and in this connexion Professor W. M. Tattersall of the University of Wales moved a resolution stressing the need for an all-India institute for research on the major problems of Indian fisheries.

In MADRAS, efforts have been made during the year under review for reviving deep sea fishing research work initiated by Lady Goschen and proposals, relating to the chartering of a boat capable of employing all known methods of sea fishing with a view to testing their suitability for Indian conditions, have reached an advanced stage. A remarkable advance has been made with regard to pearl fishing research and considerable impetus has been given to this research by the discovery of unexpected spat falls in very shallow water adjacent to the farm in places where oyster-beds had never been known before. A bed of young oysters 1/12th square mile in extent was located and 302 oysters collected therefrom were transferred to the collection at the Krusadai pearl farm. Another large bed, two square miles in area, has been discovered in Palk Bay north of the Krusadai pearl farm. 21,149 oysters have so far been added to the pearl farm and it is hoped that this large addition to the stock will now enable the department to commence pearl farming on an extensive scale and will provide sufficient raw material for initiating experiments in the culture-pearl industry. The chief cause for the failure of *Catla* and *Gourami* to thrive in the Ippur farm has been traced to the sub-soil salinity which supervenes in late summer. This knowledge will now enable the department to prevent avoidable waste of effort and money in tank stocking. The most important feature of the year in inland fish research is the proof obtained of the breeding of *Catla* in the Cauvery river and its capacity to live or breed in rapid currents in large rivers.

In the field of technological research, useful work was carried out at the Tanur Research Station.

VITAMIN A. Survey of fish oils has led to the discovery of four more Indian fish with three to nineteen times the Vitamin potency of cod-liver oil. Another notable result achieved during the year is the confirmation of the presence of vitamin A in appreciable proportions in Malabar sardine oil. A scheme to popularize the manufacture of medicinal fish oil in fishing villages, as a cottage industry, is under consideration.

The department furnished information regarding a number of enquiries relating to types of nets used in fishing, Fish-Guano manure, chemical and biological values of South-Indian fish oils as compared with foreign products in quality and prices, preparations of fish oils and establishment of a factory for quick freezing of perishable food-stuffs, specially fishes, etc.

Since the closure of the fisheries training institute at Calicut, the question of opening a technological institute at Tuticorin on the East Coast has been revived. The proposed institute is intended to impart a course in fisheries techniques to train teachers who will be employed in fishermen schools, and it will function as a technological institute for training apprentices in all branches of the fishing industry including navigation. Fifteen scholarships tenable at the institute for fisher youths of the Parava community have been promised by the leaders of that community. The abandoned harbour building on Hare Island with their extensive ground and dockyard provides an ideal site for a fisheries institute.

The department also carried out considerable propaganda for rural pisciculture. The maintenance of this department has cost the Government nearly Rs. 1·28 lakhs during the year under review as against Rs. 1·61 lakhs in the preceding year. The expenditure on fishery schools alone amounted to Rs. 77,500. The net cost to the department, therefore, was only just over Rs. 50,000.

In the PUNJAB, research activities of the fisheries section received considerable impetus as a result of acceptance by the provincial Government of the schemes submitted by the department. During the period under review, further information was collected in regard to carp breeding, fish culture, transport of fry, food of brown trout and carp, and propagation of brown and rainbow trout. It is stated that crossing of brown trout ova with rainbow trout milt did not yield satisfactory result and that, though the crossing of rainbow trout ova with brown trout milt was successful, the fry did not develop further than the alevin stage. Work was also carried out on larvicidal fish and these spawned successfully both at Lyallpur and Chhenawan.

Some 2,850 fish were supplied during the year for anti-malarial control measures. It is observed that wherever these fish were introduced, they effectively helped in controlling the mosquito larvæ.

The total revenue from fishing licences and leases during the financial year was Rs. 60,139 which means an increase of Rs. 5,497 on last year's receipts. The expenditure during the year was Rs. 39,404, thus showing a net return of Rs. 20,735.

CHAPTER IX

VETERINARY RESEARCH AND LIVESTOCK IMPROVEMENT*

1. Disease control

(a) *Bacterial and virus diseases*

THE incidence and losses from bacterial and virus diseases throughout India was little changed from the previous year, decreases in certain areas being counterbalanced by increases in others.

An increased interest in the reporting of disease and more accurate diagnosis is evident and is a pleasing feature, but it is equally evident that in general the staff available for the execution of control measures is quite inadequate and until this is remedied efforts at control will be ineffective or but partially successful.

The assistance rendered by the Veterinary Investigation Officers in the investigation of obscure outbreaks and the introduction of measures of control is again a marked feature and the addition to their programme of the investigation of the more prominent diseases of sheep, goats and poultry has produced some information which has already been extended in certain cases by the local administrations.

There is, however, a very wide field for further development and it is hoped that the beginning now made will be actively developed.

Rinderpest. This disease occurred throughout the country and as usual, was the predominant cause of mortality in bovines; one province, viz. the Punjab, reporting that it was responsible for 52 per cent of the total mortality and in other areas this figure was exceeded. A notable reduction occurred in Bengal, Bombay and South Madras.

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The methods of control used were serum alone, serum simultaneous and goat adapted virus with or without serum. Of these, goat virus either in the form of blood or spleen tissue was the most popular and has proved uniformly satisfactory both for prophylaxis and for the control of actual outbreaks in the less susceptible breeds.

The same material combined with a suitable amount of serum has found favour for the protection of buffaloes and the more susceptible breeds. Controlled experiments in the field and wide-spread vaccinations for demonstration purposes were carried out.

Haemorrhagic septicaemia. This disease is, as far as annual mortality is concerned, of little less importance than rinderpest and despite the products available for its control no large decrease in mortality has occurred.

The use of serum, serum with vaccine and vaccine alone have all been commented upon favourably as a means of controlling outbreaks, but it is evident that such control is of very local value.

The factors governing the occurrence and transmission of this disease do not appear to have been examined in sufficient detail and it is clear that more accurate information is required on the real value of the present methods of control.

The position with regard to pasteurellosis in sheep requires further investigation, as it would appear from the Disease Investigation Officers' reports that the condition may be more prevalent than at present suspected.

Blackquarter. This disease is also wide-spread. As in the case of haemorrhagic septicaemia there is little evidence that effective control has been initiated. It appears that the control of outbreaks rather than their prevention is the present general objective.

Foot and mouth disease. This disease came into prominence in the year under review owing to the occurrence of exceptionally wide-spread outbreaks of an unusually severe nature. The whole of India was affected and the mortality rate was high. Numerous outbreaks were also reported in sheep and goats, although in goats the mortality rate was not high.

Anthrax. The incidence of this disease was low and the losses correspondingly small. The use of spore vaccine as a preventive inoculation has received considerable notice and is being tried out in most provinces. The incidence in horses was unchanged.

Tuberculosis and Johne's disease. Tuberculosis is notable for its absence in the general reports from the provinces, but the reports of the Disease Investigation Officers with regard to tuberculosis and Johne's disease indicate that these conditions are probably wide-spread and may be of some economic importance. Reports of the Johne's disease in goats and sheep were received.

Sheep diseases. Sheep-pox occurred in most provinces and it was particularly prevalent in the north-west and in the south.

Outbreaks of pneumonia of uncertain origin were also numerous.

Poultry diseases. There is evidence that this subject has received considerably more attention than formerly. Fowl-pox, Ranikhet disease and fowl cholera were prevalent. The incidence of Ranikhet disease as compared with previous years was less.

Equine diseases. The only two diseases under this head deserving of mention are glanders and strangles. In the former case, the incidence was small and in the latter case, only a few sporadic outbreaks in the south were reported.

Rabies. It is difficult to estimate the extent and the importance of this disease as the reports received relate either to outbreaks in towns or to cases in which large domesticated animals have been involved.

(b) *Protozoology*

Trypanosomiasis. In the Protozoological Section of the Imperial Veterinary Research Institute, Mukteswar, morphological studies on *T. evansi* of bovine, equine, and camel origin were made during the period under review. The dividing forms usually presented a stepped appearance—a feature which according to Hoare (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 1936, *29*, pp. 619-47) is the characteristic of the *Congolense* group. The phenomenon of auto-agglutination in which the parasites exhibit 'head to tail' arrangement has been noted to occur in *T. evansi* from both cattle and horses. Atypical forms of *T. evansi* were encountered in the peripheral blood of a relapse case of equine surra, initiated artificially. The Trypanosomes were found to enter the monocytes and assume a leishmanial form. It is possible that this newly discovered behaviour of the parasite will be of use in understanding the mechanism of relapse in cases of surra treated with a single dose of Naganol.

In the Central Provinces several outbreaks of bovine and equine surra were effectively brought under control by the prophylactic use by either Naganol or tartar emetic. In the United Provinces field experiments were carried out at Aligarh and Shamli (Muzaffarnagar) to determine the minimum curative and prophylactic dose of Naganol for combating surra in the province; this work being financed by the Civil Veterinary Department, United Provinces and the National Horse Breeding and Show Society. An outbreak of bovine Trypanosomiasis in the province of Bengal was controlled by the administration of sodium antimony tartarate. In Hyderabad (Deccan) both equine and bovine surra was encountered. The largest number of cases in equines occurred in November. A single intravenous injection of a 10 per cent solution of Naganol proved efficacious for equines, while in bovines (including bullocks, cows, young stocks, and buffaloes) treated with tartar emetic proved successful. In the Madras Presidency 72 outbreaks of bovine surra as against 226 in the previous year were encountered. The method of control adopted was the intravenous injection of 5 gr. of tartar emetic in every positive case. Some cases of equine and canine surra also occurred in the province but these were successfully treated with Naganol. Cases of equine surra in the Bombay Province were treated with Naganol and it is stated that of 55 animals treated with this drug 36 recovered and 19 died. Fourteen deaths due to surra are recorded amongst cattle and buffaloes from West and East Khandesh districts. Cases of bovine and equine surra are also reported from the province of Assam. In the N.-W. F. Province four horses are reported to have died out of six affected with surra in Dera Ismail Khan. In Sind 134 horses were reported to have been affected with surra of which 19 died and the rest recovered after treatment with Naganol. Surra in equines is also reported from Coorg, Mysore, Baroda and Ajmer-Merwara with a few casualties.

Trypanosoma theileri. This haemoflagellate was obtained from a local bull at Mukteswar and cultivated successfully *in vitro.* The leishmanial and crithidial stages of the organism developed in culture tubes, as described by other workers, but no infection could be produced in healthy bulls by the experimental inoculation of the crithidial stages. Occurrence of *T. theileri* has been recorded from an apparently healthy heifer in Hyderabad (Deccan).

Theileriasis in cattle. Morphological studies on the virulent strain of theileria parasite, maintained in the Protozoological Section at Mukteswar, were carried out during the year under review. It was found that the innocuous form, *T. mutans*, invariably divided in the cytoplasm of the erythrocytes, while the dividing forms of *T. annulata* were found as Koch's bodies in the cytoplasm of the monocytes. The predilection seat for this parasite is provided by the lymphoid tissue generally, the disease being primarily an infection of the lymphadenoid tissue. The studies on the life-history of this parasite are being continued and in the meantime Hyalomma ticks sent by the veterinary authorities at Kenya have been infected with our strain and forwarded to them for comparative study against *T. parva*, the causal agent of East Coast fever. Preparation of experimental antitheileriasis serum was postponed, firstly because its demand fell low and secondly because it was considered that serum treatment would hardly solve the problem as obtained in the field. Attempts were diverted towards the finding of a suitable drug for combating the malady.

A number of young calves at a military dairy farm in the N.-W. F. Province are reported to have succumbed to theileriasis due to infection with *T. annulata*. Treatment with trypanblue, acaprin, plasmoquine and quinine did not produce any beneficial result in these cases. It is noteworthy that male calves were not affected. Theileriasis in calves from one to four years of age is also reported from Assam, the causal agent in these cases being considered to be *T. mutans*. In the Punjab cases of bovine theileriasis due to *T. annulata* are reported to have been encountered. The infection proved pathogenic for young calves and the tick, *Hyalomma aegyptium*, is held to be the natural transmitter of the disease. *T. mutans* was detected in the blood smears of a number of bovine from the Central Provinces and Ajmer-Merwara but as the presence of this parasite was not accompanied by any clinical symptom no treatment was resorted to in any case. It has been the experience of the Imperial Veterinary Institute, Mukteswar, as well as that of the Veterinary Departments of some of the provinces and states, that this parasite may appear in the peripheral circulation as a result of resuscitation due to an intercurrent disease, such as rinderpest.

Theileriasis in sheep and goats. The occurrence of *T. ovis* in sheep and *T. hirci* in goats is reported from Bombay. The disease in sheep appears to be wide-spread and is locally called 'Tidak', the chief symptoms being high temperature, rolling on the ground and passing of high-coloured urine. The disease in goats was indistinguishable from pasteurellosis, except for the fact that only adult goats showed the affection, while in pasteurellosis both kids and young goats were affected.

Babesiasis in cattle. In the Protozoological Section at Mukteswar a detailed study of the nuclear structure of *B. bigemina* was undertaken in order to ascertain if the organism originated from a flagellate as propounded by Dennis (1930).

The results obtained so far have not supported the view but, on the contrary, the observation of Nuttall and Graham-Smith (1908) that the nucleus is situated at the apical end was confirmed. The results have already been incorporated in a detailed article prepared on this subject (Ray, H. N., 1938. *Ind. J. Vet. Sci. and Anim. Husb.*, VIII, pp. 183-86). In the Central Provinces, out of 175 animals immunized against rinderpest with goat virus, three showed chronic form of *B. bigemina*. Like *T. mutans*, this parasite has also been observed to resuscitate due to the occurrence of an intercurrent disease, but its presence in the blood under such circumstances is usually not associated with the occurrence of any clinical symptoms. It is often noted that with the subsidence of the intercurrent infection this parasite disappears from the circulation. In the same province it is reported that 434 clinical cases of Babesiasis were treated with injections of trypanblue.

Babesiasis in dogs. (1) *B. canis* infection. Canine piroplasmosis due to infection with *B. canis* has been reported from the Central Provinces. Thirty-eight dogs which showed this infection were successfully treated with trypanblue. In an outbreak in Bihar 10 out of 20 dogs are reported to have died of piroplasmosis. All the affected dogs also showed helminthic infection but antihelminthic treatment brought about no amelioration of the symptoms. The drugs such as, N. A. B., S. U. P. 36, and Omnadin gave no satisfactory result.

(2) *B. gibsoni* infection. A detailed study of the different stages of this parasite within the vertebrate host was carried out in the Protozoological Section at Mukteswar. Two forms were encountered in the blood, viz. (*a*) round or oval forms and (*b*) thin elongated forms. The round or oval forms were found to divide many by means of binary fission, while the other forms multiplied in a way which was highly suggestive of schizigony. It seems possible that this morphological difference represents sexual dimorphism. An article incorporating these observations has been prepared and will soon be published. Evidence is collected to show that in a number of instances dogs affected with piroplas mosis revealed a hypersusceptibility to poisoning with organic arsenical applied in routine treatment, and it was further observed that of the organs the liver was the most affected. To minimize the toxic effects of arsenobenzene derivatives in protoan infections, the regular administration of sugar and liver extract would seem to be indicated. It is proposed that the new arsenical Neocryl (May and Baker Ltd., London), which is stated to be less toxic and more active than those hitherto known, be employed in the treatment of *B. gibsoni* infection in dogs. In the Central Provinces eight cases of *B. gibsoni* infection were encountered and it is claimed that Tryparsamide gave good result in these cases. Ten out of 20 cases affected with *B. gibsoni* are reported to have died in Ajmer-Merwara.

Bartonellosis in dogs. The occurrence of *Bartonella canis* in the erythrocytes of dogs was for the first time reported in this country in the Annual Report of the Imperial Veterinary Research Institute, Mukteswar, 1936-37. Studies were continued on a pure strain of this parasite during the period under review. This organism produced fatal and progressive anæmia in healthy dogs. The disease lasted for 16 days in acute cases and three to four weeks in sub-acute cases. The organisms occur in erythrocytes as minute coccoid or bacillary forms, and sometimes in chains of various shapes.

Babesiasis in horses. In Sind 45 cases of equine piroplasmosis were encountered of which two are reported to have progressed to a fatal issue while the rest were successfully treated.

Coccidiosis in cattle and buffaloes. Occurrence of *Eimeria smithi* in cattle and buffaloes is reported from the Central Provinces. It is stated that weak and emaciated animals are more susceptible to its attack. Cases are reported which showed symptoms of protracted illness, great weakness, inappetance, emaciation, anæmia, diarrhœa, exhaustion, and systematic derangement terminating in death. The chief predisposing factors noted in these cases were lack of proper nourishment, vitamin A deficiency, and hygienic condition. The clinical cases were treated with the following special 'coccidiosis powder':

Cupri sulphas	gr. XXX
Ferri sulphas	drams II
Pulu. Areca nut	„ II
Pulu. Catechu	„ I
Pulu. zinziberis	„ IV

The above constituents were mixed thoroughly and administered in the form of bolus prepared with rice or wheat flour and country sugar. Usually one course of treatment is claimed to be sufficient for 10 days. In chronic cases, however, the mixture is repeated after a week. It is pointed out that liberal feeding with easily digestible diet is essential. Cases of coccidiosis in bovines have also been reported from Mysore and Cochin. Resuscitation of coccidiosis was encountered in bovines used in the Goat Virus Vaccination Scheme in the Central Provinces during 1935-38. It was noted that carbon tetrachloride had no effect on the infection but the special coccidiosis powder described above ameliorated the condition.

Coccidiosis in sheep, goat, and rabbits. A series of experiments were carried out in the Protozoological Section at Mukteswar to test the pathogenecity of *Eimeria arloingi* recovered from an outbreak of suspected toxæmia in goats at Etah, described last year. The results so far obtained have been of negative order. Material from a similar outbreak in the Central Provinces was received at this institute but no definite pathogenic properties could be ascribed to the parasite.

Coccidiosis in rabbits complicated with snuffles has been reported from the Pasteur Institute, Shillong (Assam).

Coccidiosis in poultry. Both cœcal and intestinal types of coccidia were met with in birds at the Mysore Serum Institute, Bangalore. Kerr's iodized milk as well as sour milk were used as a preventive and curative in these cases.

Spirochætosis in poultry. Severe outbreak of spirochætosis in poultry is described from the Punjab. The runs were heavily infested with all the stages of ticks. Soamin was found to be a specific remedy for the malady. In Mysore, Rhode Island Reds, affected with spirochætosis, were treated intravenously with 0·3 gm. of Atoxyl per 1 lb. body weight. A second injection, if necessary, was given after four days. In Ajmer-Merwara 93 out of 117 birds are reported to have succumbed to this disease.

Keeping quality of Naganol. Experiments were undertaken at Mukteswar on behalf of the army authorities to test the keeping qualities of a 1934 batch

of Naganol against a fresh stock of 1937 in artificially infected equines. Results obtained pointed out that the stock of 1937 was less efficient.

Malaria in a flying squirrel. In the Protozoological Section at Mukteswar, *Plasmodium pteropi* was encountered in the blood of an arboreal squirrel, *Petaurista inornatus.*

Flagellate from Tabanid. The Veterinary Investigation Officer, Hyderabad (Deccan), has recorded in 50 per cent of the Tabanid flies the occurrence of viable *Crithidia tabani.* Rabbits inoculated with this flagellate gave negative result.

(c) *Helminthology*

Fascioliasis. Cases of this infection were discovered in Madras, Sind and Ajmer-Merwara and in the Punjab. The incidence of this disease in the Kangra valley was found to be 50 per cent. Treatment and prophylæxis against this disease were undertaken in Hyderabad (Deccan) and Mysore. Carbon tetrachloride gave good results in goats and sheep in the North-West Frontier Province.

2. *Verminous pneumonia.* In the Punjab and in Darjeeling Hills this disease in goats was found to be due to *Varestrongylus pneumonicus.* In the latter area *Dictyocaulus fileria* was also found to cause this condition.

3. *Hump sore.* This disease was detected in the whole of Bengal excepting the hilly tract. It is suggested that the lack of this disease in the hills may be due to the absence of insect vectors in that area. In Assam it has been observed that the old lesions of this disease can be distinguished into (*a*) active summer lesions and (*b*) quiescent winter lesions. This clinical differentiation of the lesions has its counterpart in the pathological changes undergone by the tissues.

4. *Schistosomiasis.* Cases of portal schistosomiasis were discovered in the Bombay Province, Orissa, Madras and the Central Provinces. Cases of nasal schistosomiasis were treated successfully with tartar emetic in the United Provinces, with tartar emetic and anti-mosan in Hyderabad and with anti-mosan in the Central Provinces. It has been found in Bihar that the cases of nasal schistosomiasis in buffaloes are not so rare.

5. *Parasitic gastritis.* This was found to be prevalent in the Bombay Province and Sind. It was found to be caused by *Mecistocirrus digitatus* in the Central Provinces and by *Hæmonchus contortus* in Sind.

6. *Ascariasis.* Cases of ascariasis in calves were detected in the Central Provinces. Cases of this disease were detected and treated in Orissa.

7. *Amphistomiasis.* The disease caused by immature amphistomes was detected in goats in Bihar and sheep in Hyderabad (Deccan).

8. *Microfilariasis.* In the Bombay Province two species of microfilaria were found in a tick parasiting cattle. A dog in Bihar showing symptoms of incurable ascitis was found to have a liver tumour caused by microfilariæ. Microfilariasis with associated changes was detected in two dogs in Mukteswar. Microfilariæ were detected in the blood of horses in the North-West Frontier Province, Sind, Bombay Province and at Mukteswar. Repeated attempts were made at Mukteswar to transmit microfilariasis to cattle through the agency of biting insects, but no positive results were obtained. Avian, canine and bovine, microfilariasis was detected in the Bombay Province. Cutaneous microfilariasis was detected in Orissa and Hyderabad (Deccan). In the latter state it was treated successfully with tartar emetic.

9. Nodular disease. This was detected in a ram in the Hyderabad State.

10. Study of the parasitic nodules of the liver and lungs of ponies was continued in Madras. The parasites recovered from the horse were *Strongylus vulgaris*, *Trichonema nasatum* and *T. pseudocatinatum*.

11. Ancylostomiasis of dogs was detected and treated in Orissa.

12. *Parafilaria multipapillosa*. Hæmorrhagic nodules caused by these worms were treated with success by 1 per cent solution of tartar emetic in Hyderabad (Deccan).

14. Work has been undertaken at Mukteswar to elucidate the life-cycle of the round worm of goats, *Varestrongylus pneumonicus* Bhalerao, 1932.

15. The following new records have been made by the Imperial Veterinary Research Institute, Mukteswar :

(i) *Dictyocaulus filaria* in bronchi of Buffalo, N.-W. F. P.
(ii) *Protostrongylus rufescens* in bronchi of Buffalo, N.-W. F. P.
(iii) *Trichostrongylus extenuatus* in abomasum of goats, Mukteswar.
(iv) *Echinuria uncinata* from the gizzard of ducks, N.-W. F. P.
(v) *Echinostomum revolutum* from the intestine of duck, N.-W. F. P.
(vi) *Tetrameres fissispinus* from proventriculus of duck, N.-W. F. P.
(vii) *Trichocephalus vulpis* from dog, Bhimtal, Dehra Dun.
(viii) *Schistosoma incognitum* from dog, Bhimtal.
(ix) *Catatropis indicus* n. sp. from the caeca of ducks.

16. *Pseudanoplocephala crawfordi* was recorded from pigs in Madras and *Cooperia curticei* from the abomasum of goats in the Punjab.

17. A report of the Punjab helminthological scheme was published during the period under review. Important conclusions reached as a result of experiments carried out for three years are :

(1) A mixture of copper sulphate and Kamala acts as the best anthelmintic against hæmonchosis amongst ruminants. A mixture of copper sulphate and sodium arsenite acts as the second best anthelmintic against this condition.

(2) The animals fed on a balanced ration resist the infection of worms more efficiently than those fed on grasses growing in the area that was under investigation.

18. In 1933 a coordinated scheme of helminthological research was drawn up by a special helminthological committee in order to obtain more precise information about the parasites which cause heavy losses to livestock in India. The committee suggested that the necessary identification and detailed examination of materials received from various parts of India should be carried out at the following institutes which have agreed to cooperate, viz. (1) Madras Veterinary College, (2) the Lucknow University, (3) the Imperial Veterinary Research Institute, Mukteswar and (4) the Nagpur University. Material collected for the purpose will be sent to the appropriate centre according to a regional distribution. The recommendations were accepted by the Imperial Council of Agricultural Research and research is now being carried out at the first three centres and arrangements are in progress for starting work at Nagpur.

19. Work done under the helminthiasis scheme at the Lucknow University—

(*a*) A general survey of the helminths of domestic ruminants was carried out and as a result of this one new parasite, *Olveria indica*, was discovered and a few new records were made.

(*b*) Observations were made on multiple infection due to helminth parasites and on seasonal variations of helminthic infection in animals.

(*c*) A few larval trematodes were collected from some molluscs.

(d) *Entomology*

In the Entomological Section at Mukteswar, considerable advance was made in the study of the life-history and bionomics of *Hypoderma lineatum* Daily examination of carcases at the *post mortem* room at Mukteswar showed that the œsophageal forms of *H. lineatum* larvæ occurred during a continuous period of nearly 11 months and this would appear to raise some doubt as to whether these larvæ migrate to the subcutaneous tissues of the back at all, for the warble tumours themselves are usually observable during a continuous period of not more than five months in the year. Young forms of *H. lineatum* were also recorded from the trachea, rumen, diaphragm, vertebral column, neural canal and intercostal tissues. In a number of instances, the presence of the larvæ in the œsophagus was found to be associated with hæmorrhage and stenosis of the gullet wall. It was observed that it took, on an average, 52 days for the larvæ to mature after their appearance in the subcutaneous tissues of the back of the host and that the maggots emerged from the tumours till the beginning of March.

The œsophageal forms of *H. lineatum* were also encountered in the gullets of goats at Mukteswar, while some specimens of the full-grown larvæ were collected from the subcutaneous tissues of sheep in the Punjab. These two findings are believed to be the first of their kind whether in India or elsewhere.

The results of warble-fly surveys carried out during the year showed that the seasonal occurrence of *H. lineatum* varied with climate and topographical conditions. Thus, while at Hissar, no tumours occurred on the backs of cattle after the middle of January, they were observable at Kohat, Dera Ghazi Khan and Peshawar till the middle of February. As for the goat warble-fly (*H. crossi*), it was found to be very common amongst goats of the Barbary breed in the salt range area of the Punjab.

Reports from the provincial Veterinary Departments indicate that *H. lineatum* is widespread in several localities in Northern India. Thus, 17,970 warble dressings were carried out at Hissar during the year, while the pest was found to be very common in the district of Sukkur and in certain parts of Karachi. In the North-West Frontier Province young cattle were found to be more heavily infested than adults, while in certain localities of the province warble tumours (due to *H. crossi*) were encountered in practically every one of the goats examined. In Bengal *H. lineatum* was found to be very common at Darjeeling and the neighbouring hill tracts, but the plains were practically free from it. On the basis of information supplied by the various provinces and states, a map showing the incidence of *H. lineatum* has been prepared by the Imperial Council of Agricultural Research.

During the year, severe outbreaks of mange in goats, with heavy mortality in some instances, were reported from the North-West Frontier Province, the Punjab, the United Provinces, Madras and the Central Provinces. In the United Provinces, the disease, which occurred among young stock under one year of age, manifested itself in the form of a peculiar skin infection characterized by a ' trimming ' of the hairs as if with scissors and the formation of

hyperæmic and eczematous patches on the affected region, this being followed by a cracking of the skin. The outbreak was, however, brought under control by segregation and disinfection. Several cases of scabies in sheep, resulting either in death or considerable loss of condition, were reported from Madras, the Central Provinces and Hyderabad State.

The problem of the control of ticks received special attention in Bombay, where four dipping tanks are now available for the public. Studies were also made on the seasonal prevalence and bionomics of the various species of ticks parasitic on cattle, with a view to the eventual utilization of the results of these studies in determining the frequency of the dipping operations. An investigation into the ætiology of tick toxæmia occurring in certain heavy rainfall tracts of the province resulted in a finding which seemed to be suggestive of the possibility that the toxic element was present in the saliva of the tick.

In the United Provinces an investigation was carried out at the Government Cattle Farm, Manjhra (Lakhimpur-Kheri) upon the relative efficacy of certain repellent sprays in protecting cattle from the attacks of biting flies. It was found that a spray consisting of high speed Diesel oil, 'Pyrocide 20' (a proprietory preparation of pyrethrum extract) and pine oil exercised a markedly repellent effect upon the flies, and the use of this spray also resulted in an increase in the yield of milk.

(e) *Deficiency diseases and toxicology*

Experimental research in deficiency diseases and toxicology in India does not seem to have, unlike other sciences, a long history. Within recent years, however, there has been a growing interest in these spheres as is evidenced by a comparatively larger number of contributions. The present review aims to cover the progress made during 1937-38.

The consideration of certain diseases has been included in this review in so far as dietary deficiencies affect them.

DEFICIENCY DISEASES

Osteomalacia. Osteomalacia appears to be of common occurrence in certain parts of India. Reports of a fairly great incidence of this disease in cattle were received from the villages of Alumpur taluka in Raichur district in Hyderabad (Deccan) and in buffaloes near Bihar Sharif and Nawada in Bihar. The fodder and concentrates fed to these animals were examined at the Imperial Veterinary Research Institute, Mukteswar, and found to be poor in phosphorus. Representative samples of soil from the affected areas in Bihar were examined and found to be significantly poor in nitrogen and phosphorus. The analysis of affected bones showed very low inorganic ash, calcium and phosphorus contents and chemical examination of serum revealed definite phosphorus deficiency.

In Hyderabad (Deccan) bone meal was used to control the malady with good results.

Rickets in pups. Although a large number of dogs and bitches live under the same dietetic and kennel conditions at the Imperial Veterinary Research Institute at Mukteswar, one bitch produced pups with bone deformities. Examination of the serum of the bitch and of the dog with which she was

mated showed very low inorganic phosphorus. Analyses of the bones of these pups indicated characteristic rickets of a very advanced nature.

Night blindness and nutritional optic disorders. It was noticed in Bengal that when cows were confined to the cowsheds during the entire period of lactation and fed on a dry ration, the influence of the dry ration and lack of exercise and sunlight for about 8 to 12 months on the cows produced calves which were practically or completely night blind and developed complications of eye diseases at the age of about three months. Although the health of the cows was affected, they were found fit enough for breeding purposes.

In Bihar night blindness in up-country bullocks which were kept on dry fodder exclusively was noticed and it was assumed that it may be due to vitamin A deficiency.

The frequent occurrence of blindness amongst elephants of the Madras Forest Department was reported. The affected eyes showed simple and traumatic ophthalmia, opacity of the cornea and cataract with and without opacity of the cornea. Such conditions were ascribed to the exposure of sun, maltreatment by *mahout* and injuries inflicted during forest grazing and bolting, which appeared doubtful. Investigations into these conditions were undertaken at the Imperial Veterinary Research Institute, Mukteswar, where the lachrymal secretions were examined bacteriologically with negative results. It appears that this condition in elephants has some nutritional or toxicological bearing.

Since it has been established that vitamin A deficiency is the cause of congenital blindness and night blindness in livestock a series of experiments have been initiated at Mukteswar to see whether any losses in the carotene content (vitamin A) of the fodder plants are brought about during the various stages of harvesting, drying and conserving by different methods as practised by the ordinary farmer.

Goitre in horses. Cases with unilateral or bilateral enlargement of the thyroid glands were reported from Saugor. The animals lost condition when put to hard work. Examination of the blood showed that it was low in iodine and histological examination of the thyroid gland revealed the presence of goitre for which iodine therapy was recommended.

Bovine abortion and dietary deficiency. As appears to be evident from the observations made in Bengal and Bombay, dietary deficiencies seem to play an important role. The investigation into bovine abortion, which inflicts considerable loss to dairies, was continued in the province of Bombay and one of the main factors responsible for this condition was suspected to be possibly the deficiency of calcium in fodders. An experiment undertaken to ascertain the value of administration of mineral feed in a dairy where abortion was greatly prevalent showed that out of 28 buffaloes in various stages of lactation 21 calved normally, one aborted due to *Brucella* infection and the rest remained pregnant. Fresh controlled experiments are proposed to be carried out to get confirmatory results.

Sterility in cows. This has been found to occur in Assam, Orissa and in a large number of villages of the Central Provinces and Berar. It is more common in ill-fed cattle than in the properly fed animals. In regard to the causation of sterility one of the chief factors is suspected to be an ill-balanced diet, deficient in minerals and vitamins.

Equine abortion. An examination of the serum from 87 cases of abortion in mares from different parts of the Punjab showed low phosphorus in 51·7 per cent of the cases and a gross imbalance in the calcium and phosphorus ratio in the remaining 48·3 per cent. It may be that mineral imbalance or deficiency may be an associated factor in the incidence of this condition.

Kumri and mineral imbalance. Kumri was prevalent during the year in Assam. Investigation based on clinical and *post mortem* evidence represented a stage in the development of *Osteofibrosis* or *Osteodystrophia fibrosa* caused by the imbalance of calcium and phosphorus in the diet.

Johne's disease and mineral feeding. Recurrence of Johne's disease in Assam, Bombay, Madras and Mysore was reported during the year under review. In Assam under village conditions where the diet of the animal was far from being properly balanced, the incidence of the disease was greater, but under proper care and feeding the animals remained comparatively healthy. The incidence of the disease was very substantially reduced by having recourse to the feeding of a mineral supplement. Although it is not possible to say definitely whether mineral feeding will check the progress of the disease in animals already showing clinical symptoms, it seems, however, that the feeding of mineral mixture increases the resistance of the healthy animals.

Parasitic infestation and mineral deficiency. An investigation to determine whether certain mineral deficiencies tend to lower animal resistance towards parasitic infestation showed that mineral deficiency was produced in calves and sheep when they were kept on mineral deficient rations for a period of seven months and artificially infesting them after this period with *Haemonchus* and *Oesophagostome* larvæ led to a more severe parasitic attack than the control animals fed on a balanced ration.

Mineral deficiency disease in cattle is met with in certain areas in the Punjab and a few feeding experiments have been planned to see whether the malady can be attributed to the fodder.

In the case of swine at Kalimpong in Assam, a considerable reduction in the ration consisting of boiled maize and skimmed milk led to the development of epileptic fits, convulsions and paralysis of the left facial nerves. Besides, they were very heavily infested with worms. The incidence of this condition was, however, controlled by an increase in the ration with addition of greens and cod-liver oil and treatment for worms.

In Mukteswar an investigation was undertaken to study the various fractions of serum proteins of the normal and vitamin A, calcium, and pohsphorus deficient cattle and the results showed that the animals on vitamin A deficient diet had decreased total proteins especially total globulin (although the ration is adequate in regard to protein), euglobulin, and pseudoglobulin I. This decrease in immunologically active protein fractions may probably be responsible for an increased susceptibility of the host to infections. A diet imbalanced with regard to calcium showed a similar effect but to a lesser degree.

Nutritional aspects of equine encephalomyelitis. Nutritional investigations with regard to equine encephalomyelitis were continued at Mukteswar. Fresh cases had been reported from Jamshedpur where the recurrence was observed in the same troop. Similar condition was noticed in other places. These observations showed that the disease was probably restricted to certain areas. Analyses of fodder and concentrates showed that there was a gross

imbalance of calcium and phosphorus and the serum was low in phosphorus. Three cases also occurred in the horses of the mounted military police in Bihar. Thery were destroyed after a thorough post-mortem examination. The diagnosis of equine encephalomyelitis was confirmed in every case but transmission experiments did not confirm the presence of a filterable virus as the causal agent as was previously suspected. The disease is now being studied from the biochemical point of view in collaboration with Mukteswar. Hexamine treatment of affected cases did not yield any conclusive results.

TOXICOLOGY

An investigation into an outbreak of *jowar* poisoning near Bihar Sharif in the district of Patna and chemical examination of the samples of food-stuffs showed the presence of hydrocyanic acid in every case.

It has been observed in Kangra district, Punjab, that the twigs and leaves of *Andrachne Cordifolia* Muell kill cattle when browsed in the early morning on an empty stomach.

The incidence of poisoning of cattle in Assam has been investigated and the condition resembled very much Dikoor and Geeldikopp or 'Yellows' of cattle caused by the ingestion of certain injurious plants, the main feature being photosensitization of the ears, the face and eyelids.

Lantana camera Liem, the seeds, flowers and leaves of which are known to be poisonous to cattle has been responsible for great damage both in the plain and hill areas and the animals showed grave pathological condition attended with mortality.

2. Animal nutrition

DACCA. Experiments have been continued at Dacca under the scheme financed by the Imperial Council of Agricultural Research on rice straw and its mineral assimilation when animals are fed on this material. These investigations have brought out some interesting characteristics in regard to the assimilation of lime, phosphate and potash from Bengal rice straws. This material is rich in potash which occasionally has been found to cause diuresis and in spite of this high potash content there is not always a positive potash balance in the animal. A modification of this situation is produced if linseed cake is combined with rice straw when a positive potash balance was usually secured but the opposite was the case when mustard cake was fed. With mustard cake the general phosphate and lime assimilation was unsatisfactory and this point needs further elucidation.

Amongst the more interesting results brought out in the course of these investigations is the wide variation in the protein, ether extract, and most of the minerals in rice straws from different districts.

Special attention has been given to the distribution of the various mineral ingredients in rice straws and the added concentrates in regard to the effect on mineral assimilation of added concentrates.

The work on potash has shown conflicting results and is being studied further.

Similarly rice bran is rich in phosphorus but it was found that assimilation was not satisfactory.

Napier grass is also found to be rich in potash, and when fed alone the lime-phosphorus metabolism in the animal is not satisfactory.

Studies on the water hyacinth which is so prolific in Bengal have shown that this may be utilized as a fodder reserve provided it is fed with some satisfactory concentrates and in limited quantity.

An interesting study which has been carried out is the mineral requirements of an animal in relationship to live weight, and the results so far indicate that the lime content of an adult animal in Bengal is probably a linear function of the live weight.

Work has also been carried out on Napier grass silage in various digestion and metabolic tests; further tests have also been made to throw light on the value of the new methods of estimating digestible coefficients.

COIMBATORE. The work at Coimbatore under the Imperial Council of Agricultural Research Nutrition Scheme has been carried out on the following lines:

(*a*) Mineral metabolism studies and investigations on the mineral content of blood in relationship to that of fodders.

This investigation has shown that the Kangayam breed of calves from 12 months of age require about 30 gm. each of phosphoric acid and calcium per day in order to ensure a positive calcium phosphorus balance, and a calcium phosphorus ratio in the neighbourhood of 1 : 1. It has also shown that cross-bred heifers during pregnancy do not exhibit any considerable disturbance in mineral metabolism, and that with an intake of 30 gm. of phosphorus and calcium respectively a positive balance was obtained but after parturition a considerable increase over 30 gm. is necessary in the ratio of 1 : 1.

(*b*) The blood studies for mineral content were continued from last year and the general conclusions arrived at were that in normal healthy animals the calcium content of the serum was about nine to ten milligrams per 100 c.c. and the phosphorus about five to eight milligrams per 100 c.c. of blood. These studies have also brought to light interesting data in regard to the calcium-phosphorus ratio in the fodder in comparison with the ratios found in the blood and in bone and flesh in general.

(*c*) During the year under report a number of interesting pasture surveys have been carried out in order to study the relative values of pastures in different districts of the province. The analytical data recorded for certain places however relates to rather abnormal conditions when the pastures were dead ripe and not at the best nutritive stage.

(*d*) Studies have also been carried out on the biological values of cereals in relationship to manurial treatments. The results obtained are not conclusive and this work requires to be continued. In this connexion an interesting finding was that rice grown under the effluent from activated sludge showed a higher protein content than that grown under ordinary irrigation.

MADRAS. Studies have been concluded on the minimum protein requirements of Kangayam bullocks and confirm previous findings that 100 gm. of digestible protein per day are necessary. Related to this study was an investigation on the relationship between protein metabolism and muscular work and the general findings are in conformity with general physiological knowledge.

BIHAR. Work has been continued during the year under review under the Imperial Council of Agricultural Research scheme for studies on the influence of the age of a crop, soil condition, season, geographical localities, cultivation and manuring, on the composition of fodder. This work is still in the prelimi-

nary stage and some of the results obtained have confirmed the results which have been found in the Punjab. The composition of the same fodder may vary in different localities and under different types of soil and strict correlation cannot be found.

The Bihar studies have shown distinct variations in protein and ash content in the same type of fodder on different farms, but much further work and statistical interpretation is yet required before a complete picture of the various relationships of the nutritive values of fodders with other factors can be stated in detail.

Investigations by the Department of Agriculture on the effects of supplementing the normal rations of cattle with mineral adjuncts in cases where soils are known to be deficient in mineral content have been continued. Tentative conclusions indicate that under such conditions calves when fed mineral adjuncts increase in weight more than the controls.

PUNJAB. The following investigations were carried out:

(i) An investigation on the value of decorticated cotton-seed cake obtained from a local oil press in comparison with undecorticated cotton seed. The results showed that the decorticated cotton-seed cake contained 29 lb. of digestible protein per 100 lb. of feed against 18 lb. for the undecorticated cotton-seed cake.

The corresponding figures for the albuminoid ratio were 1 : 1 and 3 : 1, indicating the superiority of the decorticated cotton-seed cake both in protein content and protein digestibility.

(ii) *Working bullocks.* An investigation was carried out with six working bullocks on the ordinary farm ration as fed at Lyallpur, using the general technique followed in digestion experiments to ascertain the efficiency of the rations in relationship to the work done on the basis of eight hours a day.

The average weight of the animals was 1,000 lb. and they were fed on wheat *bhusa*, green berseem and gram. The average intake of digestible protein per day was 1·6 lb. and on this ration all the animals showed positive nitrogen balances. The nutritive ratio of the rations calculated from the fodder actually eaten by the animals was 1 : 6 against 1 : 8 as recommended by American writers.

(iii) *Experiments on cattle feeds manufactured from molasses.* A number of experiments have been carried out in different parts of India to throw light on the value of molasses when mixed with other materials in the form of compressed cakes as a ration for animals. The Harcourt Butler Institute, Cawnpore, has produced a composite feed from bagasse screenings, mustard cake and molasses in the proportions of 2, 3 and 4 respectively. Work had been conducted with this material at the Allahabad Agricultural Institute, Naini, U. P., and the Punjab Agricultural College, Lyallpur. The conclusions drawn from the Allahabad trials are, firstly, that feeds containing molasses and bagasse are not as efficient for purposes of nutrition as other common Indian feeds with which they have been compared, such as various concentrates, oil-seed cakes, etc., and also that they are less palatable. It has invariably been found that animals do not take to these feeds, particularly at the start, and it takes a considerable time before they will tolerate them in moderate amounts. such feeds, nevertheless, form a cheap source of energy as an emergency ration but are not to be universally recommended. The results at Lyallpur have

shown that the chemical composition of the composite molassed feed was approximately that of wheat bran although its digestibility was considerably lower; the content of calcium and phosphoric acid was satisfactory in amount but not well balanced. The digestibility coefficient of the protein in molassed feed was 52 as against 75 for that in wheat bran. The general results of the Lyallpur trials indicate that there is no particularly strong case for manufacturing bulky but not exceptionally rich food materials, such as this molassed feed, and transporting them long distances, except for emergencies. The general value of such fodders appears to be as a local fodder reserve in dry areas although it is doubtful whether this would justify the cost of manufacture particularly when the danger of spontaneous combustion from such fodders is borne in mind. This fodder underwent spontaneous combustion under storage in moderate bulk both at Lyallpur and Allahabad.

Corresponding trials have also been carried out at the Imperial Institute of Veterinary Research, Mukteswar, Imperial Dairy Department, Bangalore Agricultural Sub-station, Karnal, and various other institutes.

The results from these institutions will be published when ready.

3. Breeding operations

(a) *Cattle*

At last it is possible to review the pick of the cattle of India at one place and one time, and the all-India show at Delhi enables one to assess the qualities and values, types and capacities of many breeds which have all too often only represented names to the ordinary cattle breeder. A beginning has been made with herd books, registration and the foundation of a breed society: all healthy signs that Indian breeders are slowly coming into line. Much work requires to be done, and it will undoubtedly be necessary to be definite with regard to certain breeds, which appear to represent districts rather than provinces and to shade off into other breeds of similar type. A decision on this point is required before any real improvement can be started in these parts and the all-India cattle show has brought this most important question to a head. Environment and demand would appear to be much greater and more important factors in India's breeds of cattle than was previously believed, and many so-called breeds are mere answers to the above inventions based on the spur of necessity—which clearly go to prove the skill of the Indian breeder when faced with a paying demand and a ready market for a certain type.

In the PUNJAB there were 5,962 district board stud bulls standing in different districts of the province as compared with 5,370 in the previous year. In addition to this, there were 5,340 privately owned registered bulls at stud in the various districts under Government supervision. Special attention was given to the elimination of scrub bulls, and as a result of the by-laws framed by the various district boards, Brahmini bulls have now been completely eliminated from the rural areas of the Lahore and Jullundur divisions. At the Hissar farm, the total number of stock issued for breeding and draught purposes was 1,724 animals against 1,429 in the previous year. There were 1,659 births against 1,727 in the previous year. In the Hariana tract there were 2,392 pedigree stud bulls as compared with 2,281 of the previous year. Under the Dhanni cattle breeding scheme, there were 110 district board and 347

subsidy bulls at stud as compared with 87 district board and 269 subsidy bulls in the previous year. The demand for Dhanni bulls is becoming very keen as the breed is establishing itself in most parts of the province. A number of other breeding schemes were also in operation in different tracts. The total number of approved buffalo bulls under departmental supervision, including bulls belonging to local bodies was 6,695 as compared with 2,629 last year. Buffalo breeding work in the province has been much improved by the organization of a large number of breeding societies.

In the NORTH-WEST FRONTIER PROVINCE the work on the improvement of the Dhanni, Lohani, Dajal, Sindhi and Sahiwal breeds of cattle was continued. At the end of the year there were 408 bulls at stud in the province.

In BIHAR although no definite cattle breeding policy has yet been formulated by the Government, yet due to the formation of district cattle improvement associations in certain districts, the question of improvement of livestock received greater attention than before. During the year 116,043 scrub bulls and bull calves were castrated as compared with 111,438 in the previous year. At Kanke farm, two pure-bred herds, Sahiwal and Tharparkar, are being built up side by side. A small herd of Hansi-Hissar cattle was maintained at the Pusa farm. There were 45 buffalo bulls at stud in the Tirhut range.

In BENGAL 20 out of 27 districts in the province participated in the cattle improvement scheme, and 390 stud bulls were purchased and distributed to each of the 10 districts which accepted the scheme during the year. The total number of progeny reported up to the end of the year was 5,400 and most of these are said to be in good condition. Further some 16,980 scrub bulls were castrated during the year. A sum of Rs. 7,200 was distributed in 19 districts to people who kept stud bulls in good service condition. In addition to this, several district boards also allotted funds for this purpose.

In ASSAM work on the improvement of cattle consisted in grading up the local cattle by crossing them with Friesian, Sindhi, Hariana and Tharparkar bulls. Considerable improvement in milk yield and size of cattle has been achieved by this process. The supply of cattle from Government farms, which was stopped owing to the outbreak of Johne's disease, was resumed from the Khanapara and Jorhat farms towards the end of the year. Cattle improvement was continued as in the previous year in the grazing reserves and village breeding centres. Substantial expansion of work for livestock improvement was possible due to the provision of Rs. 50,000 out of the Government of India's rural uplift grant. The establishment of the Livestock Improvement Association in 1936-37 ushered in yet another agency for carrying out cattle breeding operations all over the province.

In MADRAS the main work on the improvement of livestock was carried out at the Hosur farm. The breeds of cattle maintained there were Kangayam, Sindhi and Hallikar, while a few buffaloes and a small herd of Ongole cattle were located at Guntur. At Hosur attempts are also being made to improve the indigenous cattle by using Sindhi bulls. Altogether 53 cows, 55 bulls, 4 heifer calves and one bull calf were issued for breeding purposes.

In BOMBAY the work on the improvement of cattle was continued at Chharodi for the Kankrej breed and at Bankapur for the Amritmahal breed. at Chharodi testing and selection for the production of high milk yielders was continued. Besides this, a herd combining a fair milk yield with good draught

quality is being developed. The rearing, selection and distribution of premium bulls was continued and 253 bulls were maintained under the premium bull scheme in selected cattle breeding tracts. During the year 127 bulls were made available under H. E. the Viceroy's gift bull scheme. An impetus was also given to the scheme for the improvement of buffalo breeding in the province. A total number of 507 buffaloes in the province were tested. Herd registers of pure breeds were maintained in the interest of the local breeders. In addition to these activities, cooperation was continued with the *Gowrakshak Mandali,* Kandivli, in the breeding of improved Gir cattle, and 15 Gir bulls were put out as premium bulls.

In COORG the scheme for the improvement of cattle launched last year worked satisfactorily. The total number of stud bulls purchased up-to-date by Government was 19. The progeny of these bulls appear to be promising.

In MYSORE there were 1,387 Hallikar and 169 Amritmahal bulls maintained in the state for stud purposes. In TRAVANCORE the Department of Agriculture continued the policy of awarding grants for approved stud bulls maintained by private individuals. In BARODA a number of breeding bulls were maintained at different centres for the improvement of cattle of the state. With a view to improving Gir cattle, the Government sanctioned a scheme for issuing six bulls a year to six selected villages in Kodinar taluka. In HYDERABAD the work on the improvement of cattle was continued on the lines reported last year. At the end of the year, there were 56 breeding bulls on the register as compared with 33 in the previous year.

At the IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, a pedigree herd of Sahiwal cattle was maintained and a similar herd of Tharparkar cattle at the Karnal sub-station. At both these stations line breeding and rigid selection for milk yields was carried on. Fourteen Sahiwal and 35 Tharparkar bulls were sold during the year. At the Imperial Dairy Institute, Bangalore, pedigree herds of Sindhi and Gir cattle were maintained with a view to develop high milk yielding strains.

During the year under report, a large number of cooperative cattle breeding societies were started in different provinces and states for the improvement of cattle and other aspects connected with it. These societies maintained stud bulls for the service of cows owned by their members, advanced funds for the purchase of good cattle, made arrangements for training in veterinary first aid and also for the treatment of sick animals and organized cattle shows and distributed prizes to the winners. The number of such societies working in the various provinces and states at the end of the year was: Madras 3, Punjab 272, Delhi 7, Travancore 1, Baroda 2, while 7 new societies were registered in the United Provinces.

(b) *Horses and camels*

Some provinces in India are paying very little or no attention to horse, mule and donkey breeding. In the PUNJAB the number of horse and pony stallions in the non-selected districts* was 79 in 1937-38 as compared with 80 in the previous year. The number of donkey stallions was 82 against 80

* Hissar, Rohtak, Gurgaon (except Palwal and Balabgarh tehsils), Karnal, Ambala, Simla, Kangra, Hoshiarpur, Jullundur, Ludhiana, Gurdaspur, Sialkot, Mianwali, Muzaffargarh, Multan, Montgomery, Gujranwala and Dera Ghazi Khan.

in the previous year. The total number of mares covered by these horse and donkey stallions was 5,287 and 6,453 as compared with 5,092 and 6,183 respectively, during the preceding year. While there is a great demand for the Baloch breed of horses in the districts of Multan and Montgomery, there is great dearth of suitable stallions *even* in the home district, viz. Dera Ghazi Khan. This dearth is probably due to the fact that the old indigenous breed has practically been replaced by mixed Arabs and thorough breds. One horse and ten donkey stallions were issued to districts during the year from the Government Cattle Farm, Hissar. In most of the breeding areas in the non-selected districts horse and mule breeding societies were formed during the year. The Arab breeding operations at the Government Cattle Farm, Hissar, have been suspended under the orders of the Punjab Government and whatever livestock was available has since been disposed of.

In the NORTH-WEST FRONTIER PROVINCE five Arab and two T. B. E. horse and 15 donkey stallions were maintained in non-selected districts. They covered 314 and 1,131 mares respectively. There is great scope for developing donkey and mule breeding industries in certain hilly tracts of the province where the only means of transport are these animals. In the UNITED PROVINCES there were at the close of the year 52 horse and 10 donkey stallions. They covered 1,800 and 312 mares respectively. In ASSAM there were 14 ponies, out of which five were working ponies, three mares and six colts. There were five horse stallions at stud in the SIND Province. This number included one thorough-bred English and one Australian horse presented to the district local board, Upper Sind Frontier district, by the Race and Riding Club, Ltd., Karachi. These stallions covered 207 mares during the year against 196 in the previous year. In the HYDERABAD STATE there were 29 stallions at the close of the year as against 35 in the preceding year, while the number of stallion stands increased from 15 to 16. The number of coverings during the year was 558 as compared with 564 in the year before, which shows a decrease of six only. The total number of stallions at work, however, increased from 36 to 37. In the BARODA state there were only 2 Egyptian donkey stallions which covered 48 mares. An attempt is now being made to collect and collate all available information regarding the indigenous breeds of horses and asses in India and Burma including particulars of breed characteristics. The information when collected and published will be useful towards the improvement of indigenous breeds of horses and donkeys.

Although camels are extensively used as pack animals for riding and agricultural purposes little systematic work has been done so far for the improvement of breeding. The only province in which anything is being done, is the Punjab. The District Board, Ferozepore, subsidized 13 selected camel stallions which covered 1,080 she-camels compared with 499 coverings by 15 camel stallions in the previous year. Eight camel stallions were subsidized by the Mianwali District Board against 12 in the preceding year. The scheme is very popular with the zamindars in the tract who chiefly rely on their animals for many necessities of life. Progress was, however, retarded by lack of funds. A similar scheme of subsidizing camel stallions has also been started in the dry and sandy tracts of the Hissar, Rohtak and Gurgaon districts. As a first step towards the improvement of camel breeding, the Imperial Council of Agricultural Research is now collecting information from the camel rearing

tracts in India, regarding the various breeds of camels, their breed characteristics, the way in which they are usually bred and other relevant matters.

(c) *Sheep and goats*

Sheep and goat breeding operations in India, whether on the contribution from the Imperial Council of Agricultural Research, or financed by the provincial Governments in different provinces and the states, have been undertaken with the following objects in view :

1. To improve the indigenous breeds of sheep and goats by selection under farm conditions.

2. To provide pedigree rams and bucks in the rural areas, where goat and sheep breeding under controlled conditions is to be contemplated.

3. To investigate such economic factors as may be of value to sheep and goat breeders generally.

4. To investigate disease conditions amongst these animals.

(i) *Sheep.* In the PUNJAB the work in connexion with sheep breeding is in progress in Kangra under the sheep breeding scheme of the Kangra district, in the Jhelum district under the Rakh Dand Cooperative Sheep Breeding Society and at Hissar farm under the scheme financed by the Imperial Council of Agricultural Research. Three breeds of sheep are being tried in the Punjab and the record of wool production in each breed is reproduced below.

Average production of wool in two clips per animal per annum in each class

Breed	Class	1936-37	1937-38
		lbs.	lbs.
Merino	Rams	8·21	8·31
Hissar Dale	Rams	8·37	8·00
	Ewes	3·56	3·93
	Lambs	4·42	4·38
Bikanir	Rams	8·56	9·12
	Ewes	4·50	5·50
	Lambs	5·23	6·29

At the Hissar farm the scheme of the Imperial Council of Agricultural Research concerns the improvement and breeding of Bikanir sheep and the programme of work taken in hand promises results of great value.

The sheep breeding scheme in BOMBAY, financed by the Imperial Council of Agricultural Research, aims at evolving a type of breed superior to the indigenous sheep, and with this end in view the operation was started in 1938 with ten ewes and five rams of Merino breed of Wangenlla strain obtained from South Africa. In MADRAS attempts are being made to improve Bellary sheep by selective breeding at the Government Cattle Farm, Hosur. At the Upper Shillong Farm, ASSAM, breeding operations with Bikanir sheep were continued with satisfactory results, and the best yield for the year 1937-38 of a ram at this farm was 9¼ lb. Worm infestation was the main trouble of sheep at this farm.

In the NORTH-WEST FRONTIER PROVINCE the sheep breeding operations are being conducted in several districts with satisfactory results with Hissar

Dale (Merino and Bikanir cross) and Merino imported from South Africa. A trial is given to Bikanir sheep in HYDERABAD STATE at Hingoli farm where the flock suffered mainly from parasitic infestation in spite of preventive measures.

At three Government sheep farms in MYSORE, considerable progress is being made in sheep breeding, using Merino rams on local ewes. At Ajjampur main station and its sub-station at Basur the total number of sheep at the close of the year 1937-38 was 346 as against 315 in the previous year. At Yallachihalli Sheep Farm the flock consisted of 173 sheep. The yield of wool with improvement in its quality per head during the year 1937-38 was 12·9 oz. as against 11·4 oz. in the previous year. At Hebbal Sheep Farm the breeding operation with Merino rams was given a serious set-back due to 'Heart Water' disease to which eight Merino sheep brought from South Africa succumbed either in transit or after landing in Bombay and thereafter.

The Kolar Sheep Breeders' Association consisting of 166 members is making an appreciable effort at sheep breeding with stud rams issued to the association from the Government farms. The association had 10,000 sheep under its control at the end of the year 1937-38 as against 7,383 at the beginning of the year of which 1,200 were hybrid sheep. 12,788 sheep were machine-shorn by the association which produced 3,491 lb. of wool and sold it at prices far better than what the individual flock-owners would have realized.

In the UNITED PROVINCES, on the result of a survey on indigenous sheep industry carried out in Upper Garhwal hills, it has been suggested that considerable improvement could be effected in sheep in this region by encouraging private enterprise in selective breeding for the colour and quality of wool. The survey report also contains the possibility of encouraging livestock trade in the beginning of the winter when proper shelter to sheep is rendered practically impossible. The possibility of meat export is also envisaged by establishing private cold storage which in these hills would not necessitate an expensive plant.

(ii) *Goat.* The importance of goat breeding in the general scheme of livestock improvement in India is of no small measure on account of meat and milk supplied from these animals on low productive cost. Goat breeding schemes, therefore, are in contemplation of several provincial and state Governments.

In the UNITED PROVINCES considerable headway has been made in goat breeding at the Government Goat Breeding Farm, Etah, with Jumna-Pari and Barbari goats under a scheme financed by the Imperial Council of Agricultural Research. The report for the year 1936-37 shows that further improvement in the milk yield of the stock maintained on the farm has been effected and that the cost of production of milk per pound has been steadily reduced. By decreasing the number of days in milk from 274 in the previous years to 151 in the year 1937-38, the maximum yield per day, the average milk yield per day during lactation and the average yield per day during kidding interval have increased from 3·2 to 4·1, 1·8 to 2·9 and 1·2 to 1·10 lb. respectively. One gratifying result of goat breeding at this farm has been the demand for Jumna-Pari goats from various provinces, and during the last seven years 193 goats were supplied to nine different provinces, and 381 village goats were bred to the farm bucks during the same period.

In BENGAL, there is a demand all over the province for a larger goat. A scheme on goat breeding is under consideration by the Government of Bengal, and funds have been provided by the district boards of Dacca, Faridpur, Berhampur, Nadia, Rajshahi, Malda, Hooghly and Bankura for improvement of stock in these districts.

At the Hissar farm in the PUNJAB, 89 goat lactations were recorded and the milk yield exceeding 300 lb. was observed in 10 out of 28 goats in their first lactation, and out of 16 goats in their second lactation, 6 showed a yield exceeding 400 lb. during the usual lactation period. A scheme for the investigation of indigenous goat breeding at the Government Cattle Farm, Hissar, has been sanctioned for a period of five years at a total cost of Rs. 18,720 and funds provided.

In ASSAM, the demand for improved male goats is enormous and a herd of Jumna-Pari goats is being graded up at the Khanapara farm. As a result of mating of local she-goats by Jumna-Pari bucks, goats of improved size and quality are to be seen in certain villages around this farm.

During the year 1937-38, 16 Patnai goats were purchased from NORTH BIHAR for issue in villages where 230 services were reported and 101 kids counted.

Goat breeding continued on a small scale in NORTH-WEST FRONTIER PROVINCE with Jumna-Pari goats and during the year 1937-38, arrangements were made to bring in six Angora goats from the United States of America for the development of Mohair in the hills.

The sheep and goat breeding operations in several provinces and states appear to have been considerably affected during the year under review by incident diseases which call for investigation and proper control.

(d) *Poultry*.

From a review of the year's work it is apparent that it is now widely realized throughout India that breeding improvement schemes are necessary for the betterment of the poultry industry. Unfortunately the schemes on hand at different centres are severely handicapped by lack of knowledge in regard to all aspects of production and marketing. The epizootic diseases which periodically sweep away huge numbers of fowls together with lack of precise information on breeding, feeding, management, etc. are fundamental problems which will have to be overcome before the various breeding improvement schemes can yield their full value.

In the UNITED PROVINCES the scheme sanctioned by the central Government for the erection of a central poultry institute at Izatnagar, under the administration of the Director, Imperial Veterinary Research Institute, is well in hand, and it is hoped that research will be commenced during 1938-39. The poultry laboratory will provide facilities for fundamental research into the various epidemic diseases which sweep out whole poultry populations. A qualified veterinarian will be recruited and sent abroad for two years' study prior to taking up investigational work. Facilities will also be provided for physiological and nutritional studies and provision is being made for research into the processing and storage of both eggs and poultry. A poultry farm with accommodation for 1,000 laying birds will provide material for fundamental research together with facilities for practical research into breeding, housing, feeding and general management of different classes of fowls. The work of the

new section will be put in charge of an officer with wide practical experience in poultry husbandry and the processing and marketing of poultry products.

In the PUNJAB the principal work of the Poultry Expert was directed to the standardization of two distinct breeds of Desi fowls. Though some improvement has again been made, considerable more work is deemed necessary before the project can be carried through to a successful conclusion. On heavy clay soil heavy breeds such as Rhode Island Reds and Light Sussex gave better results than light breeds. A scheme for the improvement of table poultry has been started under the auspices of a grant sanctioned by the Imperial Council of Agricultural Research. Under this scheme Asils and Chittagongs will be tested out against improved and unimproved Desi fowls. Losses during hatching and rearing have been materially reduced by alteration in feeding and management.

In BOMBAY the scheme for research under the auspices of the Imperial Council of Agricultural Research has been continued at three centres. Trapnesting records for various periods have been obtained from White Leghorn, Rhode Island Red, Black Minorca, Light Sussex, Chittagong, Naked Neck and selected country fowls. Records have also been obtained from Khaki Campbell and Indian Runner ducks. Selection is being carried out on the basis of trapnest records but an outbreak of Ranikhet disease rather retarded progress. In addition to useful work on housing and feeding it was found that fortnightly high pressure spraying of kerosene was effective in controlling ticks. Under the scheme for rural uplift work sanctioned by the Government of India, 212 pure-bred male birds were distributed in eight centres and an inspector was sent out to advise the starting and working of poultry centres in these districts. To encourage pedigree poultry keeping in villages premiums were paid to six poultry farmers for the purchase of foundation stock and houses.

In BENGAL there has been considerable demand for improved poultry, and during the year 180 cockerels and 167 dozen of eggs were distributed to various centres. The removal of the Poultry Section at Dacca to a new site has so far prevented outbreaks of contagious diseases which had previously retarded progress. As in most former years Rhode Island Reds gave better production than other breeds. The sixth Rhode Island Red × Chittagong which appears to be well established lays as well and appears to be more resistant to heat than pure Rhode Island Reds.

In MADRAS stocks of White Leghorn, Rhode Island Red, Light Sussex, Black Minorca and an indigenous strain of Chittagong fowls were trapnested throughout the year at Hosur and a number of birds were also kept at seven other agricultural stations. At Hosur the average annual egg production from 78 laying birds was 166·9. Five thousand, five hundred and four hatching eggs for stock improvement were sold during the year.

In ASSAM at the upper Shillong experimental farm the average annual egg production from White Leghorn, Rhode Island Red, Black Minorca and local crosses was 156·9, 143·2, 125·4 and 137·9, respectively. Imported strains of Khaki Campbell ducks gave good production but gave disappointing hatchability and rearing results. A considerable number of stock birds and hatching eggs were distributed for breeding purposes to villagers.

In MYSORE the Government sanctioned the opening of small poultry farms at four of the veterinary hospitals to demonstrate and facilitate the

distribution of improved poultry to villagers. Sixty stock cockerels, 29 hens, 687 chickens and 4,159 hatching eggs were distributed during the year.

In BARODA, in addition to the distribution of improved breeds, a scheme was launched, whereby selected candidates from different districts were trained and provided with capital to start small poultry farms in order to facilitate the distribution of stock cockerels.

4. Dairying

Progress was made in many phases of dairying during the year under report. Some of the newer aspects of this very important part of Indian agriculture have shown great advances. Such matters as research and the improvement of the production of the respective breeds of cattle were given continued emphasis. The gift bull scheme of His Excellency the Viceroy received an exceptional response. Work was in some cases begun and in other cases continued with regard to the publication of milk records, definition of breed characteristics, the establishment of breed societies, cattle exhibitions, surveys of the industry, marketing, cooperative dairying and education. A short summary of the progress in each case makes up this section.

Research

At the Imperial Institute of Agricultural Research studies on early maturity, skeletal alterations, transmission of characters, full brother and full sister parallels, and stimulation of the mammary glands by manipulation before and after pregnancy were continued, while at Karnal four-time milking, pre-handling and milking and early maturity work received further attention. The Imperial Council of Agricultural Research continued to encourage study along various lines in this field. Schemes financed by this body on subjects pertinent to dairying were carried out in almost every part of the country. Results of completed studies have been or are being published and the practical application of the findings encouraged. At the Imperial Dairy Institute, Bangalore, further work was done on subjects such as the following: correlation of body weight and period of gestation, hand *versus* machine milking, bacteriological study of milk produced and handled under different conditions, milk transportation, use of a vegetable rennet in cheese making, *khoa*, freezing point of milk from cows and buffaloes and several others. Seventeen reports were completed of which five were published. The Allahabad Agricultural Institute continued schemes on the chemical composition of milk, feeding of baggo-molass, procuring supplies of raw milk, herd and dairy records, and on other specific problems.

Surveys and reports

Dr Norman C. Wright's *Report on the Development of the Cattle and Dairy Industries of India*, which appeared in October 1937, embodies 69 specific recommendations regarding the improvement of these industries in the country. Dr Wright spent nearly five months surveying very carefully these aspects of Indian agriculture.

Some of the main points covered in the report, and which may well be watched during the next few years to study the imminent effects of his visit, are: marketing of ghee and establishment of trading centres, investigations into the nutritive value of indigenous milk products, establishment of herd

books and milk recording societies, survey of the incidence of mineral and vitamin deficiency diseases of cattle, award of scholarships for post-graduate training in animal genetics, reconsideration of the courses for dairy training, the establishment of an Imperial Dairy Research Institute, reconsideration of the development of the Anand Creamery and the appointment of a central officer for recording milk registration. These are now receiving the careful attention of the central and provincial Governments.

Production

In the table below the production of several different herds is given. In the column 'Daily average' the two sub-headings, 'M. A.' and 'O. A.,' refer to the 'milking herd average' and the 'over-all herd average' respectively. These headings are used by the Imperial Dairy Institute and should be adopted for all such reports. The reader would then not be at a loss to know as to which is referred in the case of such data when it is not properly identified in the reports. It is further suggested that the 'average daily number of cows in milk' be given, as the number of cases in any biological study bears very important relationships to the results.

Herd	Breed	Average daily No. of cows in herd	Average daily production		Average yield of lactations completed during the year	Highest individual lactation	
			M. A.	O. A.		yield	days
			lb	lb.	lb.	lb.	
Imperial Institute of Agricultural Research.	Sahiwal . .	72[1]	22·2	..	..	11,003·0	304
	Thar parker (Karnal).	56[2]	20·2	..	5,716 0	8,785·0	305
Imperial Dairy Institute	Cross bred .	72[3]	18·1	11 6	1,747·0	8,076·0	292
	Sindhi . .	48[3]	12 4	7·5	3,160·0	5,862 0	399
	Gir . .	18[3]	10·5	6·6	3,087·0	4,581·0	331
	Murrah . .	21[3]	13·5	7·8	4,517 0	7,736 0	..
Civil Veterinary Department, C. P. and Berar, Telinkheri Farm	Sahiwal . .	8[3]	..	..	3,410·0	..	..
	Murrah .	25[3]	..	..	2,837·0	..	..
Coimbatore Agricultural College	..	28	14·2	10·5	..	..	..
Mysore Department of Agriculture	Hallikar . .	..	12·0	..	..	..	..
Baroda Department of Agriculture	Cows . .	21	7·6	4 1	..	..	..
	Buffaloes. .	37	9·0	6 2	..	..	..
Lyallpur College .	Montgomery .	24	20·8	19 12	..	..	..
	Buffaloes. .	10	..	12·8	..	..	..
Bihar Civil Veterinary Department	Tharparker .	..	..	12 0	..	..	..
Military dairies, Northern circle	Friesland .	9[3]	33·4[4]	..	..	16,486·0	323
	Cross-bred .	285[3]	20·8[4]	..	..	13,572·0	422
	Sahiwal at Ferozpore.	28[3]	18·4[4]	..	..	8,800·0	316
	Buffaloes .	1,078[3]	14·1[4]	8·3	3,488·5	..	..
Military dairies, Southern circle	Cross bred .	744[5]	..	14·8	7,128·0	..	..
	Buffaloes .	1,671[5]	..	9 6	3,854·0	..	..
Allahabad Agricultural Institute	Sindhi . .	19[3]	11·18	8·62	3,404·7	8,092	365

[1] Average monthly number of milking *plus* average monthly number of dry.
[2] Number completing lactations within the year.
[3] Average daily number of milking *plus* average daily number of dry.
[4] Calculated from average milk yield and average number of days in milk.
[5] Number at end of year.

The data given above does not give comparisons with those of the preceding year. Except for difficulties with regard to disease or a radical change of breeding policy in certain instances, nearly every figure is an increase over that of the last year. The Sahiwal herd at the Imperial Institute of Agricultural Research, for example, averaged 20·7 lb. daily for the milking herd a year ago, whereas for this year it averaged 22·2 lb.

Dr Wright estimates that over Rs. 50 lakhs are annually contributed to *gowshalas* and *pinjrapoles* for the improvement of Indian cattle. Certainly there are several of such institutions in which a definite improvement in the cattle is being made through the selection of bulls and careful management of the breeding policy. Press reports confirm this. It would appear, therefore, that if all such organizations would send a copy of their annual report to the Imperial Council of Agricultural Research, a great fund of valuable information on the improvement of cattle would be available for reference. This would be of great value in the summarizing of the work done in this respect in the country.

Publication of milk records

The material available to the Imperial Council of Agricultural Research for inclusion in its publication of available milk records greatly increased during the year. The preparation of the report continued so that it will be ready for distribution towards the end of 1938. This project, therefore, which was begun last year, is to make extremely valuable and needed information available very soon to the trader, breeder and research worker. Such information has been found to be indispensable in other countries to the development of their dairy industry. This gives some intimation as to the value such information will have for the Indian dairyman.

Definition of breed characteristics and establishment of breed societies

Very recently special impetus has been directed towards the definition so far as this is possible, of the characteristics of the important breeds of cows and buffaloes of all-India importance, and the establishment of breed societies in each instance. These matters were given continued attention during the year. The definition of the characteristics of each of seven such breeds of cattle will be formulated and published within the following year. The work of establishing breed societies received special attention in at least one instance. Such societies will give purpose and direction to the improvement of the respective breeds. India will then have authentic records of her cattle for her own and foreign breeders interested either in developing their own herd or in purchasing breeding stock for other purposes.

Gift bulls

In addition to steps being taken independently in nearly every province and Indian state in the matter of the selection, purchase and location of breeding bulls for the improvement of local draught and milk cattle and buffaloes, the gift bull scheme of His Excellency the Viceroy received a tremendous response. About 1,100 persons donated either money or bulls, or

promised to make a contribution to the scheme. Nearly, 1,400 bulls, including several donated personally by His Excellency the Viceroy, and about Rs. 1,70,000 were made available by the India-wide interest taken in this relatively new phase of dairying. This is an extremely gratifying report. The interest taken in this very important approach to the improvement of our Indian cattle gives assurance, it would seem, of the stability of the scheme and the certainty with which very beneficial consequences might be anticipated.

Shows and exhibitions

The first All-India Cattle Show was held at New Delhi in February 1938. The value of this show is well stated in the *Annual Report of the Imperial Council of Agricultural Research, 1937-38.* It runs as follows: 'Such shows, besides providing the necessary stimulus to improvement, by encouraging competition between breeders in order to raise gradually the stock to the highest levels of efficiency for the particular function they are required to perform, also help to stimulate trade in livestock and livestock products'. There are other values that might be enumerated as well, but mention might be made of the regular attendance of a large breeder from Australia and the intense interest he showed in the different breeds displayed.

Many smaller shows, such as local fairs, attracted considerable interest during the year. Doubtlessly the number of such shows will greatly increase in the near future because of the interest taken in the all-India cattle show.

Marketing and cooperation

1. *Ghee.* The Ghee Conference, which was held in September, recommended the establishment of experimental grading and packing stations for ghee. Such stations were established during the year at six places. A central control laboratory was set up at the Harcourt Butler Institute, Cawnpore. In the few weeks of operation of these stations before the end of the year over 12,000 maunds of ghee were tested and graded for market. Such approved ghee is now marketed as "Agmark" ghee, a trade mark adopted by the office of the Agricultural Marketing Adviser to the Government of India. Special surveys of certain areas also were undertaken on recommendation of this conference.

The aggregate value of ghee produced within the country is such that 12,000 maunds is relatively a very small portion of the total trade. It is, however, a very promising response to a great need; that of improvement and standardization of marketed ghee. The amount of this product which will be sold as 'Agmark' during the next year will, undoubtedly, be many times greater.

Cooperative societies for the production and marketing of ghee, separately or as one of several products, continue to operate satisfactorily in Madras and the United Provinces. The number of such societies is greatly increasing, especially in the latter instance.

2. *Milk.* The Royal Commission on Agriculture (paragraphs 199 to 201 of their report), in addition to calling attention to the supply of ghee to the Indian consumer, also pointed to the problem of city milk supply as being one to which greater attention must necessarily be given. The progress made during the year in the operation and establishment of milk societies is, as a

whole, very marked. Dr. Norman C. Wright discussed this problem and urged that further and more careful attention be given to milk standards.

The work being done at the Allahabad Agricultural Institute on the chemical composition of milk from cows and buffaloes will contribute greatly to the establishment of such standards.

Progress in the growth and development of cooperative milk producing organizations was shown by the Palghar dairy district scheme in Bombay, the Karimganj and Gauhati groups of societies in Assam, the cooperative dairy at Drug in the Central Provinces and the Thirumala Ksheera Vyavasaya Mahila Cooperative Society No. 1999 and others in Travancore. In the United Provinces a very promising society has been put into operation at Lucknow and a similar one is being organized for Cawnpore. Although not exactly cooperative in their organization, mention is also made of the milking stations at the Allahabad Agricultural Institute, United Provinces.

The problems involved in making available to urban markets ample supplies of good quality milk from rural areas, rather than from within the cities themselves, are being quite satisfactorily overcome by such organizations as those mentioned above. In most cases the supply is to a considerable extent unlimited. Instances of having overcome the difficulties arising from the transportation of milk over long distances by pasteurization at or near the producing area, are seen in such of these societies as that at Lucknow.

The Gauhati group of societies in Assam handled 61,000 seers of milk during the year, the Thirumala Ksheera Vyavasaya Mahila Cooperative Society handled nearly 45,600 seers and the cooperative dairy at Drug handled 20,210 seers.

Education

A statement on this part of the work during the past year is given elsewhere in this report. Mention is, however, made of it here in order to complete this section.

In addition to the Indian Dairy Diploma and post-graduate courses, there is also the new Bachelor of Science degree course at Allahabad University with the specialization in animal husbandry and dairying. Veterinary colleges, intermediate schools for agriculture and many high schools continued to give courses in dairying of increasing value to their students. New colleges where this subject, as well as animal nutrition, will be offered are being planned and will be admitting students in the near future. This is a great stride forward and is indeed very encouraging.

CHAPTER X

VETERINARY EDUCATION AND INSTRUCTION IN DAIRYING

1. Veterinary colleges

REFERENCE has been made in the preceding reviews regarding the proposal relating to the establishment of a central veterinary college for imparting the highest standard of veterinary education in India. Further action in the matter is now under the consideration of the Government of India.

Madras Veterinary College

Extensive facilities were available to the students for obtaining practical training in the various subjects included in the curricula and also for acquiring detailed practical experience in regard to all branches of the profession. The students also attended the Serum Institute, Madras, and acquainted themselves with the practical aspects of the production of some of the biological products.

During the year under review, the Government of Madras have sanctioned the extension of the Diploma course of the Madras Veterinary College to a period of four years with effect from the academic year 1938-39, and have also ordered the submission of proposals for the revision of the B. V. Sc. course in consultation with the University of Madras.

Under the orders of the provincial Government, the number of candidates to be admitted to the Degree and the Diploma courses at this college has now been restricted to 50, i.e. 40 for the students belonging to the presidency and 10 for students from other provinces, including also Burma and Coorg. The total number of admissions to the 1st year class was 50 (41 for Degree and 9 for Diploma course). One student of the Degree course and two of the Diploma course left the college during the academic year. Including the failed students (one for Degree and seven for Diploma) who joined the class in October, the strength of the class at the end of the year was 55 (41 in the Degree and 14 in the Diploma courses). The total number of students on the rolls at the end of the year in all the three classes was 118 (55 in class A, 40 in class B and 23 in class C, as against 101 in the preceding year).

One scholarship was awarded to a Mohammedan and two to members of the depressed classes who were new entrants in the 1st year class. Due to lack of a suitable candidate, one scholarship was kept in abeyance.

Out of the 32 students who appeared for the final examination of the Diploma course, 19 qualified during the year under review. The first B. V. Sc. preliminary examinations were held on the 28th, 29th and 30th June and 2nd July 1937. Of the 28 students who registered for the examination, one was disqualified due to lack of requisite attendance and three absented themselves. Of the 24 students who appeared for the examination, 9 secured a full pass; and of the remaining 15, 8 secured a pass in one subject while the rest failed in both the subjects. The second B. V. Sc. preliminary examinations were

held from the 22nd to 24th November 1937. Fourteen students registered and all of them appeared in the examination (seven for the whole examination and seven for one subject only). Of the seven who appeared for the whole examination, two passed in both the subjects, two failed in both, and three passed in one subject only. Of the seven who were examined in one subject only, six were successful. Thus, out of the 24 candidates who appeared in these two B. V. Sc. preliminary examinations 17 qualified during the academic year under review.

Meetings were held periodically under the auspices of the Madras Veterinary College Association and some interesting lectures were delivered on 'The Pathology of Tuberculosis', 'Foot and Mouth disease and some of its problems', 'Vaccinia', and 'Radiology and its application to Medicine'. The attendance at these meetings was satisfactory and the students evinced a keen interest in the proceedings.

Bombay Veterinary College

There was a heavy influx of applicants for admission to this college and this was responsible for a rather abnormal figure for admission during the year under review. It is observed, however, that, in view of the limited available accommodation and facilities, it will be necessary to limit the number of new entrants in future years.

The number of students on the rolls for the three-year Diploma course on the 1st of April 1937 was 113, and of these 61 passed the annual examination. The number of students who graduated and left the college during the academic year 1937-38 was 15, and 9 other students also discontinued their studies. In June 1937, 54 new students and one old student were admitted to class A and one old student to class B. The total number on the rolls at the commencement of the collegiate year was, therefore, 145. Of these, four left on passing the supplementary final examination in October and three for other reasons, and there were, therefore, 138 students on the rolls at the end of the year. Of the 55 students admitted to the college in June, 40 were natives of the province, two were from Sind, four from Kathiawar states, one from Indore, seven from Jammu and Kashmir and one from the Federated Malay States.

Of the seven scholarships available at the commencement of the session, three were awarded to new students in class A, two to students in class B, and two to students in class C. The Government of Sind continued the stipend to their two scholars and sent two new scholars this year. The Government of the Central Provinces and the states of Kolhapur, Udaipur, Dewas, Mysore, Rewa and Kotah continued stipends to their scholars. Some state scholars from Jammu and Kashmir, Indore, Bikaner and the Federated Malay States were also admitted. Thus, the total number of stipendiaries at the commencement of the year was 35.

During the year, 32 candidates appeared for the farriers examination and of these 30 secured the certificate for efficiency.

Bengal Veterinary College

As stated in the last review there was an increasing demand for admission into this college. The number of students on the rolls at the end of the year

for the three-year Diploma course was 207 as against 174 and 184 during the preceding two years. Out of 207 students, 75 held stipends from various bodies and 132 were private students. The district boards of Bengal awarded 35 stipends during the year 1937-38 as against 24 in the previous year. Sixty students appeared for the final examination during the year and 44 came out successful.

Punjab Veterinary College

During the year under review, the number of applicants for admission to the four-year Diploma course was 228, and of these 87 secured admission. Later four students left the College during the academic year. Of the new entrants 38 were statutory agriculturists.

The total number of students at the annual examinations held in June 1937 and the supplementary examination held in September 1937 was 127, and 79 passed their respective examinations. Of the 11 students who appeared for the final examination, six were successful in securing the Diploma of Licensed Veterinary Practitioner offered by the college. It is stated that there is a big demand for these graduates of the Punjab College both in the Punjab and the states and that, though the supply is still inadequate to meet the demand, it is hoped to overcome this shortcoming in the near future.

Amongst other facilities available at this college, six veterinary assistant surgeons received training in the new method of Goat-virus inoculation against rinderpest. Further, 77 candidates completed their training as dressers. The farriers' class was held as usual and 15 candidates were admitted to this class in September 1937. Of these, 11 were deputed by the Military Adviser, Indian States Forces, and four were private candidates. 13 candidates passed this course in June 1937.

Bihar Veterinary College

Altogether 38 new students joined the college as against 29 during the previous session while 57 out of 59 old students returned for resuming their studies. There were thus 95 students on the college rolls at the beginning of the year. The new admissions comprised of two stipendiaries of the Bihar Government, one of the Orissa Government, six of the district boards in Bihar, and 29 private students (namely 19 from Bihar, three from the United Provinces, four from Bengal, one from the Punjab, one from the Central Provinces and one from Nepal). The numerical strength at the end of the session was, however, reduced to 81, as 14 students left the college during the year. Of these, 55 were private students and 26 were stipendiaries.

Altogether 80 students (namely 33 in class A, 22 in class B, and 25 in class C) appeared for the examination in the three classes. Out of these, 56 passed, namely 21 in the 1st year, 18 in the 2nd year and 17 in the 3rd year, the percentage of passes being 63·6, 81·8 and 68 respectively as compared with 66·6, 81·8 and 63·1 in the preceding year. Five students obtained distinction in the Diploma examination—one in Veterinary Medicine, one in Veterinary Medicine and Surgery, one in Pathology and Bacteriology, and two in Operative Surgery.

2. Post-graduate courses in veterinary science

The annual post-graduate refresher course at the Imperial Veterinary Research Institute, Mukteswar was held from the 5th of April to the 3rd of July, 1937, and 10 officers attended the course. Three of these officers remained at the institute for further periods to complete the special courses.

In addition to the post-graduate refresher course short courses of practical training were given at the institute to nine officers.

At the Madras Veterinary College, 10 students (viz. six from C. V. D. Madras, two from Hyderabad, and one each from Bangalore and Travancore) attended the refresher course for veterinary assistant surgeons. It is stated that the course will be held for the usual period of nine months from July 1938.

At the Punjab Veterinary College two veterinary assistant surgeons of the district cadre joined the refresher course in September 1937.

Due to want of accommodation the post-graduate training class at the Bihar Veterinary College was not held during the year though a number of candidates including some from other provincial Governments and states had applied for admission.

Instruction in dairying

During the year under review, the total number of students trained at the Imperial Dairy Institute, Bangalore, was 98. These students came from different provinces in India and Indian states and some from places outside India, viz. Ceylon, Federated Malay States and China. Some were stipendiaries and some deputed by provincial Governments and Indian states, but the majority undertook the training at their own expense.

In Bengal, with the establishment of a dairy school at Dacca, special facilities will be available for training of the officers of the Livestock Section in dairying and animal husbandry. The proposal, which is under consideration, envisages a full course of training extending over a period of two years and also facilities for short courses for persons interested in dairying. During the year under review, students of the agricultural and some other schools and also some young men of *Bhadralok* class received training in dairying and cattle management.

3. Indian Dairy Diploma

At Bangalore, the 23 students who commenced their Indian Dairy Diploma training in November 1935 and the four 'repeat course' students who were admitted in May 1937 appeared for the final examination in October 1937. Of these, all secured the Diploma, one with Honours. A fresh batch of 23 students, which was admitted in November 1937, is now under training.

Allahabad Agricultural Institute

Reference was made last year to the accepted practice according to which students for the Indian Dairy Diploma course are admitted only once every two years. No admissions were accordingly made during the year. Twenty-four out of the 31 students admitted during 1936 continued their courses satisfactorily during 1937-38.

The teaching staff was strengthened by the appointment of a new professor of dairying. The annual grant of Rs. 6,000 from the Government of

India was continued during the year and equipment and facilities for training were improved. A herd of eight selected Murrah buffaloes was added to the milking stock at the institute farm.

A specialized course in Animal Husbandry and Dairying for agricultural students of the institute was completed during the year. Seven students took the university examination during the year and four passed in the second division.

4. Post-graduate courses in dairying

At the Imperial Dairy Institute, Bangalore, six post-graduate students who were admitted in January 1937 for a course in Animal Husbandry and Dairying completed their training at the end of March 1938 and a fresh batch of seven students, admitted in January 1938, is now under training. The post-graduate students attended the routine practical work of the dairy, cattle yard and cultivation sections of the institute and also received intensive practical experience in regard to the chemical, physical and biological examination of milk and the diverse solid and liquid milk products, analysis of cattle food, etc. Special demonstrations on items of practical interest were also staged for their benefit. As a result of instructional visits to selected dairy institutes, they gained practical knowledge about the various details of the trade. Special short courses were arranged for 12 students for periods varying from one to six months and 12 British soldiers, who were admitted in March 1937, completed a vocational training course in August 1937. A fresh batch of 11 British soldiers was admitted to the course for the last time in September 1937. This vocational training was instituted in 1934 at the instance of the Defence Department and, up to the period of its termination, 100 British soldiers will have received training at this institute.

Two parties of Indian soldiers visited the institute in connexion with the rural reconstruction scheme and attended demonstrations relating to the activities of the institute.

CHAPTER XI

DISTRICT WORK

THE Advisory Board of the Imperial Council of Agricultural Research, while considering the recommendations of Sir John Russell in regard to the methods of demonstration and propaganda, had recommended that (i) the Council should undertake an examination of the methods already in use in India with a view to evaluate their relative merits and (ii) it should study and bring to the notice of the various provinces and states promising new methods found to be under trial in India. A note on the first item has already been written and published in *Agriculture and Live-stock in India** and information on the second item is being collected for preparing a similar note to be published in one of the Council's journals. In the circumstance it has been thought best to give in this chapter only the latest figures showing the progress made in various directions and such newer account as has not been contained in the note already written on the subject and published in *Agriculture and Live-stock in India*. This chapter will thus be supplementary to the article already published. The area under improved varieties of crops in British India (excluding Burma) was 22·1 million acres during 1937-38, as compared with 22·4 million acres in 1936-37.

The reports of the provinces from which information for this note has been culled indicate an increased tendency on the part of cultivators to recognize the importance of improved methods of farming recommended by the Agricultural Departments. Propaganda and demonstration have also recently received a fillip from the rural development drives initiated by the new popular governments in various provinces.

1. Demonstrations

Practically all the departments report great success achieved by this method. These demonstrations cover a wide field and include a wide range of operations such as growing of improved seed, use of improved implements, manufacture of composts and manures, spraying of the trees with insecticides against insect pests and diseases, eradication of weeds, etc. Space forbids a detailed enumeration of all items undertaken by various departments and it is only possible to mention here a few important items of demonstration held during the year in each province.

In MADRAS there were during the year 7,963 demonstration plots in the cultivators' fields spread over the whole presidency as against 7,554 in the previous year. This does not include a large number of demonstrations conducted on the use of improved labour-saving implements, better preservation of farmyard and compost manures, treatment of seeds against fungoid diseases and of spraying against pests and diseases. In addition a large number of trials were con-

* Vol. IX, Part VI.

ducted on cultivators' fields to judge the comparative merits of improved methods of cultivation. Their number also increased from 902 during 1936-37 to 1,026 in 1937-38. The scheme of intensive propaganda by the appointment of 63 demonstration *maistries* in nine talukas of the Vizagapatam district started two years ago was further extended to a larger number of villages. The number of implement demonstrations under this scheme was increased during the year to 2,998 as compared to 1,705 during 1936-37. A noteworthy improvement was the increase made in the number of bee colonies that were hived. The colonies starting from two in 1934-35 went up to 61 during 1937-38. The scheme has served to get wide recognition all over the district of the usefulness of the Agricultural Department and the ryots have begun to appreciate the work of agricultural demonstrators and their *maistries*. Outside this scheme about 75 lakhs of arecanut palm were sprayed with insecticides in South Kanara and one lakh in South Malabar. The department distributed 89 sprayers, 83,053 lb. of copper sulphate to garden owners besides 3,100 cwt. of chemicals and 183 sprayers supplied by the cooperative organization at Puttur.

In BOMBAY during the year under report, the district activities of the Agricultural Department in connexion with demonstration and propaganda, seed distribution, land improvement, crop protection, etc., continued to develop in almost every district of the province. A special feature of the year was that the Government gave special grants of Rs. 40,000 for training a large number of cultivators in scientific bunding operations. Great interest was evinced by cultivators in learning scientific methods of constructing field bunds and embankments to protect the cultivated fields from permanent damage and loss by soil erosion and washings. As many as eight classes, each lasting for a fortnight, were held in the three agricultural divisions (four in South Central, two in North Central and two in Southern division) for training as many as 815 cultivators in the science and art of bunding their fields. These classes serve as the best form of propaganda in this direction.

During the year, 4,503 acres were protected by simple bunds in the North Central division, whilst between the South Central division and Karnatak 112 minor bunding projects were framed and carried out, protecting 2,718 acres of land. The Government have also sanctioned a scheme for reorganizing the district work by starting a large number of taluka agricultural demonstration centres on the holdings of progressive agriculturists, which are to be cultivated and cropped by cultivators themselves in accordance with the improved methods advocated by the Agricultural Department. Provision has been made to organize 50 such taluka demonstration centres in 1938-39. Along with this an arrangement has been made to select about 900 honorary agricultural agents willing to devote some of their time to the work of persuading the agriculturists of their villages to adopt certain agricultural improvements. It is hoped that these two newly created non-official agencies will materially contribute to the improvement of agricultural practice in the province.

In BENGAL the demonstration work of the Agricultural Department is greatly supplemented by the staff of the district boards, court of wards, Government estates and by zemindars. There were as many as 43 demonstrators in the Eastern circle alone. The jute restriction propaganda inaugurated by the

Government in 1930 was continued. A special staff of overseers was engaged for six months under the collectors of the jute-growing districts. The departmental officers collaborated by giving lectures and by freely distributing large quantities of seeds and cuttings of substitute crops among cultivators for which a sum of Rs. 4,000 was sanctioned by the Government up to the end of March only. The union board farms (450) started with the help of the Government of India grant proved extremely valuable but unfortunately, owing to lack of funds, are closing down. Attempts are again being made to provide funds and revive them. Propaganda for growing fodder is proving successful. Cultivation of Napier grass is especially gaining much popularity.

In the UNITED PROVINCES there exists a large number of private demonstration farms which work in cooperation with and under the supervision of the department. There are 1,372 such farms, of which the largest number is between 50 and 100 acres each. In addition to these private farms the propaganda staff carries out demonstrations by working in close cooperation with the staff of other departments such as the Cane Development Department, Irrigation Department, Cooperative Department and the rural development organizations. In the Sarda circle alone the demonstrations during the year increased from 6,600 to nearly 9,000 and covered a wide range of crops and agricultural practices, the total area under demonstrations being about 7,400 acres. The staff of the Agricultural and Irrigation Departments work jointly in developing intensive agriculture in special zones located in the Sarda circle. They have worked in close cooperation in developing a rapid increase in the areas under fodder crops especially berseem, in introducing suitable rotations, economizing the use of irrigation water, use of green manuring crops in sugarcane areas and in the utilization of available canal supplies in April and May for reclamation of mild *usar* (alkaline) and *banjar* (waste) lands and in September-October for cultivation of late paddies. In the Western circle the special staff provided for intensive agricultural development in the state tube-well areas extended its activities from 105 to 175 centres.

Remodelling of holdings in this area was carried out, by consent, on a further 6,864 acres, bringing the total to 18,081 acres. The year's work provided for 2,622 acres of sugarcane and 4,242 acres of wheat sown in blocks, the cost per acre including the construction of water channels and roads being 10 as. 5 pies and 8 as. 8 pies respectively. Provision for work on somewhat similar lines was made during the year in the Mat branch circle of the Upper Ganges Canal. Joint effort by the Agricultural and Cooperative Departments is a marked feature of the development work in the eastern districts, particularly in Sultanpur, Benares and Fyzabad. In Partabgarh there are organized centres at a large number of important villages where assistant *gudies* encourage the adoption of improved farming practice under the supervision of inspectors of both the departments. In the North-eastern circle red-rot in sugarcane was a cause of anxiety during the year and a clean up campaign was carried out in January 1937. In the Bundelkhand circle some 332 acres of *kans* infested area were ploughed by departmental power plant consisting of two Diesel caterpillar tractors. The cost of the operation was reduced to about Rs. 12 per acre.

In the PUNJAB 5,443 demonstration plots were laid out on cultivators' fields as against 4,866 in the preceding year. The scheme of contestant holdings introduced in the Nilibar colony is producing good results. The scheme was

recently extended to the Pir Mahal and Khika extensions of the Lower Chenab Canal area. The most remarkable feature of the year was the inauguration of a special rural reconstruction scheme in one selected tehsil of each district of the province except Simla. A special staff of one agricultural assistant and two *mukaddams* has been sanctioned for each of these selected tehsils and the aim is to intensify further the district and propaganda work in these localities. *Pohli* weeks were observed in cooperation with the Revenue and Irrigation Departments on some canals and large areas were cleared of this obnoxious weed.

In BIHAR, as a result of demonstration work, practically the whole of the area under sugarcane is planted with Coimbatore canes and similar results will soon be recorded in the case of wheat as well. Altogether in the course of the year 21,307 demonstrations were given to show varietal, cultural and manurial improvements on different crops, while 2,432 demonstrations were given on the manufacture of composts. The staff provided by the Government for district work consists of one overseer and three *kamdars* per sub-division. It has been felt, however, that the efforts of such a small number of workers scattered over such a large area as a sub-division are rather dissipated and so it was decided during the year to concentrate such staff in one *thana* ot one sub-division per district to see how the results would improve. Another change introduced during the course of the year was the appointment of advisory committees in every sub-division to be associated with the overseer in this work.

In the CENTRAL PROVINCES the number of private demonstration plots in the Northern circle was raised from 16 to 24 during the year. In the Southern circle 31 private plots were run under the advice of the department and efforts are being made to start many more in accordance with the accepted policy of making them the real centres of demonstration of the activities of the department. 'Farmers' Days' were held at Seoni and Betul farms to enable agriculturists to see at a close range the agricultural improvements advocated by the department. Ploughing demonstrations were arranged at 1,817 centres and on the occasion of important religious fairs. A scheme designed to stimulate interest in growing different kinds of fruit trees in home *baris* was organized in the Balaghat district in cooperation with the Revenue Department to commemorate the Coronation of His Majesty King George the VI. A large number of fruit trees was distributed under the scheme. In the Eastern circle where the system of absentee landlordism is prevalent the successful running of demonstration plots has created a demand for trained village managers. A new scheme designed to provide this kind of training is intended to be submitted to the Government shortly. There was a rapid increase in fruit and vegetable cultivation in this circle. Orchards have been extended from 281 during last year to 489 during the year under review. Practical demonstrations given on various occasions were 3,736 as compared to 2,803 during the last year. 'Farmers' Days' were held at five centres. In the Western circle the staff organized 3,256 ocular demonstrations as compared to 2,886 during the last year.

In SIND as a natural extension of the work at the auxiliary farms, a move has been made by the department to open model farms. These farms are located on the zemindar's land. The area is about 32 acres and the cropping scheme

is decided in consultation with the zemindar. A few of these model farms have already been started. It is expected that they will serve a useful purpose as centres of propaganda in the interior.

The number of demonstration plots during the year was about 1,000, the Government foregoing the levy of assessment on those portions of the zemindari land which were utilized by the department as demonstration plots. Ten ' Farmers ' Weeks' were held during the year on different farms, the most notable one was that held at Oderolal on the occasion of His Excellency's visit.

In BALUCHISTAN extensive demonstrations of spraying with lead arsenate, Rosin fish oil soap and lime sulphur wash together with rat killing were given throughout the fruit growing tracts of the province.

In HYDERABAD there were 14 aided farms working in the state during the year. Five new farms, which have been sanctioned, will start functioning shortly. In addition to the work on these aided farms propaganda is also carried out on demonstration plots in villages. There were 3,407 demonstration plots during the year as compared to 2,967 during the last year. The methods of control of red hairy caterpillar and castor semi-looper were demonstrated as usual by conducting campaigns in heavily infested districts. Demonstrations on improved methods of farming were also given in connexion with the rural development work conducted at the Patancheru centre.

In MYSORE the Government sanctioned the formation of ten circles instead of four as originally proposed, each with a district officer in charge. The number of ranges has also been raised from 35 to 43 so as to provide one range inspector for every taluka. This will now give a convenient size of area to each circle officer to work in. A regular system of conducting demonstrations on ryots' fields has also been instituted. For this purpose 200 ploughs were granted free to selected village *panchayats*. One thousand nine hundred and thirty-three demonstration plots were laid out during the year as compared to 1,080 during the previous year.

In BARODA the scheme for demonstrations with the help of intensive units made further progress and an intensive contact was established with 327 more villages. The travelling demonstration carts arranged to make seven circuits during the year touched about 284 villages. It is calculated that about a lakh of people must have come in contact with this enterprize. As a result of this method 587 field tests dealing with crops' treatment were organized in Baroda, 398 in Mehsana district and several in Amreli and Navsari. The third method of laying out aided experimental plots as a link between departmental and experimental farms and the intensive units of demonstration also made great headway during the year. Demonstration on various items of agricultural improvement was also conducted at the rural reconstruction centre at Kosamba where the work was further extended to 22 more villages during the year.

In TRAVANCORE a scheme for reorganizing the propaganda section of the department has been submitted to the Government and it is expected before long that one agricultural inspector or demonstrator will be appointed for each taluka of the state. Most of the demonstrations conducted during the year related to the manuring of the principal crops grown in the state. Eighty-four demonstrations on paddy and 87 on coconut were conducted during the year. A new colony was started during the year in Palode village of the

Nedumangad taluka by the Travancore War Service Men's Association. Though intended mainly for the benefit of *ex*-service men, the aim of this land colonization scheme is to meet in some measure the problem of unemployment among educated men in the state and to bring into existence a class of holdings which would demonstrate to agriculturists the advantages of cooperative cultivation. A night school has also been started in the colony for the benefit of the colonists and their families and the neighbouring inhabitants including the hillmen in the adjoining forest.

In COCHIN new centres of demonstration were selected in all the talukas and to cope with the increased work, two centres each on paddy, sugarcane and coconuts were placed under the supervision of an agricultural trained teacher in each taluka. Besides supervising the centres, the teachers advised the ryots on the general lines of improved agriculture. Six such teachers were appointed and they were given a bonus of Rs. 50 each at the end of the year.

2. Other forms of propaganda

These consist mostly of the utilization of motor vans and other mobile units equipped with magic lanterns and other appliances for showing to cultivators in the interior the various methods of improvement recommended by the Agricultural Departments. Cinema and radio are replacing the gramophone and magic lantern and are being utilized to a greater extent in the rural development drives initiated in different provinces.

In MADRAS 1,243 lectures with and without the aid of lantern slides were delivered on the occasion of fairs, exhibitions, *jamabandi* camps and conferences. The three motor exhibition vans of the department toured throughout the presidency except in the VIII circle and attracted large gatherings of villagers throughout the areas they visited.

In BOMBAY rural uplift vans equipped with agricultural-propaganda material visited a number of villages in the Southern, South-central and North-central divisions during the year. These itinerant units proved extremely useful in educating cultivators in improved methods of farming. The members of the Agricultural Department contributed articles dealing with matters of local agricultural problems in numerous papers and periodicals in the districts. A special leaflet showing how to organize gun clubs and a poster to show how the Forest, Police and Agricultural Departments can cooperate in protecting crops against animals were printed and freely distributed.

In BENGAL a large number of lectures illustrated by magic lantern slides were given during the year in connexion with the jute restriction propaganda. Cinema shows depicting the activities of the department as also of other Government departments were also arranged by the publicity department in course of propaganda tours of their peripatetic staff. A new film on agricultural operations at the Dacca farm was prepared during the year.

In BIHAR in the Tirhut range alone 93 illustrated lectures were given in the course of the year. These attracted large crowds of interested people. Similar lectures were given at other important centres on the occasion of fairs.

CENTRAL PROVINCES. In the Northern circle 183 lantern and cinema lectures were given at Dindori and Saugor farms. In the Southern circle a cinema demonstration was held at the Ramtek fair and also at Chhindwara where films of agricultural interest were exhibited to gatherings of teachers

and students drawn from schools working under the control of the district council. Lantern lectures were delivered at 56 centres as compared to 21 during last year. In the Eastern circle 116 lantern lectures were given as compared to 55 during the last year and in addition 75 cinema shows were demonstrated at important centres. In the Western circle illustrated lantern lectures and cinema demonstrations were given at 280 centres as compared to 213 during the last year.

In SIND the touring party of the publicity section equipped with cinema outfit visited 86 villages from September to April. The party also gave cinema lectures on the occasion of agricultural shows, farmers' weeks and at other such gatherings of cultivators. Posters were prepared and were exhibited in the countryside to create interest in the agricultural well-being of the province and the department issued bulletins and press notes dealing with important subjects.

3. Agricultural shows and exhibitions

Agricultural shows and exhibitions were as usual held at important gatherings in all provinces and states. These varied considerably in size and scope. A few important ones held during the year in different provinces are noted below.

IN MADRAS the number of exhibitions held during the year was 352 as against 299 in the previous year. Special mention may be made of the exhibitions held at Gadithamadugu and at Prodatur in conjunction with cattle fairs arranged under the auspices of the district economic councils. The rural exhibition at Tritala was the first of its kind where prizes were awarded for the best crops, methods of conservation of manure and for the best products exhibited by the farmers. A comprehensive exhibition on important lines of research work pursued by different sections of the Research Institute was held in conjunction with the 'Annual Day' of the Agricultural College and Institute at Coimbatore.

In BOMBAY the Karnatak Agricultural Show was the outstanding event of the year. This show was held at Belgaum in January 1938. Though the show was organized on divisional basis it was of the same magnitude and comprehensiveness as the other two previous presidency shows held at Poona and Ahmedabad.

Most of the states, geographically related to the division, took part in the show.

In BENGAL the department contributed grants to 30 exhibitions including those held in Darjeeling and the Chittagong hill tracts. Of all exhibitions, those held at Suri, Midnapore, Faridpur, Brahmanbaria, Rangpur and Cooch Behar were the most important.

In the UNITED PROVINCES a number of *swadeshi* exhibitions were provided with agricultural stalls, the most important of which were at Lucknow, Benares and Allahabad. In the Western circle the number of agricultural shows held during the year was 30 of which the more important were those held at Aligarh, Meerut during Nauchandi fair and at Hardwar at the time of the *Kumbh mela*. In the Eastern circle a first class show was organized in connexion with the *Magh mela*, and an extensive exhibition was held on the occasion of Babuganj fair. In addition 18 other shows were attended by the departmental staff where agricultural materials and lectures were given. In the Rohilkhand

circle 14 agricultural exhibitions were arranged during the year, the most important being the Bareilly Industrial and Agricultural Exhibition.

In the PUNJAB the agricultural stall at Lyallpur continued to serve as a very useful medium for the sale of improved seeds and also acted as a link between the department and the trading community. The total quantity of seed of different crops sold for sowing purposes during the year was 9,456 maunds as against 8,632 maunds sold during the previous year. The number of visitors rose from 30,821 in the preceding year to 32,108 during the year under report. To stimulate interest of the hill men of Murree and Kahuta tehsils two fruit shows were held in July and September respectively and the competitors were awarded prizes.

In BIHAR agricultural displays were given at most of the important fairs held in the province during the year. Competitions were arranged at Sitamarhi, Hijla, Gulabbagh and Khagra. In addition, a cattle show for the Shahabad and Bachhaur breeds was held for the first time at Sonepore on the occasion of the annual fair and it proved such a success that it is hoped to make this an annual event.

In SIND altogether 30 agricultural shows were held during the year under report. At Sukkur, Jacobabad and Sajan Sawai the agricultural shows were run in conjunction with the industrial, health and village uplift departments. The Revenue Commissioner in Sind inspected the show at Jacobabad. An agricultural and horticultural show was held at Hyderabad. It was opened by the Honourable Minister of Agriculture and attended by His Excellency the Governor of Sind who presided over the prize distribution ceremony.

In BALUCHISTAN agricultural shows were organized at Sibi and Usta. In the latter place the Assistant Entomologist and Agricultural Assistant gave short discourses on agricultural topics.

In HYDERABAD the annual horticultural and poultry show was held in February 1938 and a rural development exhibition was held at Patancheru in March 1938.

In MYSORE an exhibition took place in the Town Hall at Chikmagalur in November 1937 in connexion with the Mysore State Women's Conference. The department took five stalls and actively participated in the exhibition.

In BARODA the Second Baroda Fruit Show was held during the year and was very well attended. About 40,000 people visited the exhibition which contained about 385 exhibits. The department also participated in the annual rural exhibition of the rural reconstruction centre at Kosamba.

In TRAVANCORE the department actively participated in the Sri Chitra Exhibition at Trivandrum, the Vavubeli Exhibition at Kuzhithura and the exhibitions held at Oachira in connexion with the Karunagapally Cooperative Conference and at Karunagapally in connexion with the All-Kerala Coconut Growers' Conference.

In COCHIN the department took part in five exhibitions by sending several kinds of agricultural exhibits including charts illustrating the control of pests and diseases.

4. Agricultural associations

In the large list of associations that are being established for all phases of improved farming, it is only possible to mention the activities of a few important ones and of those newly established.

In MADRAS the fruit growers' association at Vizianagaram conducted the first fruit show during the year. Three more agricultural associations were started during the year, two in South Arcot district and one in North Arcot district. The district agricultural association of Trichinopoly conducted an agricultural exhibition on an elaborate scale at Srirangam during the *Vaikunta Ekadasi* festival. Six agricultural associations were newly started in the Tinnevelly district during the year. The cooperative loan and sale society at Anakapalle sold 107,272 maunds of jaggery worth about Rs. 86,896. The Bimlipatam society disposed of 6,800 bags of groundnut valued at Rs. 36,339. One loan and sale society was started at Proddatur.

In BOMBAY the organization of gun clubs for the protection of cultivators' crops from damages by wild animals was continued and one lakh of acres in the southern division and 40,000 acres in East Khandesh were protected. The number of taluka development associations was 102 at the close of the year 1937-38. Subsidies amounting to Rs. 40,840 were granted during the year as against Rs. 37,879 in the previous year. The associations have been classed by the divisional boards of agriculture in order of merit as class A including those which are most successful and class B struggling associations which deserve help if possible and class C the *moribund* associations.

In BENGAL almost all the district agricultural associations in the presidency are now in a *moribund* condition for want of funds. Of these associations, the 24-Parganas Agricultural Association is the only active body that is doing some constructive work. The Midnapore District Agricultural Association was reorganized towards the end of the year on a broader basis under the name District Rural Reconstruction Committee. There is no agricultural association in Eastern Bengal, but a cooperative rural reconstruction society at Brahmanbaria (Tippera) opened a small farm and entertained a demonstrator.

In the UNITED PROVINCES about 200 better-farming and better-living societies have been organized and a dozen seed unions were working during the year in the eastern districts. In the Sultanpur district the number of better-farming societies rose from 17 to 26 and in addition a number of agricultural credit societies have begun to function. Better-farming societies have also been organized in the rural development centres, some of which have commenced to do good work. The fruit development board—an organization of fruit growers and nurserymen—further consolidated its position and increased its utility under the guidance of its executive committee. Its membership increased during the year by 63 to a total of 599 and Their Highnesses the Nawab of Rampur and Maharaja Sahib of Tehri, Garhwal, accorded their patronage to the board. The objective of the board is the furthering of fruit production and its marketing throughout the province, in which it cooperates with affiliated district fruit growers' associations to which financial aid is given for maintenance of nurseries and for the holding of fruit shows. The board's work is financed in regard to its general activities by the subscriptions of its members, but it receives a grant of Rs. 4,500 from Government as a help in its fruit marketing schemes.

In the PUNJAB village farmers' associations are making very satisfactory progress and are greatly appreciated. The total number of such associations has increased from 3,129 during the preceding year to 3,482 in the year under

report. These associations consist of prominent practical farmers of the district who meet twice a year for bringing local problems to the notice of the Agricultural Department and the results of the department's labour to the notice of farmers.

In BIHAR the Agricultural Department, as usual, worked in close cooperation with the directorate of those cooperative banks and institutions that are interested in agricultural development even though they may not be active participants in the work of agricultural propaganda themselves. The only bank that maintains *kamdars* on its staff now is the Siwan Bank. A close liaison was also maintained with the cane-growers' cooperative societies that were established in the Tirhut and Patna ranges. In the former range alone no less than 1,230 demonstrations were carried out in the fields of the members and in addition to this sugarcane and green-manure seed, fertilizers and castor cake were distributed free to various societies.

In the CENTRAL PROVINCES in the Southern circle four new agricultural associations were registered during the year which increased the number of cooperative agricultural associations to 14. The re-orientation of the departmental policy with regard to seed unions whereby efforts are directed to consolidate the existing seed unions rather than to increase their number has proved helpful in consolidating the principles of self-help and cooperation among cultivators. In the Eastern circle 12 seed unions were registered under the Cooperative Societies Act and 29 unions were supplied with pure seed from Government farms in exchange for ordinary seed as against 18 unions supplied during the last year. In the Western circle there were 23 taluka agricultural associations and 29 branch associations. These associations run shops for the supply of pure seeds, implements and spare parts.

In SIND in order to ensure closer cooperation between the Agricultural Department and the Revenue and Public Works Department on the one hand and with the non-official public on the other, district agricultural committees have been formed in each district. They meet twice a year to review the progress made in agricultural propaganda in their respective districts and to devise means to promote the welfare of the cultivator. These committees have proved very useful in keeping on the one hand the non-official public fully informed of what the department is doing for the zemindar and the *hari* and on the other in giving valuable assistance to the department in conducting propaganda in the districts.

In HYDERABAD the village improvement association of Patancheru continued to do useful work under the guidance of the centre in the way of improving water supply of villages, organizing relief work and opening of seed depots for the supply of improved seeds to cultivators.

The cooperative cotton sale societies at Kophal in the Raichur district and at Nanded and Aurangabad and cooperative implement sale societies continued to function on profitable basis.

In MYSORE two paddy growers' associations were started for the first time one at Kunigal and the other at Mayasandra in the Turvekere taluka. Work through cooperative societies and village *panchayats* was continued in all the circles. The total value of sales of seeds and implements through societies amounted to Rs. 967.

In BARODA better-farming societies were organized in many villages and although much success has not so far been achieved in installing the idea of co-operative effort, growing individual interest and cooperation with the department are amply evident. In the year under report three cotton sale societies with a membership of 412 growers sold through the marketing organization bales of cotton valued at Rs. 1,80,000 at an average premium of Rs. 7-5-11 per *khandi*. The Dhari taluka fruit association showed good progress during the year. Its membership was over 110 and it took part in the Baroda Fruit Show.

In TRAVANCORE the Thirumala Kaheera Vyavasaya Mahila Cooperative Society further increased its membership during the year. It continued to supply milk to several public institutions in Trivandrum town and made a profit of Rs. 562.

5. Seed multiplication and distribution

The production of improved seed and its multiplication forms one of the important functions of the propaganda staff of the Departments of Agriculture.

The Indian Central Cotton Committee continued to help the Agricultural Departments in the more extended distribution of pure seed of improved varieties of cotton. At the commencement of the period under review there were 13 seed distribution and extension schemes in operation on cotton. During the year, however, five new schemes were sanctioned, two for the maintenance of nuclei of pure seed of improved varieties of Indian cotton in the presidency of Madras and the Central Provinces and Berar, one for financing seed distribution in Sind, one for the distribution and marketing of Buri 107 cotton in the Burhanpur tehsil (Central Provinces) and one for the extension of *BD8* cotton in the Baroda State.

The Imperial Sugarcane Breeding Station, Coimbatore, continued as usual to supply seed and seedlings to stations in sub-tropical India, i.e. Karnal, Shahjahanpur, etc. A brief account of the important seed distribution and extension schemes in each province is noted below.

In MADRAS the Cambodia cotton was tried in the I circle for the first time as an irrigated crop and the growth of the crop was satisfactory. In all 312,126 lb. of improved Cambodia seed was distributed for sowing during the year as against 249,355 lb. in the previous year, of which the VIII circle alone was responsible for 188,507 lb. as against 148,000 lb. in the previous year. The total area in the presidency under the improved strains of Cambodia during the year was 246,367 acres as against 206,550 acres in the previous year. It is estimated that the acreage of these strains in the VIII circle alone was 180,022. Of the Karunganni cotton which is grown only in the V, VI and VIII circles, 252,470 lb. of pure seed was distributed during the year as against 60,624 lb. in the previous year. The strains recommended were K1, A10 and C 7. It is estimated that 203,924 acres were under these strains during the year as against 165,440 acres in the previous year. 'Northerns' cotton is confined to III circle and N 14 is the chief strain under distribution. The area under this cotton during the year was 4,368 acres as against 3,925 acres in the previous year.

The total area under different improved strains of paddy in the presidency including natural spread was estimated at 1,774,024 acres as against 1,395,043

acres in the previous year. The total quantity of paddy seed distributed in the whole presidency was 2,718 tons. In potatoes Great Scot is the chief variety that is largely distributed. 103,675 lb. of seed material was distributed to ryots from Coonoor and Ootacamund. The area under improved strains on Nilgiris was estimated to be 12,068 acres and the total quantity of seed distributed in the whole presidency amounted to 106,590 lb.

The total area under improved strains of sugarcane in the presidency was 46,064 acres as against 42,650 acres in the previous year.

In BOMBAY the following seed distribution schemes for the improved varieties of cotton were in force. These schemes continued to receive financial assistance from the Indian Central Cotton Committee.

(i) *Distribution of 1027 ALF seed in the Surat area.*—During the year under review, the Department of Agriculture controlled a seed multiplication area of 26,618 acres (including 1,160 acres grown with farm pedigree seed) against 25,583 acres (including 1,589 acres grown with farm pedigree seed) in the previous year, and distributed 2,936,110 lb. (including 1,660,449 lb. supplied to Indian states) against 2,687,009 lb. (including 1,477,946 lb. supplied to Indian states) in the previous year.

(ii) *Khandesh (Jarila Scheme).*—This scheme, which has for its object the extension of Jarila cotton in place of Banilla in the Khandesh area, was sanctioned in March 1937 for a period of 10 months from the 1st of May 1937 and was extended in January 1938 for a further period of one year up to the 28th of February1939. 84,315 lb. of seed was made available for multiplication over an area of 4,000 acres under controlled conditions as against 520 acres in the last year. This is in addition to the area spread of its own accord without departmental supervision. The Jarila cotton produced at different centres was pooled together at Jalgaon and Bodwad centres, ginned under departmental supervision and was sold by auction at a premium of Rs. 26 to Rs. 46 over Broach.

(iii) *Deccan Canals (Banilla) Scheme.*—During the year under report, 31 acres were sown with this cotton at the Kopergaon Government Farm. A very poor yield of 368 lb. of *kapas* per acre was obtained against 678 lb. of the previous year and 733 lb. per acre of the year before. The reason for this was reported to be the uneven distribution of rainfall, attack of green caterpillar, pink bollworm and growth of weeds.

(iv) *BD 8 Scheme.*—This scheme was extended in July 1938 for a further period of five years, the total grant sanctioned for the scheme being Rs. 47,501. During the year under report, an area of 6,268 acres was under *BD 8* as against 20,012 acres in 1936-37. The reason for this fall in area was reported to be the excessive rains at the beginning of the season. Out of 2,035 bales of pure *BD 8* produce, 1,770 bales were sold through sale societies and gin-owners. *BD 8* realized Rs. 3 to Rs. 4 more per *bhar* (1,020 lb.) than Goghari *kapas*, against Rs. 2 to Rs. 7 less per *bhar* during the previous year.

(v) *Revised Jayawant and Gadag No. 1 Scheme.*—This scheme replaced five schemes in the Southern division, viz. the Hubli, Gadag, Athani, Haveri and Bailhongal seed distribution and extension schemes. It commenced work on the 1st of June 1936 and is due to terminate on the 31st of May 1941. The scheme is intended to cover, within five years, 9½ lakhs of acres with improved varieties. During the year under report, 2,755,200 lb. of pure Jayawant

seed was sown over an area of 245,318 acres against 961,100 lb. of seed sown over an area of 102,306 acres during the last year. The natural spread of Jayawant was estimated to be 1¼ lakh acres, bringing the total area under this variety to about 4 lakh acres. 1,295,700 lb. of pure Gadag No. 1 seed were sown over an area of 92,539 acres against 844,100 lb. of seed sown over an area of 84,410 acres during the last year. The natural spread of this variety was estimated at 25,000 acres, making a total of 117,539 acres. 2,866,920 lb. of Jayawant seed, sufficient for about 3 lakh acres, and 1,588,580 lb. of Gadag No. 1 seed, sufficient for about 113,470 acres, have been purchased so far for the 1938-39 season.

The cultivators' produce was pooled together and sold by auction at different centres and sub-centres. In all 14,940 *docras* of Jayawant and 13,569 *docras* of Gadag No. 1 were sold during the year and the extra profit realized by cultivators is estimated at about Rs. 37,350 and Rs. 73,000 respectively.

(vi) *Scheme for maintenance of nucleus of pure seed of improved varieties of cotton.* In pursuance of the policy of the committee to maintain a nucleus of seed of all approved varieties of cotton, a scheme for the maintenance of nucleus of each of the following seven varieties of cotton was sanctioned in August 1937 at a total cost of Rs. 2,660 per annum (i.e. Rs. 380 per variety) and it came into operation during the season 1937-38 :

1. 1027 ALF
2. BD 8
3. Jarila (wilt-free zone)
4. Jarila (wilt-zone)
5. Jayawant
6. Gadag No. 1
7. Banilla

The multiplication and distribution of pure seed of improved varieties of all crops, other than cotton, is carried out chiefly by departmental agencies, assisted, in some places, by cooperative organization and taluka development associations. The main features of this work during the year under report were the distribution of 483,300 setts of improved sugarcane varieties at concession rates to cane growers in the Deccan Canal tracts. In the North-central division, progress reported during the previous year was maintained in the distribution of improved wheat strains Nos. 168, 224 and Pusa 4 and as much as 440,000 lb. of improved wheat seed were distributed with the help of funds available with the village uplift societies and other organizations. About 4,000 lb. of Maldandi *jowar* seed was supplied in Khandesh and large quantities of improved seed of Kolumba varieties were distributed to cultivators in the Thana district.

In BENGAL a well-planned scheme for growing long staple cotton on cultivators' fields in some of the districts of Bengal has been devised in consultation with the Bengal Millowners' Association who have promised cooperation and a substantial contribution of funds towards its working. It is expected that the scheme, if sanctioned by the Government, will be launched during next year.

In the UNITED PROVINCES there has been a considerable increase in the number of seed stores in connexion with rural development schemes. The total number has been increased from about 200 to 600.

In the Eastern districts the department is concentrating on producing only one type of seed over a wide area in several villages. This scheme, which is proving successful, is greatly facilitating the collection of seed of satisfactory

quality and purity for further distribution and it is intended to be completed in the first instance in wheat and barley to be followed up later with other crops like rice, linseed, etc. The total quantity of seed distributed during the year including the supply of sugarcane setts through the departmental seed stores and associated agencies was 2,398,157 maunds. This does not include the sugarcane seed distributed for planting in the cane development zones under the Cane Commissioner. The largest quantity of seed distributed during the year was that of sugarcane amounting to 1,953,764 maunds followed by 361,110 maunds of wheat. In cotton the total area under the two selected varieties of cotton, i.e. C402 and C520 dropped to 1,898 and 362 acres respectively against 2,619 and 1,008 acres in 1936-37. The scheme for extension of seed of C402 sanctioned by the Indian Central Cotton Committee was closed down in 1938 as the area under C402 was not likely to expand to an extent that would justify an expenditure of further money.

In the PUNJAB the work of seed multiplication and distribution has progressed very rapidly during the last three years.

The following statement will give some idea of the expansion:

	1933-34	1937-38
	Mds.	Mds.
Wheat	88,150	278,000
Cotton	32,750	94,800
Rice	3,358	5,700
Gram	4,700	29,700

In BIHAR 16,300 maunds of seed inclusive of 14,700 maunds of cane setts and 985 maunds of cuttings of elephant grass were distributed during the year free of cost. 22,445 maunds of seed inclusive of 14,680 maunds of cane setts and 147 maunds of cuttings of elephant grass were sold. In addition 118 fruit plants and 7,325 vegetable seedlings were sold. The demand for wheat No. 52 in North Bihar was considerable and exceeded the supplies that were possible to be made even with the help of several planters who were growing seed for the department.

In the CENTRAL PROVINCES the total number of seed farms in the Eastern circle numbered 4,662. The quantity of improved seed distributed from all sources amounted to 1·12 lakhs of maunds, exclusive of over 6 lakhs of maunds of whole canes. The seed farms have been classified into central, A and B categories. Central and A class farms are under the direct supervision of agricultural assistants while B class farms are looked after by *jamadars*. Fresh seed is supplied to the central farms every year, and to the others as often as is considered necessary. Seeds of improved varieties of all crops recommended by the department are estimated to have covered 5·31 lakhs of acres as compared to 5·03 lakhs during the previous year and to have brought an increased profit of at least Rs. 14·9 lakhs as against Rs. 15·02 lakhs in the preceding year to cultivators. The number of fruit seedlings distributed was 48,741 as compared to 40,209 in the preceding year. In the Western circle the number of seed farms rose to 7,981 as compared to 6,042 during the previous year. The total quantity of seed distributed during the year amounted to 52,560 maunds as compared to 38,579 during the previous year. In the 'Scheme for the extension and marketing of V434 cotton' the Agricultural Department distributed 4,233 *khandies* of pure seed of improved strains (sufficient to cover an

area of about 87,649 acres) as against 5,594 *khandies* of pure seed distributed in 1936-37. 4,575½ bales of pure cotton were disposed of at an average premium of Rs. 39-1 on Broach and Rs. 57-7 on Oomras, against Rs. 1-3 on Broach and Rs. 19 on Oomras in the previous year. The drop in the area covered during the season under report was mainly due to the exceptionally low premium of Rs. 1-3 on Broach and Rs. 19 on Oomras obtained for Verum during the previous season.

The scheme of distribution and marketing of Buri 107 cotton in the Burhanpur tehsil and the scheme for the maintenance of nucleus of pure seed of improved strains, V434, Late Verum, No. 438 and Buri 107 are expected to come into operation shortly.

In SIND the total quantities of pure seed of improved varieties distributed during the year amounted to 80,949 maunds. In the case of wheat the registered growers found it difficult to store the whole quantity of the produce and were obliged to see it in the local market. To save that good seed from sale for consumption in the market the Government as an experimental measure sanctioned a sum of Rs. 27,500 for the purchase and distribution of wheat seed. 7,348 maunds of wheat were purchased from the registered growers and were distributed to zemindars. A scheme for the extension of cotton on the right bank of the Indus which was sanctioned by the Indian Central Cotton Committee has led to a considerable increase in the area under cotton in that tract. During the year under report the area under cotton has gone up to 51,500 acres (including 7,000 acres under natural spread), of which 45,000 acres were under 4F-98 and 2,000 acres under Sind Sudhar. In the previous year the area under improved varieties was 41,020 acres (including 1,500 acres under natural spread). The Agricultural Department distributed 14,490 maunds of 4F-98, Sind Sudhar and Sea Island varieties against 14,060 maunds of 4F-98 and Sind Sudhar in the previous year. On the Left Bank the most striking development has been the introduction of American cotton in place of *desi* cotton. During the year under report 445,000 acres were under Sind NR and Sind Sudhar, against 400,000 acres during the last year. 2,908 maunds of Sind NR, 11,569 maunds of Sind Sudhar, 500 maunds of 4F-98 and 200 maunds of Egyptian were distributed during the year, against 3,685 maunds of Sind NR, 21,586 maunds of Sind Sudhar and 812 maunds of Egyptian during the previous year. The cultivators generally realize eight annas to one rupee more per maund for the *kapas* than the local rate by getting their produce ginned at the Government ginning factory at Mirpurkhas and by selling the lint and seed separately.

In pursuance of the policy of the Indian Central Cotton Committee for the maintenance of a nucleus of seed of all varieties of cotton, the spread of which has been approved by it, a nucleus scheme for the following five varieties of cotton was sanctioned in August 1937 at an estimated cost of Rs. 2,500 per annum, for a period of five years :

1. Sind NR
2. Sind Sudhar
3. 4F-98
4. Sea Island 2-4
5. Boss III-16

In HYDERABAD the department supplied 3,341,634 lb. of seeds of improved varieties of all crops during the year for an area of 244,899 acres. This does

not include the seed which is spreading naturally, passing directly from one cultivator to another without the intervention of the department. In cotton three improved varieties are being introduced on a large scale. The first is Gaorani 6 the seed of which, enough for 217,345 acres, was distributed in the Gaorani protected area. The other two are Jayawant and Gadag No. 1, the seed of these varieties distributed during the year under report amounted to 263,945 lb. sown over an area of 21,092 acres against 374,633 lb. sown over an area of 13,871 acres during 1936-37 and 553,880 lb. on an area of 41,256 acres in the year 1935-36. To procure pure seed of the improved varieties for distribution in the ensuing season the Agricultural Department reserved an area of 3,500 acres in the Kopbal and Gulburga talukas where the crop was rogued and supervised by the staff of the department. This area is expected to yield 360,000 lb. of pure seed sufficient for sowing 26,000 acres in the coming season.

In MYSORE the total quantity of improved seed of different crops such as sugarcane, cotton, paddy, *ragi*, groundnut, etc. distributed by the department during the year amounted to 120 tons. The number of sugarcane setts distributed in the year was 222,058 as compared to 914,000 setts during the previous year.

In BARODA in the scheme for rapid spread of 1027 ALF variety of cotton sanctioned by the Indian Central Cotton Committee 21,830 lb. of seed raised from pedigree seed was secured under the supervision of the department during the year and of this 21,675 lb. was issued to 'A' class growers for sowing on an area of 2,500 *bighas*. From the controlled area of 2,506 acres of 'A' class growers and 3,544 acres of 'B' class growers, 1,255,727 lb. of 1027 ALF were produced, out of which 447,680 lb. was distributed to 'B' class growers for sowing on an area of 13,194 *bighas*. The approximate area under improved seed during 1937-38 was about 75,000 acres. In the past, the Baroda seed organization had no farm-grown seed for supply to 'A' class growers, but last year the Baroda Government opened a seed farm of about 70 acres near Vesma, a village about eight miles from Navsari, to serve as a nucleus for supplying seed to 'A' class growers. To secure better prices for 1027 ALF cotton, a marketing office was opened at Surat in February 1938. Certificates of purity for 559 cotton bales, ginned under the supervision of the department, were issued. Most of this cotton was sold at a premium ranging from Rs. 3 to Rs. 11 per *khandy*. Another scheme for the extension of BD 8 cotton in the Baroda district was sanctioned by the Indian Central Cotton Committee and is expected to come into operation shortly. Similar schemes for supply of improved wheat seeds of Pusa 52 in Mehsana and Pusa 4 in Amreli were put into operation and stocks amounting to 132,440 lb. and 16,000 lb. of the respective types were stored at Jagudan and Amreli. In fruits, 5,000 fruit plants chiefly mango grafts, pine-apple suckers, guavas, figs and pomegranate were distributed and arrangements for supply of 31,000 Basarai banana were made.

In TRAVANCORE during the year under report 9,329 lb. of selected paddy seed was sold from the paddy farm at Nagarcoil while 3,744 lb. was distributed by the Economic Botanist. The distribution of setts of improved strains of sugarcane continued to receive special attention, and during the year 25,075 setts were supplied to ryots from the demonstration farm at Alwaye A great demand has sprung up within recent years for seed nuts and seedlings

of coconut and arrangements have been made to raise large coconut nurseries on the departmental farms at Alleppey and Oachira.

In COCHIN during the year under report 1,530 seedlings of different varieties of coconut were sold to 153 persons. In paddy, 1,050 *paras* of seed were issued to 210 persons as against 1,045 *paras* issued to 207 persons in the previous year. Eight paras of improved type of paddy known as Cochin I was distributed for trial to eight ryots of the Chittur taluka through the local inspector, and to some ryots of other talukas. There have been reports of increase in yield in some places even up to 50 per cent as compared to local types.

6. Implements

A steady progress was maintained during the year in the introduction of improved implements. In Appendix V will be found a statement of the agricultural implements sold through departmental agencies. As stated in the last report these figures do not give a correct estimate of the total number of implements sold as a large number of private agencies and village blacksmiths have sprung up over vast areas which also deal in implements. Departmental sales therefore represent a part of the material purchased by cultivators during the year.

In MADRAS the total number of iron ploughs of all descriptions sold during the year throughout the province reached a record figure of 5,257 as against 3,000 sold during the previous year. In the Vizagapatam district the number of implement demonstrations rose from 1,705 during 1936-37 to 2,998 during the year under report. The number of demonstrations with different implements throughout the presidency during the year totalled 19,056 as compared to 8,973 during the last year. *Takkavi* loans to the extent of Rs. 22,373 were granted to ryots for the purchase of agricultural implements as compared to Rs. 16,660 granted during the previous year. Loans, for implements costing Rs. 25 and less, amounting to Rs. 17,318 were sanctioned by the department and the Revenue Department sanctioned loans to the extent of Rs. 5,055.

In BOMBAY six improved seed drills were sent to Khandesh and Southern divisions for trial and demonstration and about 114 acres were sown with them. Three such improved drills were also sold outside the Bombay Province. Further improvements were made in the winnowing fan and a considerable demand for such fans came from Khandesh where arrangements for making them locally are being made. In the plant-puller propaganda scheme at Broach and Surat, rise in prices of plant-pullers and the fall in prices of cotton affected the sale of plant-pullers. Seventy-six iron handle and 381 wooden handle plant-pullers were sold during the year.

In BENGAL the demand for improved ploughs designed in previous years showed a gradual increase. Several improved *gur* furnaces were designed and tested. A double-pan type was found to be the most successful although it is slightly on the larger size for individual cultivators.

In the UNITED PROVINCES the total number of different types of implements and spare parts sold during the year was about 50,000 showing an increase of 12,500 over the last year. These chiefly consisted of Meston ploughs, shares for ploughs, chaff cutters, harrows and hoes, the largest number being sold in the Rohilkhand and Kumaun circles followed by the Sarda circle. The chaff cutters were mostly sold in the Western circle.

In the PUNJAB it is difficult to estimate the correct number of improved implements in use without a regular survey as a large number of common and popular implements are now made in the villages. Roughly as far as it could be ascertained the total number of implements sold during the year under different heads was as follows :

(*a*) Imported	6,370
(*b*) Made in India	49,585
(*c*) Made by the Agricultural Department	1,021

Of these about 6,700 were ploughs and 22,154 were chaff cutters. District ploughing competitions which are held on the occasion of large cattle fairs create a great stimulus for the use of improved implements. During the year under report a divisional ploughing competition was held at Jullundur.

In BIHAR 1,500 complete instruments and 631 parts were sold during the year. The sale of parts indicate the continued use of implements already sold during previous years.

In the CENTRAL PROVINCES unsatisfactory economic conditions affected the sale of implements. The implement chiefly in demand was the iron plough of which 1,279 were sold during the year as against 2,753 during the previous year. There was also a reduction in the sale of spare parts from 23,019 during the previous year to 17,090 during the year under report. The largest number of 12,921 of spare parts was sold in the Western circle. The total number of cane mills sold during the year was 193 as compared to 223 during the previous year, the largest number of 119 being sold in the Southern circle. The sale of other miscellaneous implements remained approximately the same, of which the largest number was sold in the Northern circle.

In SIND a special grant of Rs. 9,090 received from the Government of India for rural reconstruction was utilized for maintaining seed and implement depots at 18 important centres. The total number of implements sold during the year from these depots amounted to 855 and the number lent was 1,299.

In HYDERABAD the progress in the sale of iron ploughs was maintained during the year. Cultivating plants, Persian wheel, chaff cutter, sugarcane crusher and *gur* boiling setts continued to be sold. The departmental sale of implements amounted to 1921 during the year under report of which the largest number of 1,705 was that of the spare parts.

In MYSORE the total number of implements sold during the year was 5,205. Of these 713 were ploughs, 4,356 shares and spares, 126 cultivators and 10 sugarcane mills. Practically half the number of shares and spares was sold in the Mandya area.

In BARODA the total number of implements sold during the year was 1,033 of which the largest number was that of the Baroda hoe. In order to facilitate despatch of implement by minimizing the cost of transport to the farmers, arrangements were made to stock the material at various centres. About 500 to 600 plant-pullers were in use in 11 villages of the rural reconstruction centre at Kosamba. During the year under report about the same number was sold in 22 additional villages.

In TRAVANCORE several ploughing demonstrations were held with the improved types of ploughs recommended by the department. The 'Pallikkal' plough, which is an imitation of the improved type, is rapidly gaining favour

with ryots. Demonstrations of pumping setts, garden tools and sugarcane mills were given on an extended scale.

7. Fertilizers

Appendix VI gives the sale of fertilizers through departmental agency. An increase in the manufacture of compost and the extended use of green manures was evident. The imports of chemical fertilizers amounted to 78,425 tons in 1937-38 as compared to 83,653 tons in 1936-37. This included 53,216 tons of sulphate of ammonia, 2,928 tons of muriate of potash, 7,405 tons of superphosphate and 2,167 tons of ammonium phosphate. The production of ammonium sulphate in India during the year amounted to 17,977 tons as compared to 16,041 tons during the previous year and the approximate consumption of ammonium sulphate to 69,274 tons as compared to 74,653 tons during 1936-37. A brief account of the use and sale of various fertilizers in different provinces is noted below.

In MADRAS the department continued its propaganda on better methods of preservation of cattle manure. The number of manure pits, dry earth sheds and loose boxes maintained in all the circles during the year was 73,942 as compared to 51,711 during the previous year. The total number of compost pits maintained during the year was 3,063 as against 1,792 in the previous year. The quantity of green manure seed distributed during the year was 408 tons excluding the quantity disposed of by private agencies. In regard to artificial fertilizers these are not stocked by the department but only a general advice in regard to their use is given.

In BOMBAY work of conserving village manure supply by improving manure pits and by making compost was steadily pushed on particularly in the Khandesh and the Karnatak divisions. A quantity of 9,729 lb. of the *sann* seed was distributed in the *kharif* season of 1937 for green manuring from the stock available with the village improvement committees. Besides, a quantity of 24,105 lb. was distributed by the taluka development associations and the district staff. Imperial Chemical Industries Ltd. sold through the taluka development association 1,212,683 lb. of ammonium sulphate in the North-central division as compared to 735,597 lb. during the previous year. Advantage was taken of the concession given by the Government for the use of denatured salt for manurial purposes and a sufficient quantity was used by mango growers in North Konkan. During the year under report a quantity of 2,453 maunds of salt was used as compared to 2,332 maunds during the last year.

In BENGAL cultivators have so far generally failed to take advantage of the farmyard manure prepared from waste materials. The method of preparation and application of farmyard manure from waste material using water hyacinth as one of the ingredients is intended to be demonstrated on the cultivator's fields wherever possible.

In the UNITED PROVINCES the policy of distributing concentrated fertilizers in the form of mixtures of oil cake and ammonium sulphate for manuring sugarcane in the tube-well areas was continued. Government sanctioned a permanent advance of Rs. 2,00,000 to finance the purchase operations. During the year under report 27,242 maunds of fertilizer mixture No. 1 of 12·5 per cent nitrogen (consisting of eight parts of groundnut cake and five parts of

ammonium sulphate) and 3,500 maunds of mixture No. II of 7·5 per cent nitrogen (consisting of five parts of mustard cake and one part of ammonium sulphate) were purchased and issued to the Cane Development Officers, State Tube-well Agricultural Development Officer and Deputy Directors of Agriculture. The total quantity of fertilizers distributed during the year amounted to 63,716 maunds, which includes 4,012 maunds of seed for green manures. This does not include the fertilizers supplied in the cane development zones, under the Cane Commissioner but includes the fertilizer mixtures supplied in the tube-well areas. The largest quantity of fertilizer sold during the year was that of the ammonium sulphate which amounted to 12,977 maunds.

In the PUNJAB the advantages of the proper pitting of farmyard manure and the collection of waste organic matter to add to the manure pits are being realized more than ever. Not less than 50,000 pits were dug by zemindars for this purpose during the year.

In BIHAR the department gave over 6,500 demonstrations during the year to show to cultivators the advantages of the use of castor cake, fertilizers and green manures. About 376 maunds of green manure seed, 490 maunds of cake, 1,050 maunds of fertilizers and 56 maunds of gypsum were distributed free. In addition, over 1,000 maunds of green manure seed, 3,570 maunds of castor cake, nearly 1,000 maunds of fertilizers and 16,000 maunds of gypsum were sold by the department. These are merely the sales put through by the department and these figures do not by any means represent the total sales in the province. 2,130 demonstrations of compost making were arranged in the course of the year It has been estimated that the trash from an acre of cane will provide, if composted, sufficient manure for half an acre of cane crop. Such work is of the most fundamental importance and is being demonstrated.

In the CENTRAL PROVINCES in the Eastern circle 7,021 maunds of cake and artificial fertilizers were supplied during the year as against 6,198 maunds during the previous year. *Takkavi* loans amounting to Rs. 20,997 were given for the purchase of improved seeds, manures and implements as against Rs. 21,745 during the previous year.

In SIND as a result of successful demonstrations zemindars have realized the value of using sulphate of ammonia in preference to farmyard manure, by the *rabbing* method. The farmyard manure which is saved is now being put to better use for manuring the land instead of burning it for *rabbing*. In order that sulphate of ammonia may be made easily available arrangements have been made by Imperial Chemical Industries Ltd. to stock the material with local shopkeepers.

In HYDERABAD 237,707 lb. of artificial fertilizers and other manures were sold through departmental agency in the year under report for 1,555 acres. Out of this the amount of ammonium sulphate was 183,136 lb. This does not include the large quantity sold by the fertilizer firms direct to cultivators.

In MYSORE the total quantity of manure supplied during the year amounted to 261 tons.

In BARODA 23 tons and 19 maunds of manures consisting of bone, castor cake, ammonium sulphate and seed of sunn-hemp were distributed during the year in villages of the rural reconstruction centre at Kosamba. This does not

include the large quantities obtained by societies and individuals direct from dealers.

In TRAVANCORE the aggregate value of the fertilizers sold during the year by the leading firms, i.e. Messrs. Parry and Co., Stanes and Co., Shaw Wallace and Co. and the Imperial Chemical Industries Ltd. amounted to Rs. 1,07,715. Of the local firms, Mr. A. G. Chinnappan's Manure Works at Poovar in South Travancore is by far the most prominent. That firm sold during the year manures worth Rs. 3,311. The number of agency manure depots which conducted manure sales under the supervision of the department was seven. The total sales from all these depots amounted to Rs. 432 as against Rs. 894 during the previous year. As in the previous year the most active agency depot which conducted the largest sale was the Thattayil Cooperative Society and it sold manures to the value of Rs. 318.

8. Animal husbandry

Hitherto district work done by the departmental staff in the field of animal husbandry has found only a brief mention in this review. The actual and potential value of this contact with the villagers and the direct help that is rendered to them, however, deserve more detailed treatment and it is proposed in future to recount these activities in greater detail in these pages.

District work may be divided into two classes: (*a*) work done by the veterinary staff on tour in treating cases, visiting areas of outbreaks, performing inoculations against diseases, castrations, etc. and (*b*) propaganda by means of shows and fairs, lectures and distribution of pamphlets. Work done under category (*a*) is summarized in Appendix X.

The work dealing with contagious diseases has already been dealt with in detail in Chapter VIII. The best index of the volume of work done in regard to non-contagious diseases and public health is probably provided by the number of hospitals and the cases treated there as well as outside. The following is a comparative statement for the past three years:

——	1935-36	1936-37	1937-38
Number of hospitals and dispensaries . .	1,086	1,111	1,138
Number of cases treated at hospitals and dispensaries.	3,476,739	3,873,968	4,052,200
Number of cases treated on tour . . .	2,283,127	2,189,425	2,504,917

It will be seen that there is a steady expansion of these activities from year to year.

The main activity centres round the periodical shows and fairs and the distribution of prizes and *sanads*. The value of such shows in creating a healthy spirit of rivalry in exhibiting the range and value of livestock of the country and in evolving standards cannot be over emphasized. As will be noticed from the following a number of shows were held during the year at various localities in each province. The provincial officers visited these shows, delivered lectures and carried out other propaganda relating to common diseases and their control, hygiene, breeding, first aid and treatments.

Two principal shows were held in the province of BOMBAY during the year, one in Ahmedabad district and the other in Belgaum. The latter was a central

show and was composed mostly of animals chosen from preliminary rallies of about 865 animals held in different localities. The staff of the Veterinary Department opened stalls at these shows and departmental exhibits were demonstrated. Lectures were also delivered at these gatherings.

In BENGAL the demand on the services of the propaganda officer continued to be heavy and as many as 555 calls were made on him. Propaganda was carried on in regard to cattle welfare and the better treatment and care of livestock. Fairs and shows were also fully utilized by departmental officers for delivering propaganda lectures with the help of posters, models, etc.

In the UNITED PROVINCES, 36 important horse and cattle fairs were held during the year, which were attended and utilized for propaganda by the departmental officers. Arrangements were also made by the staff for the treatment of sick animals and for warding off epidemics at these fairs as far as possible.

In MADRAS, propaganda on the usual lines was carried out by the staff of the Veterinary Department in the course of their tours by distributing leaflets, holding magic lantern lectures, participating in health and baby week celebrations, etc. and demonstrating castration by the Burdizzo method. Cattle fairs and shows were also utilized for the purpose. The department has two motor vans which toured the districts and did intensive propaganda. People gathered in crowds round the van and appreciated the lectures, demonstrations, etc.

In BIHAR the veterinary staff delivered 7,808 propaganda lectures during the year on the different aspects of development and care of livestock. Many of these were delivered with the aid of magic lanterns.

Ten fairs were held in ASSAM during the year and the departmental staff took part in them and carried out propaganda.

In the CENTRAL PROVINCES AND BERAR, nine shows were held during the year and propaganda was carried on through them.

One hundred and seventy-one lectures were delivered by the veterinary staff in ORISSA on cattle welfare. In the previous year the number of such lectures was only 84. During the year a magic lantern was purchased and several new slides were added to the old collection.

In the PUNJAB, 294 cattle fairs were held during the year as against 254 in the previous year. All these were attended by the officers of the Veterinary Department and educative exhibits were set up in them. In addition to these regular fairs, 77 one-day shows were also organized in the villages, and several cash prizes were offered. The scheme for the establishment of the veterinary first-aid centres is being gradually pushed up. The number of visits paid to villages, cases treated and castrations performed showed a considerable increase over the previous year.

One of the outstanding items of propaganda during the year was the pavilion organized by the Punjab Veterinary Department in the all-India exhibition held at Lahore in the winter of 1937-38. As many as 300 self-explanatory charts, models, pictures and diagrams explaining the various animal husbandry problems were on view, and were deeply appreciated by all interested in the subject. A modern dairy experiment where pasteurised milk was sold attracted large crowds.

CHAPTER XII

AGRICULTURAL EDUCATION

1. Agricultural colleges

THERE was an increased demand for admission into the agricultural colleges, especially at Coimbatore, Poona and Cawnpore. The total number of students on the college rolls, who attended all courses exceeded the numbers of the previous year. In the Agricultural College, Lyallpur, the record figure of 569 was reached. Two new posts, i.e. of Associate Professor of Entomology and Assistant Professor of Horticulture were added to the staff of the college. At Poona a Forest Rangers' course was started in the college during the year and was well attended. The proposed agricultural institute at Dacca is expected to be in working order in 1940. The Government of Bengal has also sanctioned a dairy for the institute and its construction is in progress. Another agricultural institute was started at Khulna in 1937. At the Agricultural College, Cawnpore, 10 nominees of the Bihar Government were admitted for the first time on a reciprocal arrangement by which a similar number of candidates from the United Provinces will be given training in the Bihar Veterinary College. The proposal for starting an agricultural institute in Sind was further pursued and it is expected that a start will be made with a certificate course shortly. In Baroda another donation of Rs. 50,000 was received for an agricultural institute from Sheth Bhogilal Rajaram of Nardipur and the Government has decided to locate the new institute at Jagudan. A brief account of educational activities in the provinces and states is given below.

In MADRAS 184 applications were received for admission to the Agricultural College, Coimbatore, as against 156 in 1936-37 and 116 in 1935-36. Of this number 42 were selected and 13 were placed on the waiting list. Only 37 of the selected candidates joined the college and seven were admitted from the waiting list. Four failed students were re-admitted. The final strength of the first year class stood at 48. The number of candidates that passed the B.Sc. (Agri.) final examination in 1937 was 20.

In BOMBAY during the year under report the number of students who attended the Agricultural College, Poona, showed no diminution. The new B.Sc. (Agri.) course was in full working order. A Forest Rangers' class was started during the year at the college wherein some of the science courses were taught by the college staff and the forestry part was dealt with by the Forestry Instructor. The Agricultural Graduates' Employment Board maintained at the college to assist the agricultural graduates to obtain suitable employment after graduation had only 28 members this year as against 94 during the last year as a large number of old members discontinued membership. Four new members were added. Fifteen enquiries were received from employing agencies and were circulated among members. Nineteen students and some members of the college staff took part in the rural reconstruction work in the Satara district. Some students also worked as foremen instructors in the *bunding* classes conducted by the department.

In BENGAL the scheme for the establishment of an agricultural institute at Dacca was speeded up. A sum of Rs. 1,50,000 was provided in the budget for 1938-39 for the construction of buildings and other expenses. It is expected that the institute will open in 1940. Government sanctioned the establishment of a dairy at Dacca to be attached to the institute and the work of its construction is in progress. The animal husbandry course at the Dacca Agricultural Institute with 10 students will be started as soon as its construction is completed. In the Basanta Kumar Agricultural Institute at Rajshahi which was started in 1936 through the munificence of the late Kumar Basanta Kumar Roy of Dighapatia, the courses of study include theoretical and practical training in horticulture and fruit canning, dairying, animal husbandry, poultry keeping and cigar making. Provision has been made for training two classes of students, casual and regular. The former are generally students who, along with their studies in the college classes at Rajshahi or elsewhere, join the institute for such vocational training as may be available, while the latter are whole-time students at the institute. There were 22 students on the rolls as against 17 during the previous year and there were three regular students and one casual in the fourth year class. All the students, both regular and casual, passed the final examination of the institute.

The Daulatpur Agricultural Institute, Khulna, was started in 1937 with a view to imparting higher education in special branches of agriculture, both theoretical and practical, as well as to enable qualified young men to undertake agriculture of their own either individually or cooperatively, with a fair chance of making a living. The course of study covers two complete years.

In the UNITED PROVINCES in the Agricultural College, Cawnpore, the number of applications for admission during the year increased to 167 as compared with 131 and 129 in the two previous years respectively. Fifty-eight candidates were accepted for admission. Of the total number of applicants only 10 declared their purpose of study to be government service alone ; 53 indicated their intention to take up private farming. One hundred and three proposed to undertake farming if they failed to obtain Government appointments. This is in distinct contrast to the state of affairs a few years ago when practically all applicants seeking admission to the college had government service as their aim. The fact that so many of the applicants for training in scientific agriculture have an intention of farming their own lands augurs well for the future of the country as well as of the college. The number of students on the college roll in Januaty 1938 was 153 of whom 39 were in the first year, 37 in the second year, 42 in the third year and 35 in the fourth year class. Of these 136 passed in the varying classes of which 30 belonged to the final year class. To meet the increasing demand for training of students in agriculture it has been decided to increase the capacity of the college. Proposals made to the Government for providing facilities for this purpose were sanctioned and it was decided to have about 80 students in the first year in place of 40 and ultimately to double the capacity of the college and to have altogether about 300 students. Of a total of 143 students who have passed out of the college in the four years 1934-37, only five are known to be unemployed. The expansion of the Agricultural Department and the need for agriculturally trained men in the Rural Development Department as well as the increasing tendency on the part of students to take up farming in their own lands should effectively absorb all the graduates

of the college for some time to come. Among the new entrants for 1938 are included 10 nominees of the Bihar Government deputed for training on a reciprocal arrangement by which the United Provinces candidates are given training in veterinary science in Bihar. A post of Lecturer in Estate Management has been sanctioned on the recommendations of the Sapru Unemployment Committee.

The Government continued to contribute Rs. 20,000 per annum to the Allahabad Agricultural Institute towards the expenditure on the intermediate classes and the B.Sc. degree course in agriculture of the Allahabad University. The Allahabad Agricultural Institute is one of the two centres in India approved for giving training for the Indian Dairy Diploma course. Three stipendiary students under the unemployment relief scheme were undergoing the course during the year. The total number of students on the roll of the institute was 164. Out of 32 students in the Intermediate class and 22 in the B.Sc. (Agri.) course 27 and 14 passed in the final examination respectively.

In the PUNJAB the total number of students on the rolls of the Agricultural College, Lyallpur, who attended all courses was 569 as against 565 last year. This beats all previous records. Of the 569 students, 255 attended the degree course and the remainder the various other short courses. There were 290 applications for admission to the first year of the degree course as compared with 412 during the last year and 94 students were admitted as against 82 during the last year. The standard of qualification of the students admitted this year was much higher than that during the previous three years. Five M.Sc. students were admitted to the M.Sc. (Agri.) class this year. Fifty-seven candidates appeared in the B.Sc. (Agri.), Part I and 34 in the B.Sc. (Agri.), Part II. Out of these 45 and 20 respectively passed in these two examinations.

In the CENTRAL PROVINCES there has been a considerable increase in the number of students seeking admission to the College of Agriculture, Nagpur, in recent years. Formerly, admission was limited only to the number which could be accommodated in the hostel but a departure from the standing rule requiring residence in the hostel was made in the year under report. Thirty-eight students were permitted to reside with their parents or accredited guardians. Applications for admission numbered 127 as compared to 157 during the last year. Of these, 58 were finally admitted. The same number was admitted last year. Twenty-nine students appeared for the B. Sc. (Agri.) examination out of whom 16 were successful, one in the first division. Thirty students were members of the University Training Corps. The College Platoon secured the Guard Mounting Cup for the second time and one University Training Corps member was elevated to the rank of Under-Officer.

In SIND the Government granted scholarships to the sons of the agriculturists for their education at the Poona Agricultural College. Four such scholarships, each of Rs. 30 per mensem, are granted every year. The total number of students receiving training at the Poona Agricultural College during the year was about 50. The Government of Sind considered a scheme for starting an agricultural institute in Sind and it is expected that the certificate course will start from 1939 and the degree course a year later when the buildings are constructed. The funds for this institute have been made available from His Majesty King George Memorial Fund.

In HYDERABAD two scholars returned this year after completing their courses in the Nagpur Agricultural College. Three more scholarships were granted during the year, but one was not availed of. Altogether eight scholars were studying during the year in Nagpur, Poona and Cawnpore Agricultural Colleges.

In BARODA agricultural educational work is carried on chiefly by the Sheth Dosabhai Maganlal Agricultural Institute, started during the last year. One hundred and seventeen applications were received during the year, of which 25 were selected for stipends. Three more joined the course at their own expense. The Government during the year received another offer of Rs. 50,000, from Sheth Bhogilal Rajaram of Nardipur (Kalol taluka), in the Mehsana district, for an agricultural institute. It has been decided to locate it at Jagudan in association with the department's farm there. Land has already been acquired and the Public Works Department plans and estimates for the institute building costing about Rs. 40,000 have been recently sanctioned by the Government. Necessary proposals for staff, etc. will be submitted to the government in due course.

2. Post-graduate training in agriculture

THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI. For the post-graduate course commencing in November 1937, 52 candidates applied for admission, of whom 33 were recommended by the provincial authorities. Sixteen applicants were selected for admission—four in botany, three in agricultural chemistry, two in entomology, two in mycology and five in general agriculture. Of these, one in entomology left soon after admission and one in agricultural chemistry left after 10 months, on getting appointments.

During the year under report ten post-graduate students successfully completed the two-year course and qualified for the Institute Diploma ; four in botany, three in agricultural chemistry, one in entomology, one in mycology and one in sugarcane breeding. Three students completed the one-year course in farm organization and general farm engineering.

In addition, one employee of the Assam Government, one of the Indore State and two private candidates were admitted for short course training in particular subjects.

The special course in flue curing of tobacco was attended by seven candidates : two from the United Provinces Agricultural Department, one from the Madras Agricultural Department, one from the Sind Agricultural Department, one from the Baroda State and two private candidates from the United Provinces.

Eight honorary research workers were afforded facilities for carrying out definite pieces of work—four in chemistry, two in entomology and two in mycology.

The total number of students trained in the old sugar courses of the HARCOURT BUTLER TECHNOLOGICAL INSTITUTE, CAWNPORE, during the period 1931 to 1937 was 207, out of whom 107 passed in the sugar diploma course, 33 in the sugar analyst course, 66 in sugar boiler course and one in *khandsari* foreman course. Over 85 per cent of the students secured employment in sugar factories.

3. Agricultural schools

In MADRAS the school at Usilampatti continued to function during the year. It was however decided by the Government to close it from the end of this school year and to amalgamate it with the local high school. The three farm labourers' schools at Anakapalle, Palur and Coimbatore continued to function. At Anakapalle there were 24 boys on the rolls during the year as against 25 last year. At Palur there were 35 on the rolls as against 31 in the previous year. At Coimbatore there was only one boy in the school with wages and 19 boys without wages as against three and 24 respectively in the previous year. Steps have since been taken to admit more boys with wages in this school.

In BOMBAY the Marathi and Kanarese agricultural schools at Dhulia and Devihosur continued to work under the control of the Department of Agriculture. Another Marathi agricultural school at Rajapur was managed by a private agency. All the schools continued to do good work. The Dhulia school completed its fifteenth year and had 30 students on the rolls during the year, 14 being in the first and 16 in the second year. The local agricultural school committee continued to manage the finances of the school efficiently. The school at Devihosur completed its twenty-fourth year and had 32 students, 13 being in the first year and 19 in the second year. The Rajapur school had 18 students in the first year and eight in the second year.

In BENGAL 25 students and three teachers were admitted to the Dacca Secondary Agricultural School during the year. The maximum number of students on the rolls was 51, including six teachers under training. The Government awarded 17 stipends and the District Board 20 stipends for different communities. Twenty students sat for the final examination, including one *ex*-student, of whom 18 passed.

In the UNITED PROVINCES the two schools at Bulandshahr and Gorakhpur provide a two-year course which is essentially vocational and practical and which includes only such elementary scientific knowledge as is necessary to the practical farmer. The number of applications continues to increase, indicating thereby that the schools were meeting a real need and that their number and size were inadequate for the growing requirements of the province. Provision has accordingly been made for a considerable increase in the number of admissions annually and for such additions to the school farms as are requisite for the practical training of the increased number of students. In addition to the two-year course the schools also provide a six months' course for fieldmen, a course for farm mechanics and from time to time according to the requirements of the Education Department for the agricultural training of school teachers. The Bulandshahr school which is in its seventeenth year of working continued to show steady progress. Out of 100 applications for admission during the year only 30 were selected. The total number of students on the roll was 117 against 80 during the previous year. Of these 72 were in the diploma course, 23 in fieldman class and 12 in farm mechanic's class. In addition 10 teachers were receiving agricultural training. At the final diploma examination held in December 1937, 30 candidates appeared and all were declared successful. In addition to cultivation of their plots on the school farm, the students are allotted vegetable garden plots for the practical growing of vegetables, the

produce of which is consumed by the students themselves. The number of students in the Gorakhpur school during the year was 102 as compared to 88 in the previous year. Of these 42 and 36 were in the first and second year respectively of the diploma course and 24 in the fieldman class.

In the PUNJAB the strength of the vernacular class was raised from 50 to 100 students and the duration of the course extended to one year. The six months' vernacular course at Gurdaspur was abolished. During the year under report only three students joined the Leaving Certificate class. No separate class was therefore started and a time-table was arranged for these students so as to cover the syllabus for the Leaving Certificate class. Only one student appeared in this class and was declared successful. Since this class has outlived its usefulness the question of its abolition is under consideration.

In the CENTRAL PROVINCES the number of boys on the rolls of the Powarkheda Agricultural Middle School, including new entrants at the beginning of the session, was 95, of whom 20 left during the course of the year. All of them were drawn from cultivating classes, being sons of either *malguzars* or cultivators. The High School Entrance examination having been abolished in the year under review, the pupils of the VIII class were examined in the school itself. Sixteen boys appeared, of whom 13 passed. An area of 6·5 acres cultivated by the boys produced a total income of Rs. 307. The number of boys at the Betul Agricultural Middle School at the beginning of the session was 63 including new entrants of whom five left subsequently. All the boys came from the Betul district and, with three exceptions, belonged to cultivating classes. Sixteen boys appeared for the VIII class examination, of whom 14 passed. An area of 1·80 acres cultivated by the boys fetched an income of Rs. 38-8. The inclusion of instruction in carpentry and blacksmithy in the curriculum has been decided upon. The Peace Memorial Agricultural School at Buldana has been providing a two-year course in agriculture and allied subjects since 1929. During the year 58 boys applied for admission and 19 were admitted, of whom four subsequently left. Nine boys were promoted and eight out of nine second-year boys passed the final examination.

In MYSORE the total strength of the Hebbal Agricultural School was 50 as against 70 in the preceding year. Of these 20 were in the final year class, 20 in the second year and only ten in the first year. Seven old students also joined the final year class at the end of the year. Twenty-eight scholarships were granted during the year. Out of 24 students who appeared for the diploma examination 21 were declared successful. Want of opportunities for employment after passing has seriously affected the popularity of the Hebbal Agricultural School. The number of applications for admission was 44 in 1935-36, 38 in 1936-37 and only 26 in 1937-38.

The vernacular agricultural school at Ramakrishnapur, Anekal taluka, developed considerably during the year. The number of students on the rolls increased to 31. Out of 30 students who sat for the examination 28 were declared successful.

In the Sri Krishnarajendra Vyavasaya Dharma Patasala at Chikkanahalli, Sira taluka, 18 students were admitted to the school in the year, all of whom were given a scholarship of Rs. 10 per month.

In TRAVANCORE, the department maintains two agricultural schools, one at Kottarakara and the other at Koni. The course of studies extends over a period

of two years and is essentially of a practical nature, and every student is required to grow his own crops and thoroughly familiarize himself with all field operations. Periodical excursions are also arranged to the experimental stations both in Travancore and Cochin states to enable the students to acquaint themselves with new agricultural developments. Almost every student receives from the Government a stipend of Rs. 40 per mensem, and facilities are provided to supplement this income by working as part-time labourers on the school farms.

In the Kottarakara school there were 17 pupils on the rolls at the beginning of the year. All of them passed the final examination. A new batch of 22 students was admitted during the year. At the Koni school, of the 31 candidates on the rolls 29 passed the final examination.

In COCHIN the agricultural school attached to the central farm was not run during the year on account of lack of sufficient number of students forthcoming. The three horticultural schools at the central farm, Trichur and Hill Palace continued to make satisfactory progress during the year. The number of students on the rolls was 17, 14, and 15 respectively. All of these passed the final examination. The competition in school gardening and the system of giving prizes to the best gardens were continued. About 20 schools entered for the competition.

4. Rural 'bias' schools

In BOMBAY the number of agricultural bias classes remained unchanged at 93 during the year under report. The committee appointed by the Government to report on the vocational training in primary and secondary schools has suggested a compulsory primary course of agriculture for the first seven standards for all rural schools, and if this course is to be adopted and developed on proper lines the Department of Education should have the services of a first-class agricultural officer trained in agricultural education preferably in U. S. A. where the agricultural courses in primary schools and high schools are well developed. Such an officer assisted by a number of agricultural graduates in different divisions will develop properly the whole system of agricultural education in rural schools.

In BENGAL the scheme for opening agricultural classes in the English middle and English high schools started in 1928 continued to work satisfactorily. Three teachers from these schools are annually trained in agriculture in the Dacca secondary school to fill up the vacancies. A necessity for training a larger number of teachers has been felt. Fifty-eight schools participated in the scheme including Ushagram Boys' High School and Chapra King Edward English Middle School. The former has been raised to a high school and maintained an agricultural teacher while the latter has followed the scheme with considerable modification, having two years vocational training instead of continuation classes. Ramgarh English Middle School has been excluded from this scheme and transferred to the Education Department. Out of the 58 schools, five schools were without any agricultural teacher during the whole session and five schools had agricultural teachers only for a short time owing to scarcity of trained teachers. In 54 schools, 4,055 boys received agricultural training with an area of 185 acres of land under cultivation. In most of the schools both *rabi* and *kharif* crops were successfully grown. The progress in

20 schools was highly satisfactory both theoretically and practically. Many schools under the scheme have been gaining popularity, the number of students on the roll being on the increase. In some localities the cultivation of English vegetables and other departmental crops have received a good impetus due to the efforts of the local school authorities who have taken a keen interest in the introduction of departmental crops among cultivators. On the whole, the scheme has been working satisfactorily, the working of the English middle schools being generally better than that of the English high schools, so far as agricultural classes are concerned.

The primary schools at Kishoreganj and Burirhat farms, where preliminary practical and theoretical training in agriculture as well as in general education to the sons of the local cultivators is given, were continued. In both schools classes III and IV have been added and the schools are raised to the standard of upper primary schools. There were two teachers available during the year and the number of boys is increasing.

Two literate Chakma youths completed their course of one year's practical training at the Rangamati farm. Some hillside and valley lands were allotted to them and they carried on farming under the instructions of the District Agricultural Officer.

In the UNITED PROVINCES the Muslim University, Aligarh, includes agriculture in its high school course and has been given on lease the experimental farm of the Agriculture Department for training boys in practical agriculture, subject to the right of the Deputy Director of Agriculture to conduct experiments thereon. The Jat Intermediate College, Lakhauti, which teaches agriculture up to the intermediate standard supplies a number of applicants annually for admission to the Agricultural College, Cawnpore, for the B.Sc. degree course. The Ingraham Institute, Ghaziabad, Mission School, Roorkee, and K. E. M. A. V. High School, Atrauli, continued to devote considerable attention to vocational training in agriculture. The members of the district agricultural staff continued to assist the institutes.

In BIHAR departmental officers, particularly in the Bhagalpur Range, took an active part in carrying out propaganda in rural areas in collaboration with the sub-inspectors of the Education Department. Lectures were given in a large number of schools and demonstrations were carried out in school gardens. The overseers at Kishanganj and Pakur were particularly active in this respect. The teachers under training at the Government training schools at Ghurmara were also given occasional lectures on agriculture.

In the Central Provinces a special course in agriculture was provided at the middle schools at Itki and Chandur Railway which have small plots for practical work. Teachers trained in agriculture were provided for by the Education Department and it is hoped that such training will stimulate interest in manual work. Similar training was given in Amarwara, Lakhnadon, Chhapara and Chaurai middle schools in the Southern circle. In the Northern circle training in practical agriculture was given to classes V and VI of the Middle School, Piparia, on Silari farm and to classes VII and VIII of the Fisher Middle School, Khandwa, on the plot attached to that school.

In TRAVANCORE the only agricultural bias schools worthy of mention are the summer schools conducted by the rural demonstration centre at Martandam and the rural school at Ollannoor. The aim of these institutions is to

infuse into the villagers a desire for better village life, and the students are mostly adult men and women teachers, farmers and local leaders. The training extends over a period of two to three months and includes short courses on the scientific methods of cultivation, the preservation of manure, poultry-raising, bee-keeping and other cottage industries. Both these schools made good progress during the year and have proved a great success. The officers of the Agricultural Department visited these schools from time to time and rendered every possible help.

5. Short courses

These pertain to all types of subjects of agricultural science and extend from a few days to a few months. These are becoming very popular.

In MADRAS at the Agricultural College, Coimbatore, short courses on farm management, horticulture, insect pests and diseases, dairying and malt making, care of animals, bee-keeping, jaggery making, farm implements, manuring and crop improvement were conducted during the year. Fourteen, the largest number of students, were admitted to farm management course.

The short courses in agriculture that were started last year at the agricultural research stations at Nandyal and Taliparamba were continued this year also. The course lasted for nine months. At Nandyal 10 applications were received; six of them were selected but only three completed the course. At Taliparamba five students were admitted but only three completed the course.

A short course in fruit culture and nursery practices was instituted at the Fruit Research Station, Kodur, for a period of six months. Seventeen applications were received of whom seven underwent the course for six months, three for four months, one for three months and two for two months. In addition, two agricultural subordinates and one demonstration *maistry* underwent training at the station.

A short course of practical training in agriculture was given, as in the previous year, to educated unemployed young men for a period of four months at several agricultural stations in the presidency. During the period of training, the students were given a stipend of Rs. 15 each per mensem. Of the 60 candidates that were selected for admission, 34 completed the course and the remaining 26 did not either join the course or left it after joining.

In BOMBAY special courses were, as usual, held at the Agricultural College, Poona. The number of students attending being 28 as compared with 24 in the previous year, showing thereby the increased demand for specialized training. Special short instructional courses were arranged for the Assistant and Deputy Collectors, army rural reconstruction classes, Reservists of Royal Bombay Sappers and Miners, Cooperative Department training classes and honorary agricultural agents of Poona district.

A training class for oil-engine mechanics was conducted by the Agricultural Engineer to the Government. Eighteen students were admitted and given training in the management and care of oil engines and pumps. Sixteen students from various districts were trained in poultry-farming at the Government Central Poultry Farm, Kirkee. Fifteen students attended the practical course in animal husbandry and dairying at the Agricultural College Dairy, Kirkee. Thirty students attended the practical training class in horticulture at the Ganeshkhind Fruit Experimental Station, Kirkee, and, in addition, district

classes in horticulture were arranged by the Divisional Deputy Directors with the help of the Horticulturist where necessary.

In BENGAL several young men of the *Bhadralog* class are given training every year in mechanical work in the workshops, maintenance of agricultural machinery, manufacture of *gur* and sugar in departmental type of factories, irrigation, etc. and then found employment in Government service as demonstrators or with the public who are in need of skilled men to work their plant. Many apprentices were given a permanent or temporary employment during the year.

In the UNITED PROVINCES as a result of the recommendations of the Sapru Unemployment Committee, a short course of six months was introduced at the Agricultural College, Cawnpore, to provide training for educated unemployed youths in the handling of milk and milk products. Each student was given a stipend of Rs. 25 per mensem. Of the ten students who joined the first batch in February 1937, six have completed their course. The second batch of 13 began their training in September 1937. A short course on fruit preservation and canning was arranged in the college by the Fruit Expert and was attended by 18 students, most of whom were graduates or undergraduates. Training in sericulture which forms a compulsory subject for students of the college was made available free of cost for the public. During the year about 200 persons were supplied with *eri* and mulberry silkworm eggs. In pursuance of the recommendations of the Sapru Unemployment Committee, 20 graduates and diplomates in agriculture were selected for practical training in agriculture. Half of these were trained at the Fyzabad Government farm where five students were given individual holdings of ten acres each and the remaining a single holding of 50 acres to work on a cooperative basis. The training was continued throughout the year under report The Allahabad Agricultural Institute has agreed to cooperate with the Government in a three-month class for the training ofrural development organizers.

In the PUNJAB a large number of short courses such as vernacular course, teachers course, training class, *lohar* class, fruit culture and fruit preservation courses, estate managers' course, jail warders' course, course for training of *mukaddams* in diseases and pests, etc. were given during the year in the Agricultural College, Lyallpur.

In BIHAR five stipendiaries who were recruited in the previous year and posted to Pusa for practical training continued their work in general agriculture and livestock management. In the course of the year three of them were appointed as Assistant Directors of Agriculture and the other two as Agricultural Inspectors. At the Patna farm two men received free practical training in agriculture while 33 students were trained in the preservation and canning of fruit. One post-graduate student continued his training in the chemical section of the department.

In the CENTRAL PROVINCES in Chhattisgarh agricultural education was imparted at four selected centres, of which Mahuadih was the most important in that the practical training has continued on systematic lines. At other centres the teaching was mainly theoretical for want of adequate area for growing crops. The training class in the workshop was attended by seven candidates of whom three were found proficient.

In SIND a scheme for giving practical training to sons of zemindars at the Government auxiliary farms has not so far proved very successful and only few students availed themselves of the facility offered. During the year under report two short courses extending to a week each were held at the Agricultural Research Station, Sakrand, for the purpose of giving practical training in crop estimates to junior civilians, *mukhtiarkars* and assistant engineers. The *kharif* class was attended by seven officers of the Revenue Department and five officers of the Public Works Department. The second course was attended by six officers of the Revenue Department and four officers of the Public Works Department. During the year under report a course of training in 'Danabandi' was sanctioned by the Government for the village establishment of the Revenue Department. The object of training these subordinates is to enable them to estimate yield forecasts of the standing crops with some measure of accuracy.

In HYDERABAD the Patancheru centre is serving as an institution for training rural development workers for the Dominions. During the year under report training in all aspects was given to 35 headmasters of village primary schools. In all 180 workers have so far been trained, including the propagandists of the cooperative unions and teachers of village schools, some of whom are doing good work in their villages. Training in making fruit jellies and pickling was given to 15 persons belonging to the Patancheru village. The two night schools started by the centre continued to function and 42 villagers were taught reading and writing and simple arithmetic, besides being given general information on rural development subjects including agriculture.

There is a considerable demand for trained engine drivers in the state, since the use of power pumping plants has become more and more common. Two classes were held in the year, each of which was of three months duration. Twenty-five students attended the class during the year under report, of which 17 passed out successfully. This class has turned out 163 engine and pump drivers since its inception.

There is also a two years' course of practical training in all operations of growing of fruits, vegetables and flowers. There were nine students on the roll this year, of which six passed out successfully. This class has supplied 26 trained gardeners to various garden owners since its start.

There is a farmers' class, the object of which is to train the sons of cultivators in modern methods of agriculture. Students are given practical training in all operations connected with farming on improved lines. The duration of the course is two years. Arrangements for this training have been made at the Himayatsagar, Parbhani and Rudrur farms. The total number of boys on the roll at all the three farms was 50 of whom 21 passed during the year under report.

In MYSORE short courses in practical bee-keeing were given in Bangalore, Mysore, Hassan and Kadur districts during the year. The classes were attended not only by local ryots and others interested in bee-keeping but also by a few agricultural officers from outside the state.

In BARODA the educational efforts of the rural reconstruction centre at Kosamba have been well taken advantage of in the various courses it offered for training in cottage industries, teachers' place in rural uplift, poultry work demonstrations and shows. In the horticultural section a *mali* training class

was held for the whole year and periodical short courses were given on fruit preservation. About eight students attended the former and four the latter.

A three months' course in better farming was also offered from 15 July to 15 October and was attended by 30 entrants. Similar courses were also given at Amreli and Jagudan farms with 17 and 23 students respectively. A special course was also started in cigarette tobacco curing and was taken advantage of by nine students. The Agricultural Engineer held a twelve-week course in oil engines, pumps and tractors.

In COCHIN a short course of training in agricultural and horticultural methods is given at the Central farm according to the prospectus of the agricultural schools prescribed by the Government.

CHAPTER XIII

THE COOPERATIVE MOVEMENT AS AFFECTING AGRICULTURE*

UNFAVOURABLE agricultural conditions due to inadequate and untimely rains in most provinces and the continuance of the low level of prices of agricultural produce and commercial commodities led to a further deterioration of the movement in most of the provinces in British India and the Indian states. Only in Bengal the outturn of crops was better than in the previous year owing to better rainfall, and in Madras there was a slight rise in the price of paddy. The heavy overdues in Bengal, coupled with the inability of the central banks to give adequate relief in the form of a substantial deduction in interest and the absence of effective methods of recovery of overdues, did not, however, make it possible to effect any improvement, while in Madras the slight rise in the price of paddy was more than neutralized by a substantial fall in the price of commercial crops like areca, cotton, groundnuts, coffee, etc. In the Punjab the difficulties were further aggravated by an epidemic of plant diseases, while in the North-West Frontier Province the disturbed conditions of the area containing Dera Ismail Khan and Bannu made it difficult to achieve any appreciable progress. The decreased repaying capacity of the agriculturists was mainly responsible for the low percentage of recovery and the increase in the extent of overdues. It is believed, however, that the agriculturist members were in many cases inclined to evade payment on the plea that the economic depression was still continuing. The credit side of the movement maintained its position fairly well in Madras, the Punjab and the United Provinces, while deterioration was noticeable in most of the other provinces and states, particularly in Orissa, Bihar, the Central Provinces and Bengal.

It has been realized by most of the administrations that the existing demand is far greater than the annual repaying capacity in most cases and that the percentage of collection to demand, or to the amount of overdues, which must necessarily increase from year to year, has lost its real significance. The policy of examining the condition of individual members of societies with a view to ascertaining what can be expected to be realized in suitable annual instalments within a reasonable number of years has been adopted by most of the provinces in one form or another. In Bombay the examination has taken the form of classifying the debts as frozen, doubtful and bad. The policy of rectification, which Madras was wise enough to start several years ago in spite of the comparatively more satisfactory condition of its societies, was completed in more than 7,000 societies during the year. In the Central Provinces and Berar the reorganization of societies also made steady progress. The Bihar scheme of rehabilitation involves an enquiry into the assets, liabilities and repaying capacity of members and scaling down the dues of individual members to an amount which they can pay in annual instalments within their

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repaying capacity over a maximum period of 15 years. The Mudaliar Report for Orissa has also recommended a preliminary enquiry similar to that in the Bihar scheme. In Bengal the department initiated an enquiry for the determination of actual repaying capacity of individual members in village societies for the purpose of fixing annual instalments and for determining the amount of bad debts.

Everywhere the general policy of controlled credit and cautious expansion is being followed. It is being realized more and more that strict scrutiny of the needs of members and their eligibility to membership in the light of not only their character but also their repaying capacity should be insisted upon before a society is registered. The result of this cautious policy has been that fresh registration is not increasing with as much speed as before. As to the nature of the loan to be advanced, all the provinces and states have been advising that fresh finances should be restricted mainly to short-term loans and, in some cases, to intermediate-term loans, for productive purposes, and that credit societies should not undertake any long-term business. Most of the Registrars have issued executive instructions to banks and societies on this point. In Bombay the model by-laws have been revised so as to restrict the business of credit societies to short-term and intermediate-term loans for periods not exceeding five years. The Bihar scheme contemplates statutory rules of business on similar lines. Long-term business is being recognized more and more to be the function of another type of institution, namely the land mortgage bank. The indication is that there will be more and more clear cut separation between short-term and long-term business in the future development of cooperative banking.

The central cooperative banks throughout British India and the states continued to be adversely affected by the unsatisfactory condition of the credit societies. With the development of marketing societies, requiring advances for various periods, the necessity of a provincial cooperative bank to work as a balancing centre has been recognized in the United Provinces, and the Government have sanctioned the establishment of a provincial bank.

The necessity for land mortgage banks for taking over long-term business is being felt throughout India. The land mortgage banks maintained their progress in Madras and the Government of Madras increased the maximum of their guarantee in respect of debentures from Rs. 125 lakhs to Rs. 200 lakhs. The primary land mortgage banks in the Punjab, Bombay, Bengal, Assam and the Central Provinces continued to be financed by the provincial cooperative banks in the absence of any central land mortgage bank. The work of the land mortgage banks in the Punjab and Assam was not satisfactory. The question of re-organization of the land mortgage banks is engaging the attention of the Governments of these two provinces. The primary land mortgage banks in Bombay and Bengal made fairly good progress. In Bengal measures were adopted to coordinate the working of debt settlement boards and land mortgage banks by establishing special debt settlement boards for the purpose in places where land mortgage banks have been established. In Bihar, on due consideration of the report of the Special Officer, who had been deputed to study the land mortgage banks in other provinces, it has been decided to take up the question of opening land mortgage banks after the rehabilitation of the credit side of the movement. A central land mortgage bank is proposed

to be established in the Central Provinces and Berar when the business of the primary land mortgage banks exceeds Rs. 15 lakhs.

A contrast to the depressing character of the reports regarding the credit side of the movement is provided by the satisfactory expansion of non-credit activities, particularly in British India. The outstanding types of non-credit agricultural societies are production and sale societies, marketing societies and rural welfare societies. The loan and sale societies of Madras made a remarkable progress and the Government inaugurated a scheme for advancing loans for the construction of combined godowns, village halls and reading rooms, the Government paying 25 per cent of the estimated cost as a subsidy. The Salem district has been selected for the experiment, and it is proposed that the godowns at the district headquarters will serve as centres for sale and those at taluka headquarters for storage of produce. The cotton and ginning societies of Bombay, the milk unions of Madras and Calcutta, the societies for the consolidation of holdings, particularly in the Punjab and the United Provinces, extended their activities, and a scheme for the consolidation of holdings was introduced in Madras after the return of the Registrar from a study tour in the Punjab. Of the marketing societies, the cane-growers' cooperative societies in the United Provinces and in Bihar, particularly in the former, deserve special mention. The ghee societies in the United Provinces and the central paddy sale society of Bengal also achieved considerable success. The Egg Grading and Sale Association of the North-West Frontier Province continued to maintain its unique position in India. Development of rural reconstruction societies was most marked in Bengal.

Considerable attention was paid to cooperative training and education during the year. Schemes for training the departmental and the bank staff as well as *panches* and members of societies in British India were financed out of the Government of India grant, as in the previous year. The Punjab maintained its lead in the systematic training of cooperative workers, both stipendiary and honorary. Madras proposes to enlarge the Central Cooperative Institute into a college of cooperation for a better and higher standard of training and to have the college affiliated to the University of Madras, which will confer a degree in cooperation to the qualifying candidates. A training institute with an ex-Registrar as the officer-in-charge has been started in Bengal. In Bihar the training institute has been reorganized on a residential basis and the syllabus has been revised so as to give a comprehensive training, both theoretical and practical, not only in the usual subjects but also in rural economics, economic geography, social psychology, first-aid bandaging, public speaking, survey and settlement work, vegetable gardening, riding and cycling. An interesting feature of the Bihar scheme is the provision for inviting eminent cooperators from all parts of India as part-time honorary lecturers. Everywhere, it is being realized more and more that cooperation is a technical subject and that in the administration of cooperative institutions, good intentions are not enough but should be supplemented by a comprehensive theoretical and practical training in all subjects, allied to cooperation. It is obvious that the cost of maintaining a sufficiently large permanent staff capable of teaching all the subjects in an institute with a limited number of students will be prohibitive and that the only possible course is to maintain the minimum permanent staff and to arrange for securing the deputation, for short periods, of

experts in different subjects. There are obvious difficulties in the maintenance of such an institute by one province alone and the indication is that it may be to the best advantage of the movement throughout India to establish an all-India college of cooperation, where experienced officers and professors with special knowledge of subjects connected with cooperation may be deputed for short periods. There should be no difficulty in reserving a certain number of seats in the college for candidates from the different administrations contributing towards the cost of maintenance of the college. In view of the keen interest the Government of India are taking in promoting cooperative education, there should also be no difficulty in obtaining adequate financial support from the central Government for such a college. Apart from imparting training with the assistance of the best available brains in the country, a college of this kind would also be able to render invaluable assistance in guiding cooperative research and in evolving comparable methods of procedure in the solution of various problems like disposal of lands, rehabilitation enquiries, etc. which are engaging the attention of the different administrations.

Some detailed figures are given below regarding the movement in the different provinces and states.

MADRAS. The south-west monsoon was generally defective while the north-west monsoon was bordering on or about normal in some of the districts. The slight rise in the price of paddy was coupled with a fall in the price of commercial crops with the result that there was no marked improvement on the whole in the economic condition of the ryots.

The total number of all types of agricultural societies at the end of the year was 11,184 as against 11,110 at the end of the previous year. Out of the total number of societies, 101 were land mortgage banks, 10,520 ordinary credit societies, 135 purchase and sale societies, 45 production and sale societies and 383 were other types of societies. The passing of the Madras Agriculturists' Relief Act, 1938, contributed to a great extent to the increased demand for the organization of new societies. Besides the toddy tappers, having been thrown out of employment on account of the introduction of prohibition, were brought in the cooperative fold and a few societies for the manufacture of jaggery out of coconut and palmyra juice were organized. The societies advanced loans to the members to the extent of Rs. 211·94 lakhs as against Rs. 162·90 lakhs in the previous year. There was an appreciable increase in the volume of loan transactions with the members of societies which was largely accounted for by the increase in the volume of trade of sale societies. Of the total loan advanced during the year, 25 per cent was for cultivation expenses and nearly 11 per cent was for urban business. The advice given by the Registrar to the primary societies to refrain, as far as practicable, from advancing loans for long periods was readily followed and the loans for long terms were advanced by the land mortgage banks.

The policy of rectification started in the previous years was continued during the year. Examination of 7,105 societies was completed during the year. The total amount of loans including interest, involved in these societies, was Rs. 303 lakhs out of which about Rs. 40 lakhs was estimated to be bad debts. As the central banks concerned hold strong reserves, it is expected that they will be in a position to meet the losses by setting off bad debts against a portion of their reserves and that the creditors will not have to bear

any part of the loss. The amount of overdues on the 30th of June 1937 was about Rs. 178 lakhs, the demand for 1937-38 being about Rs. 128 lakhs. Out of the total demand of about Rs. 306 lakhs from members of agricultural societies, the total of extension and collection was about Rs. 136 lakhs, the balance being about Rs. 170 lakhs. The percentage of balance to demand under principal in agricultural societies was 55·45 as against 58·76 in the previous year.

Two hundred and thirty-five societies were liquidated during the year, while the committees of 12 societies were superseded. At the beginning of the year, 1,236 societies were under the management of agents appointed under by-law 62. The assets to be collected in these societies amounted to about Rs. 73 lakhs. In the opinion of the Registrar, the existence of such a large number of societies under the management of agents is an altogether unsatisfactory feature of the movement and in the cases where the agents have either substantially reduced the overdues or have improved the condition of the societies, the normal constitution of the societies should be restored as early as possible.

There were 118 loan and sale societies at the end of the year as against 111 at the beginning of the year. The societies advanced loans to members to the extent of Rs. 62·12 lakhs as against Rs. 26·16 lakhs during the previous year. During the year 13 sale societies were sanctioned. Government advanced loans amounting to Rs. 1,32,276 and made a free grant of Rs. 43,144 for the construction of godowns. Government have so far sanctioned loans to 20 sale societies for the construction of godowns. The free grant of 25 per cent of the estimated cost of the godowns put up by sale societies is met out of the Government of India grant for rural reconstruction. Government were pleased to extend the concession to selected credit societies which intend putting up combined godowns, village halls and reading rooms. About 13 societies have availed themselves of this concession and the free grant sanctioned to these societies amounted to Rs. 7,100. These societies are in a position to meet the balance of 75 per cent of the cost of the godowns from their general funds. The godowns which will be put up in Salem district will serve as auxiliary to those constructed by the sale societies in the taluka headquarters, the idea being to cover the entire district with godowns at important taluka centres with auxiliaries in the villages. The main godowns will be centres for sale while the auxiliaries will provide facilities for storage of produce. The success of the new scheme will be watched with interest.

The main function of the loan and sale societies is to market the produce of members but the societies have not yet developed this side of the business to any large extent. With a view to helping sale societies to market their goods, the Madras Provincial Marketing Society was started in 1936. The value of the goods marketed and the net profit earned by this society were Rs. 93,224 and Rs. 2,317 as against Rs. 8,979 and Rs. 196 respectively in the previous year. Fruits and vegetables, including potatoes, were the chief articles sold, their value being Rs. 55,119. Other important commodities marketed were ghee, butter, hand-pounded and milled rice, tamarind, jaggery, eggs and honey. One factor, which stands in the way of the greater progress of the provincial society is the irregular supply of commodities of certain quantity and quality by the mofussil societies. The result is that the provincial

society is not in a position to guarantee the regular supply of articles to the consumers.

There were four milk supply unions at Madras, Coimbatore, Madura and Nellore. Only the union at Madras appears to have achieved any success so far. It purchased 531,872 measures of milk for Rs. 1,63,941 about half of which was sold to the state hospitals in the city, the unsold milk being converted into milk products sold for Rs. 14,179. The union had 44 depots in the city for sale of milk. It earned a profit of Rs. 14,492 of which Rs. 10,930 has been set apart towards the Pasteurization plant and building fund.

The organization of societies for consolidation of holdings was taken up by the Registrar after his visit to the Punjab. In his opinion there is no reason why the scheme should not succeed in Madras as it had succeeded in the Punjab, both the provinces having an overwhelming population of peasant proprietors, who are considerably handicapped by the cumulative evils of fragmentation of holdings. Five societies were registered during the year. With a view to encouraging the formation of societies of this type the Government of Madras have allowed the Government of India grant for rural reconstruction to be utilized for meeting the cost of consolidation of holdings, as in the Punjab.

The number of sugarcane societies and unions at the end of the year was 15. The scheme for promoting the organization and operation of cooperative societies among sugarcane growers so as to help them in securing fair prices was approved by the Government of India and the scheme was put into operation during the year. According to the scheme, the grant of a cash subsidy to the societies and unions for the purchase of seed, manure, implements, etc. is given. The amount spent over implements will not be recovered from societies, but the amounts advanced for the purchase of seed, manure, etc. will be recovered after the harvest. The amount thus recovered at the end of the fourth year is proposed to be spent in giving premia during the fifth year to the members, who grow the best variety of cane and those whose yield per acre is the greatest. It may be of interest to mention that according to the orders of the Government of Madras, the Registrar of Cooperative Societies, the Director of Agriculture and the Director of Industries are to meet quarterly, and if necessary oftener, for discussing matters connected with the schemes. This is certainly a move in the right direction for ensuring coordination between the different development departments.

Mention may be made of the South India Cooperative Insurance Society, Madras, which is one of the few cooperative insurance societies successfully working in India. Out of 2,866 proposals for about Rs. 25 lakhs received, 2,792 proposals for about 24·2 lakhs were accepted during the year. The total life assurance business on the 30th of June 1938 amounted to Rs. 64·41 lakhs in respect of 7,630 policies as against Rs. 44·66 lakhs relating to 5,354 policies at the end of the previous year. The society collected premia to the extent of Rs. 2·26 lakhs as against Rs. 1·59 lakhs in the previous year and had a statutory deposit with the Controller of Currency to the extent of Rs. 2 lakhs.

The number of central banks remained the same as in the previous year, viz. 31. The central banks showed an appreciable improvement in their collection. From societies, the overdue at the beginning of the year was about Rs. 118 lakhs and the demand for the year was about Rs. 110 lakhs. Out of the total demand of about Rs. 228 lakhs, the total of extension and collection

amounted to about Rs. 114 lakhs out of which Rs. 108 lakhs represented collection. The percentage of balance to demand under principal was 50·20 as against 51·15 in the previous year. The rise in the arrears in interest and the fall in the amount of principal overdue are partly due to the fact that in the case of bad societies the central banks have been crediting the collections towards principal first instead of interest, as advised by the Registrar, and partly also due to the fact that the arrears are due from societies, which are on the verge of liquidation. The central banks were advised to develop more of short-term business, the suggestion being that 75 per cent of the borrowing capacity may be set apart for short-term loans. The ratio of short-term to long-term loans issued was 1 : 0·47 as against 1 : 0·82 in the previous year. With a view to implementing the Agriculturists' Relief Act and thereby justifying the exemption given to cooperative societies from the operation of the act, the Registrar advised that the lending rate on new loans to societies should be reduced to 5 per cent, and in any case, should not exceed 5½ per cent and that the rate of interest on outstanding loans should not exceed 6 per cent. The response from most of the central banks was generally satisfactory, and as many as 18 banks brought down their lending rates to 5 or 5½ per cent.

The Madras Provincial Cooperative Bank continued to make steady and satisfactory progress during the year. The deposits from individuals fell from Rs. 57 to Rs. 56 lakhs and the deposits of societies also from Rs. 79 to Rs. 62 lakhs. Loans to the extent of Rs. 32·79 lakhs were issued during the year as against Rs. 9·23 lakhs in the previous year. The loans outstanding against the central banks at the end of the year amounted to Rs. 28·78 lakhs of which as much as Rs. 25·86 lakhs were under short-term. Only one bank defaulted in its payment. The net profit during the year was Rs. 2·93 lakhs as against Rs. 1·98 lakhs in the previous year.

The central land mortgage bank continued to progress on sound lines. The debentures of the bank were quoted at a premium in the market and enjoyed the confidence of the investing public. On due consideration of the suggestion of the Reserve Bank that the bank may create a sinking fund for the repayment of debentures on maturity, the Government accepted the suggestion of the president of the bank to create a debenture redemption fund to which annual equated payment is to be made so as to provide sufficient funds to pay off the debentures at maturity. During the year, Government further increased the maximum of their guarantee in respect of debentures from Rs. 125 lakhs to Rs. 200 lakhs. The number of primary land mortgage banks rose from 93 to 101. The land mortgage banks cover 12,816 villages and loans have been issued in 3,440 villages. The total amount of loans issued by these banks up to the 30th of June 1938 was Rs. 175·83 lakhs as against 141·24 lakhs in the preceding year. The percentages of arrears under principal and interest at the end of the year were 16·16 and 2·44 as against 14·15 and 3·85 in the previous year.

The Central Cooperative Institute arranged three training classes, one in non-credit activities for the departmental inspectors and office bearers and employees of non-credit societies, one for the Cooperative Sub-Registrars and non-officials in the duties of secretaries and managers of central and urban banks and the third for a number of candidates who had been selected by the Madras Public Service Commission for appointment as junior inspectors of

cooperative societies. Seventeen candidates deputed from the Indian states, Coorg and Ceylon were also trained. One special feature in the working of the Central Cooperative Institute during the year under review was the institution of the Government Central Cooperative Institute examination, which has now replaced the Government technical examination so far prescribed for the subordinates of the Cooperative Department as a requisite qualification. There is a proposal to enlarge the existing Central Cooperative Institute into a college of cooperation where training of a better and higher standard can be given in cooperative banking, auditing, book-keeping and rural economics during a course of two years. It is further proposed that the college should be affiliated to the University of Madras, which will confer a degree in cooperation to the candidates.

BOMBAY. The failure of the rains in some of the districts and excessive rains in others coupled with the continuance of low prices rendered the outlook very depressing to agriculturists. Land revenue was suspended in many places and it was too much to hope that the cooperative movement would show any appreciable upward progress. Government appointed Mr. Vaikunth Lal Mehta, Managing Director of the Provincial Cooperative Bank and Mr. M. D. Bhansali, I.C.S., Registrar of Cooperative Societies, to examine and report on the present position of the cooperative movement with special reference to the proper method of dealing with frozen assets, cooperative education, audit, finance and development of non-credit cooperation.

The total number of societies, excluding central banks, was 5,066 as against 5,055 in the previous year, the number of members being 593,365 as against 571,559 in the previous year. The number of agricultural societies was 4,017 with 2·64 lakhs of members as against 4,035 with 2·71 lakhs of members in the previous year. Of these the number of agricultural credit societies was 3,702 as against 3,718 in the previous year, the number of members being 1·96 lakhs as against 1·98 lakhs. Twelve new credit societies were registered while 28 were cancelled, there being a net decrease of 16 societies. The small number of fresh societies is due to the policy of subjecting all proposals for registration to a very careful scrutiny. In spite of the fall in the number of credit societies, their working capital increased from Rs. 294·67 lakhs to Rs. 298·13 lakhs. Advances during the year amounted to Rs. 68·65 lakhs mainly for short-term purposes, while recoveries amounted to Rs. 65·57 lakhs and extensions to Rs. 22·27 lakhs, the amount of overdues being Rs. 144·31 lakhs. The percentage of unauthorized arrears rose from 52 to 63. The policy of examining the nature of overdues and of classifying them according to security or repaying capacity of debtors into good, bad and doubtful debts, started in the previous year, was continued. These investigations were completed in 3,392 societies out of the total number of 3,702 societies. Out of a total loan of Rs. 240·58 lakhs in these societies, the frozen assets, doubtful debts and bad debts amounted to Rs. 58·93 lakhs, Rs. 19·76 lakhs and Rs. 11·91 lakhs respectively, the total of frozen, doubtful and bad debts being Rs. 90·61 lakhs. Under the process of rehabilitation liberal remissions of interest were allowed after examination of each individual case, and in the case of doubtful debts all recoveries were credited to principal and accrued interest was shown in suspense account and recovered later if and when possible. Societies were advised to enter into hire purchase bonds with members if adequate assets and repaying capacity

existed for the purpose. The total losses written off during the year amounted to Rs. 55·591 lakhs. With the expansion of the Small-Holders Relief Act to the agriculturist members of cooperative societies during the year, the debtor members are entitled to stay of proceedings for the sale of land on payment to the society of one year's interest on the amount for the recovery of which the land is sought to be sold. These concessions were availed of by 90,047 members in 1,684 societies, the total amount of rebate granted being Rs. 1·57 lakhs. According to the revised constitution, the lending business is restricted to short-term loans and intermediate-term loans for periods not exceeding five years and members are also required to sell their produce through a cooperative marketing agency whenever available. There are also provisions for compulsory deposits at harvest times. In pursuance of the recommendations of the Joint Report, a multi-purpose society at Gorhe has been organized.

Most of the agricultural non-credit societies continued to make steady progress in spite of unfavourable conditions. The number of cotton sale societies increased by one bringing the total to 29. The quantity of cotton sold and the price realized were 5·48 lakh maunds and Rs. 37·83 lakhs as against 6·18 lakh maunds and Rs. 43·84 lakhs respectively in the previous year. The Purushottam Cooperative Ginning Society installed 18 additional gins, worked by electricity and ginned 86,987 maunds of cotton and earned Rs. 23,278 as ginning charges and Rs. 9,772 as profits. The number of fencing societies also increased by one bringing the total to 16, the length of fence or wall and the area protected being 77,249 yards and 19,663 acres respectively. The number of crop protection societies showed an increase from 20 to 23, the total profit being about Rs. 2,000. They have invested small amounts in guns, spray pumps, nets and other articles for the protection of members' crops. Two new taluka development associations were registered during the year, the total number increasing to 105 and the total membership to 30,641. The aim of these associations is to encourage better farming and to improve the breed of cattle and poultry and to do rural uplift work generally. Their income is derived from subscriptions from members and societies, donations from local bodies and grants from Government. The amount of Government grant received was Rs. 39,611 as against Rs. 48,520 in the previous year and the total of contributions from individuals, societies and donations received was Rs. 51,615 as against Rs. 59,667 in the previous year.

The Nasik District Central Cooperative Bank, Ltd., was liquidated during the year, reducing the number of central banks from 13 to 12. The Registrar ascribes the failure of this bank to frequent frost and failure of rains since 1930 and states that the failure of this bank had no repercussions on the working of other central cooperative banks in the province. The working capital of the 12 central cooperative banks decreased from Rs. 306·52 lakhs to Rs. 295·38 lakhs, but the paid-up share capital, reserves and other funds recorded a satisfactory increase. Notwithstanding the reduction in deposits, mainly owing to the liquidation of the Nasik Bank, most of the central banks continued to have a plethora of surplus funds. The percentage of unauthorized arrears of societies showed a slight drop from 33 to 32·9.

The Bombay Provincial Cooperative Bank had another year of successful working. Its working capital declined from Rs. 231·88 lakhs to Rs. 212·20 lakhs as a result of withdrawals of savings deposits by school boards and local

boards and reduction of deposits from cooperative societies. Rs. 26·36 lakhs were advanced for short-term and intermediate-term purposes and repayments amounted to Rs. 26·13 lakhs as against Rs. 26·80 lakhs in the previous year. The percentage of arrears rose from 18·5 to 23. In spite of an increase in the percentage of arrears, the sound financial position of the banks is apparent from the fact that out of the working capital of about Rs. 212 lakhs as much as Rs. 43 lakhs represent non-withdrawable long-term capital.

The paid-up share capital of the Provincial Land Mortgage Bank rose from Rs. 3·74 lakhs to Rs. 3·94 lakhs during the year. The loans sanctioned in 526 cases amounted to Rs. 7·33 lakhs the total amount of loans up to the 30th of June 1938 being 13·04 lakhs. The first series of debentures for Rs. 20 lakhs, the principal and interest of which Government had agreed to guarantee in the previous year, was issued at 3½ per cent. Cooperative banks subscribed to the extent of Rs. 3·81 lakhs while Rs. 12·75 lakhs were subscribed by private banks and individuals, during the period the debentures were kept open for subscription by the public. The work of transfer of assets and liabilities of the land mortgage department of the Provincial Cooperative Bank to the Provincial Land Mortgage Bank was in progress during the year.

The number of primary land mortgage banks continued to be 13 as in the previous year, but there was a steady increase in their business. The total share capital increased from about Rs. 2 lakhs to Rs. 2·27 lakhs and the number of members from 6,562 to 7,654. Loans advanced amounted practically to double the amount advanced in the previous year and stood at Rs. 13·60 lakhs exclusive of the loans advanced previously by the provincial cooperative banks to the three old primary land mortgage banks at Dharwar, Pachora and Broach. Rupees 0·46 lakhs in principal and Rs. 0·61 lakhs in interest were recovered during the year, leaving a balance of Rs. 0·70 lakhs, the amount overdue from members in all the banks being Rs. 0·61 lakhs including interest. Only seven of the banks showed some profit at the close of the year. All the new land mortgage banks registered in 1935 received a subsidy of Rs. 500 for the third year in succession towards the cost of the land valuation officers lent by the Cooperative Department.

Three training classes of four months' duration for the departmental staff and the employees of the central banks and unions, three classes of one month's duration for managers and secretaries of urban banks, one class for 15 days for honorary organizers and one class for three weeks for land valuation officers were organized under the cooperative training scheme. The scheme provides for tutorials in which discussions on the subjects taught take place and also for a weekly test. The teaching staff consisted of two Inspectors and one Assistant Inspector and continued to be in charge of an Assistant Registrar.

BENGAL. In spite of more favourable weather conditions and outturn of crops than in the previous year, there was no marked improvement in the collection of the dues of cooperative societies during the year. The huge accumulation of arrears had induced the feeling of despair among the members who, too, readily excused themselves from paying in the belief that the economic depression was still continuing. The inability of the central banks to reduce their rate of interest on loans adequately and the absence of any summary power of recovery also contributed to the poor collection. The policy of restricting new loans to short-term productive purposes was continued.

The number of agricultural credit societies increased from 19,790 to 19,928, their membership from 4·47 lakhs to 4·48 lakhs, and the working capital from Rs. 5·91 crores to Rs. 5·94 crores. The owned resources amounted to Rs. 251·28 lakhs or 42·51 per cent as against 43·8 per cent in the previous year. Loans issued to members increased from 23·30 lakhs to Rs. 23·79 lakhs, and repayment also showed a slight increase from Rs. 30·48 lakhs to Rs. 31·02 lakhs. Overdues at the end of the year amounted to Rs. 326·68 lakhs or 80·8 per cent as against Rs. 345·81 lakhs or 86·6 per cent in the previous year. As no effective arrangement for realization of overdues was possible without the determination of the actual repaying capacity of individual members in village societies, the department initiated an enquiry in this direction. As it was not possible for the central bank to engage the supervising staff exclusively for this enquiry work, the department also gave some assistance in the enquiry. It was suggested to the central banks that on completion of the enquiry, the overdues of a society and all its individual members should be scaled down to what they can pay in a number of annual instalments within their repaying capacity. The remission granted should be set off against the owned resources in the first instance. A draft revised bill for amendment of the Cooperative Societies Act, 1912, incorporated the special provisions for land mortgage banks and for recovery of cooperative dues by summary methods was under the consideration of Government during the year.

Unlike the credit societies many of the agricultural non-credit societies made considerable progress during the year. The number of purchase and purchase sale societies decreased from 73 to 67, their membership and working capital decreasing from 13,510 to 13,297 and Rs. 7·80 lakhs to Rs. 7·52 lakhs respectively. The central paddy sale society at Calcutta handled 1·47 lakh maunds of paddy and rice as against only ·57 lakh maunds in the previous year, and earned a profit of Rs. 3,016 as against a loss of Rs. 3,189 in the previous year. This society also marketed *gur* amounting to 3,132 maunds belonging to the members. The Gosava Jamini rice mills handled 96,439 maunds of paddy as against 50,163 maunds in the previous year and earned a profit of Rs. 2,204 as against Rs. 1,340. The fall in the amount of profit, in spite of increase in the amount of paddy handled, is due to the fact that the society had to sell old stock at market rate which was below the cost price due to the competition of Rangoon rice in the Calcutta market. The number of irrigation societies increased from 957 with 21,869 members to 975 with 22,091 members, the total irrigable area increasing from 141,008 *bighas* to 143,778 *bighas*. The utility of most of the societies in the Burdwan district ceased owing to the opening of the Damodar and Eden irrigation canals by the Irrigation Department. Of the six stream schemes in the district of Birbhum the Dadpur Dowki Jalsarbaraha Samiti served 10,000 *bighas* of land in 23 villages and extended its area of operation during the year. The Calcutta Milk Societies Union sold 37,612 maunds of milk for Rs. 3·22 lakhs as against 35,293 maunds for Rs. 3·04 lakhs in the previous year, the daily average milk handled being 103 maunds as against 97 maunds in the previous year. The net profit earned by the union rose from Rs. 117 to Rs. 27,488 during the year, mainly as a result of reduction of cost of management amounting to Rs. 11,000 by judicious retrenchment and reorganization of staff. The number of milk societies remained at 243, and of these the primary societies affiliated to the

Calcutta Milk Societies Union supplied milk valued at Rs. 1·82 lakhs and earned a profit of Rs. 5,247. The rural reconstruction societies showed a remarkable increase in their number from 27 to 512, the number of members increasing from 932 to 8,816. The programme of these societies includes improvement of the economic condition of members by adoption of subsidiary occupations such as vegetable gardening, poultry farming and handloom weaving, spread of primary and vocational education, and improvement of sanitation and communications. These societies were responsible for opening 17 new roads covering 24 miles and five canals covering eight miles and for excavation of six tanks by organized voluntary labour. The outstanding achievement of these societies was the excavation of the Nilokhi Khal in the Dacca district which has led to the reclamation of 5,000 *bighas* of inundated lands.

The number of central banks stood at 118, while their total working capital decreased from Rs. 518·11 lakhs to 515·89 lakhs. The share capital and the reserves showed appreciable increase in spite of unfavourable conditions, the total owned capital being 22·4 per cent of the working capital as against 20·9 per cent in the previous year. Deposits from individuals and other sources dropped from Rs. 278·80 lakhs to Rs. 268·99 lakhs, while loans from provincial and other banks increased from Rs. 121·83 lakhs to Rs. 122·15 lakhs. The loans issued by the banks to societies amounted to Rs. 93·08 lakhs as against Rs. 88·24 lakhs in the previous year, the recoveries falling from Rs. 102·23 lakhs to Rs. 98·39 lakhs. The total profits rose from Rs. 9·02 lakhs to Rs. 9·86 lakhs. The percentage of recovery of principal was 26·9 as against 27·2 in the previous year, the percentage of collection being 71·4 as against 70·9 in the previous year. The average borrowing rate of central banks was reduced from eight to five per cent while the lending rates ranged between $9\frac{3}{8}$ and $10\frac{1}{2}$ per cent, the interest charged by societies to members being $10\frac{15}{16}$ per cent.

The working capital of the Bengal Provincial Cooperative Bank, Limited, rose from Rs. 233·21 lakhs to Rs. 233·31 lakhs, but there was a drop in its paid-up share capital from Rs. 16·70 lakhs to Rs. 16·66 lakhs. The reserve fund, however, increased from 5 lakhs to Rs. 5·50 lakhs. Deposits from members and others decreased from Rs. 195·95 lakhs to Rs. 192·52 lakhs. Recovery of loans amounted to only Rs. 18·49 lakhs during the year. The net profits amounted to Rs. 81 lakhs which will enable the bank to make up a portion of the deficits of the previous years. The most important event of the year was the decision taken by Government to make a subsidy of Rs. 24 lakhs at the rate of Rs. 2 lakhs a year to the provincial bank so as to enable it to make good the loss due to the failure of the jute sale and supply societies and to build up a reserve with a view to reduction of interest rates charged to central banks and primary societies. The first instalment of Rs. 2 lakhs was paid during the year. Apart from this subsidy, the bank will be audited free of charge for a period of three years.

The number of land mortgage banks continued to be five but their working capital rose from Rs. 2·02 lakhs to Rs. 3·48 lakhs, the membership increasing from 1,087 to 1,564. The total amount of loans outstanding from members at the close of the year was Rs. 3·73 lakhs as against Rs. 2·08 lakhs in the previous year. Out of a total demand of Rs. 16,629 as principal and Rs. 20,478 as interest, recoveries amounted to Rs. 20,135 and Rs. 20,860 respectively

some members having repaid their loans in excess of instalments due. The total amount of overdues at the close of the year was Rs. 2,437 as against Rs. 708 in the previous year, the overdues being mostly due to circumstances over which the members had no control. The dues of the Bengal Provincial Cooperative Bank were regularly paid except in the case of two banks. Out of Rs. 5·2 lakhs sanctioned during the year, Rs. 3·99 lakhs was actually advanced. The loans represented about 33 per cent of the value of the property mortgaged and is considered by the Registrar to be well within the margin of safety. The period of repayment has been fixed with reference to the repaying capacity of each member and varies from 5 to 20 years. Measures have since been adopted to coordinate the working of debt settlement boards with that of land mortgage banks by establishing special debt settlement boards for the purpose in places where land mortgage banks have been established. In the absence of effective measures for speedy recovery of the dues of land mortgage banks, it was not possible to float debentures on the mortgages obtained by them. Since the close of the year an amendment of the Bengal Public Demands Recovery Act has been passed by the legislature authorizing the use of certificate procedure for recovery of the dues.

A cooperative training institute, maintained out of the Government of India grant, was opened at Dum Dum, Calcutta, in April 1937 and 47 departmental officers, mostly Inspectors, were placed under training. The teaching staff consists of six Inspectors, who had been specially trained at the Gurdaspur Training Institute in the Punjab, the Officer-in-charge being an ex-Registrar of Cooperative Societies. It is proposed to train all the departmental Inspectors as well as Supervisors and members of central banks and primary societies.

UNITED PROVINCES. The policy of expansion of the non-credit side of the movement, particularly of marketing and of better-living societies, was continued with considerable success.

The number of societies, excluding 72 central banks, was 9,063 with 368,842 members as against 8,316 with 278,622 members on the 30th of June 1937. The number of agricultural primary societies rose from 7,788 to 8,439, the number of members rising from 2·09 lakhs to 2·72 lakhs. Out of a working capital of Rs. 119·14 lakhs, the owned capital in the agricultural primary societies was Rs. 66·56 lakhs. The number of primary land mortgage societies remained unchanged at five but their membership rose from 456 to 556 and advances, mostly for redemption of previous debts, rose by about Rs. 15,000 to Rs. 42,000. The borrowing rate of these land mortgage societies was 4½ per cent and the lending rate 7½ per cent. The total of advances made by all the primary credit societies rose from Rs. 32·24 to Rs. 36·89 lakhs and repayments increased from Rs. 30·0 to Rs. 32·28 lakhs, the rise in the percentage of recoveries being 45·0 to 46·7. The overdues came down to 46·8 per cent as against 49·9 per cent in the previous year. Collections were credited to principal in a number of cases and overdues in respect of interest rose from 17·17 to 17·70 lakhs.

On the non-credit side, the outstanding achievement was of the cane supply societies and the ghee societies, particularly of the former. There were two kinds of cane marketing cooperative societies, namely (1) those formed in the gate areas of the 27 sugar factories which have joined the cane development

scheme and (2) those organized by the Cooperative Department for whole districts or sub-divisions. The object of cooperative marketing of sugarcane is to arrange proper regulation of supplies, to ensure correct weight and price and, above all, to organize growers so that they may learn to adopt better agricultural practices with the sanction of the group behind them, and to arrange for the cheap supply of credit, improved implements, manure and seeds. While the ultimate object of both the types of societies is the same, in areas under the cane development scheme, special attention was given to the improvement of cane cultivation. According to the cane development scheme, which was initiated towards the end of 1935, Government offered to develop the cane in the gate areas of the factories, which were willing to pay an annual contribution of Rs. 3,000 a year and to purchase cane through the cooperative society on commission. Each zone has a staff of one Assistant Cane Development Officer, three Supervisors and nine *kamdars*, who are expected to develop an area yielding 2,000—2,400 acres of cane annually, the staff being paid by the Government out of the Government of India grant from the sugar excise fund. In the first year in every zone, a small area, usually 200 acres, is put under new varieties of cane and a full area of 200,000 acres is developed in the third year of working. During the year, about 19 lakh maunds of seed of new varieties, 80,000 maunds of various fertilizer mixtures and 4,000 improved implements were distributed in the areas under the scheme. About 3,000 acres of land were green-manured and about 5,000 manure pits were also maintained. The membership rose from 10,624 to 29,097 during the year, the area under the scheme rising to about 1,000 acres of land. The societies under the scheme supplied 1·34 crore maunds of cane while the other societies, outside the area under the scheme marketed 1·42 crores and earned Rs. 2·12 lakhs as commission, and Rs. ·26 lakhs as profits. The concessions given under the United Provinces Sugar Factories Control Act of 1938 (a right to get a contract, a right to a reasonable commission, a right to equitable purchase and compulsory arbitration) have enabled a rapid expansion of these societies since the close of the year under report, but it is noteworthy that even without this legislative prop, nearly one-fifth of the total cane supplies of factories was handled by cooperative societies.

The number of ghee societies rose from 153 to 227, the increase being mainly in the districts of Etawah, Mainpuri and Agra. The primary societies have been federated into unions. The amount of ghee, jointly marketed, rose from 1,981 maunds to 4,305 maunds, the profits being Rs. 20,000 excluding Rs. 5,200 distributed as bonus on supplies. The quality of ghee sold by the societies is subjected to a double test before it is put on the market. The *panches* test it according to village methods, which are fairly effective and the ghee is subsequently tested with a refractometer at the headquarters of the ghee union. During the year the middlemen made desperate attempts to recover their custom by offering better rates to members of ghee societies but the strength of these societies was amply demonstrated by the unflinching loyalty of the members. The number of societies for consolidation of holdings rose from 93 to 118. 8,800 *bighas* were consolidated, the number of plots being reduced from 11,992 to 1,290. The total area consolidated so far is 56,000 *bighas*, the number of plots having been reduced from 56,706 to 5,434.

Under the new rural development scheme, the Government have appointed a special staff for organizing better-living societies with definite economic purposes like credit, joint sale and supply.

The number of central financing institutions continued to be 72 as in the previous year, the total working capital increasing from Rs. 92·25 lakhs to Rs. 94·87 lakhs. A very satisfactory feature of these banks is that the owned capital amounts to as much as 42 per cent of the working capital except in the case of four or five banks which the Registrar regards to be ' the black spots ' in the movement. The banks had no difficulty in raising the necessary deposits at 3½ per cent and in some cases at even 2 per cent. The five bad banks made little or no advances and worked merely as debt clearing institutions. Advances to primaries rose from Rs. 37·74 lakhs to Ps. 39·25 lakhs but recoveries fell from Rs. 37·56 lakhs to Rs. 33·93 lakhs, while overdues rose from Rs. 16·60 lakhs to Rs. 16·72 lakhs. The percentage of recovery was 61·3 as against 71·1 in the previous year, the percentage of overdues to outstandings being 41·5 as against 45·8 in the previous year. It may be of interest to mention that in pursuance of the scheme of repayments in kind, described in previous reports, the Moradabad bank purchased wheat worth Rs. 1·05 lakhs as against Rs. ·77 lakhs in the previous year. The collection was nearly 100 per cent even though there was a small loss of Rs. 657. The Etawah and the Kotdwara banks have also started accepting repayments in kind.

The scheme for establishing a provincial bank to work as a balancing centre of the movement was approved during the year and the Government allotted Rs. 75,000 for setting it up. Up till now inter-lendings between the central banks have been going on without any interference by the department but now with the development of marketing societies requiring advances for various periods, the necessity for a provincial bank is being felt all the more.

The Partabgarh Training Institute trained 67 supervisors and 13 auditors and 115 training classes for *panches* and secretaries were held during the year. The department continued to publish two pamphlets, *Sahyog Shiksha* (Co-operative Education) and *Hidayat Secretary* (Instructions to Secretaries).

PUNJAB. Owing to inadequate and ill-distributed rainfall and severe onset of various plant diseases in different areas, the agricultural conditions were unfavourable. There was also a drop in the prices of certain commodities like cotton and wheat.

The total number of societies of all classes increased by 471 from 23,186 to 23,657, membership increasing from 8·63 lakhs to 9·14 lakhs. The number of agricultural credit societies with unlimited liability increased by only 35 from 16,982 to 17,017, the number of members increasing from 5·14 lakhs to 5·28 lakhs. Their loan business showed a marked increase to Rs. 106·85 lakhs as compared to Rs. 96 lakhs in the previous year, over one-third of the total loans issued to members being crop loans and for the purchase of cattle. Recoveries during the year amounted to Rs. 112·19 lakhs as principal and 43·55 lakhs as interest. The percentage of recovery of principal to the amount outstanding at the beginning of the year rose from 16·03 to 17·7. There was a fall in the percentage of recovery of the interest mainly because recoveries were being taken towards repayment of principal in the first instance. There were 17 societies and one union for purchase and sale mostly working in settlements

for criminal tribes. Their total business during the year was valued at Rs. 1·72 lakhs as against Rs. 1·56 lakhs in the previous year. Cattle breeding societies increased from 222 to 272 and sheep breeding societies from 12 to 13. At 60 veterinary first-aid centres, maintained by these societies, over 10,000 animals were treated. Societies for better-farming distributed about 6,796 maunds of sugarcane and improved varieties of cotton and other grain seeds. The fruit growing societies in the Muzaffargarh district continued to make progress. 179 new societies with 24,415 members for consolidation of holdings were registered during the year. In 255 villages 1·32 lakh acres were consolidated during the year, the total area consolidated in the whole province up to the 31st of July 1938 being 9·19 lakh acres. The staff for consolidation was increased to 15 Inspectors and 240 Sub-Inspectors. The cost of 15 Inspectors and 187 Sub-Inspectors was met by the local Government and the Government of India. Nine new crop failure societies were registered in Hoshiarpur. These societies collected Rs. 2,593 and returned Rs. 1,769 to members on failure of the crops.

The number of central banks was 48 and of banking unions 68, besides these there were four industrial unions and two new unions were registered during the year. The working capital of the central banks decreased from Rs. 669 lakhs to Rs. 658 lakhs, but their owned capital and reserves increased from Rs. 117 lakhs to Rs. 122 lakhs at the end of the year. The total profits amounted to Rs. 4·45 lakhs as against Rs. 5·78 lakhs in the previous year. The average dividend declared was 4·9 per cent. Loans issued by societies during the year increased from Rs. 54·27 lakhs to Rs. 61·34 lakhs, the number of non-borrowing societies being as high as 12,223. Out of the demands of Rs. 55·02 lakhs and Rs. 59·07 lakhs on account of principal and interest, the recoveries amounted to Rs. 68·45 lakhs and Rs. 19·07 lakhs respectively, the percentage of principal recovery during the year on the amount of loans to societies at the beginning of the year being 18 as against 19·3 in the previous year. The principal recoveries include sums paid in excess of demand. The central banks are continuing to give relief as far as they can by accepting repayment in kind, by reducing their lending rate and by granting rebate of interest on punctual repayment. Their strong position is indicated by the fact that they were able to maintain adequate fluid resources and their investments in Government securities increased by Rs. 14 lakhs during the year and were valued at Rs. 182 lakhs.

The total number of land mortgage banks was 10. The registration of the land mortgage banks at Gurgaon and Sonepat was cancelled during the year. The working capital decreased from Rs. 17·10 lakhs to Rs. 14·10 lakhs and the recoveries decreased from Rs. 2·09 lakhs to Rs. 1·32 lakhs, which is the least figure for the last four years. Great difficulty is being experienced in enforcing the coercive provisions of law and an increase in physical resistance to possession of lands of the banks is reported. The question of reorganization of these land mortgage banks awaits the passing of the new Cooperative Societies' Bill.

The Punjab Provincial Cooperative Bank continued steadily to strengthen its financial position, even though there was a drop in the volume of its business. Its working capital decreased from Rs. 149·28 lakhs to Rs. 148·80 lakhs and the amount advanced as loans to central banks and unions from

Rs. 49·02 lakhs to Rs. 42·44 lakhs. No loan was advanced to the land mortgage banks. It is significant that the amount of loans and deposits from the central banks and unions amounted to Rs. 105·37 lakhs as against only Rs. 16·04 lakhs from the public, there being no loan from Government outstanding. Its fluid resources were Rs. 31·11 lakhs which were slightly lower than the amount prescribed, and the market value of the Government securities held by it was Rs. 106·51 lakhs. It borrowed at 2 per cent for new deposits and allowed $2\frac{3}{4}$ per cent of renewals while the lending rate was 4 per cent for cash credit and $3\frac{1}{2}$ per cent for fixed deposits, the bank rate throughout the year being about 3 per cent. The profits made by the bank amounted to about Rs. 0·65 lakhs as against Rs. 0·32 lakhs in the previous year.

One hundred and eight classes for secretaries, 129 classes for office-holders of societies, 16 classes for members of industrial societies, 11 classes for liquidators and execution agents, and one training class for managers and *munims* of cooperative commission shops were organized by the education staff maintained by the Government of India grant. The educational staff also delivered 42 public lectures, 72 lectures in schools and colleges and four lectures to military reservists. Intensive propaganda through drama, broadcasting and articles in the press was also carried on, the number of radio talks being 44. A cooperative drama was also successfully broadcast and a series of gramophone records dealing with village uplift were prepared in the Department at the request of the Commissioner of Rural Reconstruction. The Punjab Cooperative Union, Ltd., continued to publish its monthly magazine *Cooperation*, a special number of which was brought out on the occasion of the visit of His Excellency the Viceroy to Lahore. The union also published a new book containing the collection of cooperative dramas which had been played by the cooperative drama party during the last two years. Two Assistant Registrars and three Inspectors paid a special visit to the North-West Frontier Province to study the work of egg grading and marketing societies. A Deputy Registrar and an Assistant Registrar also made a study tour in the United Provinces.

BIHAR. The agricultural condition continued to be unfavourable and there was further deterioration of the movement during the year under report.

There was a net increase of 111 societies including 85 cane-growers' cooperative societies during the year, the total number of societies of all kinds at the end of the year being 7,010. The number of agricultural societies of all classes increased by 123 and was 6,790 at the end of the year. The membership decreased by 2,889 and stood at 161,287. Their working capital dropped from Rs. 152·44 lakhs in the previous year to Rs. 148 lakhs owing to the liquidation of a number of societies and inadequate advances. The total amount of loans advanced during the year was only Rs. 2·61 lakhs as against Rs. 3·67 lakhs in the previous year, about Rs. 48,000 being advanced for payment of rent to landlords. The percentage of collection was only 7·8 in respect of principal and 11·4 in respect of interest, the amount of principal and interest outstanding at the end of the year being Rs. 97·96 lakhs and Rs. 60·45 lakhs respectively.

While the condition of the credit side of the movement continued to be unsatisfactory, there was satisfactory expansion in the development of the non-

credit side, particularly in the organization of cane-growers' cooperative societies. The scheme for the cooperative marketing of sugarcane came into operation towards the end of 1935. In spite of the difficulties created by the unsympathetic attitude of several mills, during the crushing season, 1936-37, 117 societies with 2,204 members supplied 9·23 lakh maunds of cane while 203 societies with 4,174 members supplied 11·52 lakh maunds of cane during the crushing season of 1937-38. The cost of this scheme is being met by the Government of India out of a grant from the sugar excise duty. Rs. 30,000 has been set apart for advancing loans at an interest of 3½ per cent and arrangements have also been made for obtaining credit for cane-growers' cooperative societies from the authorities of the sugar mills cooperating with the scheme. Special attention is being paid to the development of sugarcane of improved varieties and in the introduction of improved agricultural implements, village sanitation, and village uplift work generally. The officers of the Agricultural, Veterinary and Public Health Departments as well as local bodies like district boards have been cooperating with the staff. *Eri* rearing and spinning as cottage industries are also being introduced with the assistance of the Industries Department. With the passing of the Sugar Factories' Control Act, the expansion of this side of the work will be greatly facilitated.

The four village welfare centres, one in each division, under the Bihar Village Welfare Scheme, which had been inaugurated in 1936, out of the Government of India rural reconstruction grant, continued to progress during the year. Each centre comprises a group of three to five villages. The paid staff consists of a graduate rural welfare officer, a village guide, a *kamdar* and a trained *dai*, working under the general guidance of a rural welfare committee of local men of influence. Their object is to promote improved methods of agriculture, cattle welfare, village sanitation, training of village *dais*, village communications, amicable settlement of disputes and education of the masses; maintenance of night schools with the assistance of honorary teachers recruited locally receiving their greatest attention. Thirty-six such schools, including two for girls, were started during 1937.

There were 53 central cooperative banks and unions as in the previous year. Their working capital decreased by Rs. 3·02 lakhs and stood at Rs. 167 lakhs. The precarious condition of the central banks will be apparent from the fact that the total demand for withdrawals of all kinds of deposits in central banks amounted to Rs. 47·01 lakhs against which the central banks maintained fluid resources to the extent of only Rs. 6·88 lakhs or 14·6 per cent. Two banks held creditors' meetings under section 21 (A) of the act during 1937, thus bringing the number of banks subject to terms of compromise to five. Fourteen other banks, which are unable to meet the demands of the creditors, arranged to hold similar meetings in 1938. The combined percentage of collection of principal and interest was only 7·6 as against 8 in 1936 and 10·7 in 1935 respectively. The amount advanced to societies was Rs. 3·41 lakhs as against Rs. 3·89 lakhs in the previous year.

The position of the Bihar Provincial Cooperative Bank, most of the investment of which is in the central cooperative banks, continued to be adversely affected by the unsatisfactory condition of the central cooperative banks. Its working capital dropped from Rs. 110·13 lakhs at the end of 1936 to Rs. 102·24 lakhs as a result of the sale of Government securities for refund of

deposits maturing during the year and its inability to collect its dues from the central cooperative banks. The amount outstanding against the banks at the end of the year was Rs. 53,28,000 as against Rs. 53,56,000 in the previous year. Out of a total demand of Rs. 46·06 lakhs only Rs. 79,000 could be collected, and the amount of overdue was Rs. 8·67 lakhs at the end of the year. The net profit amounted to only Rs. 30,000 as against Rs. 21,766 in the previous year and no dividend could be declared as in the two previous years.

The financial position of the Bihar and Orissa Cooperative Federation continued to be unsatisfactory owing to poor collection. The Federation Press continued to incur losses. The press has since been closed and the control of the audit staff transferred to the Government in pursuance of the resolutions of the Cooperative Federation Congress held in April 1938. The publication of the *Co-operative Journal* in English and of the *Sahyog* in Hindi was continued.

Special attention was given to cooperative training during the year. The Cooperative Training Institute, which had so far been housed in a few rooms lent by a society at Patna, and was functioning more or less as a lecturing institution, was re-organized on a residential basis and shifted to the Pusa estate in the district of Darbhanga, where ample accommodation and playgrounds in an excellent environment for a corporate life were available. The proposal of the Registrar to train 40 graduate stipendiaries, each with a stipend of Rs. 30 a month, for a period of one year and to invite, as part-time honorary lecturers, experts from other departments in Bihar as well as from other provinces in India was sanctioned during the year. The stipendiaries were selected by a special committee appointed by the Government and Rs. 3,000 was sanctioned by the legislature for paying honoraria and travelling expenses of part-time lecturers. The revised syllabus included economic geography with special reference to Bihar rural economics, social psychology besides cooperative law, banking, book-keeping and accounts. Training in first-aid and bandaging, survey and settlement work, public speaking, riding and cycling, vegetable gardening, was given and daily attendance at drill and games was compulsory. Lectures on the work of other nation building departments by selected officers were also arranged. The department has since been fortunate enough in securing the services of eminent cooperators like the Hon'ble V. Ramdas Pantulu, Dewan Bahadur Professor H. L. Kaji of Bombay, Dr. Radhakamal Mukharjee of Lucknow and others as part-time lecturers. Those who qualify at the final examination will be eligible for the posts of inspectors, liquidators, managers, etc., and may, in time, provide the nucleus for a closed service for the department. In recognition of the high educational qualifications and the nature and extent of the training at the Cooperative Training Institute, the Public Service Commission have also agreed, as a special case, to appoint one of the stipendiaries, who occupy the first four places in the final examination, to a gazetted post in the department.

During the year, a comprehensive scheme for the rehabilitation of banks and societies was drawn up by the Registrar. According to the scheme, the first essential is to have an enquiry into the assets, liabilities and repaying capacity of each member of every society requiring reconstruction. Those members who are found to be dishonest, uncredit-worthy or otherwise unfit, are eliminated and in the case of others considered fit for retention, the dues

are scaled down to what they can pay within a reasonable number of years not exceeding 15, repayments being arranged in suitable annual instalments within their repaying capacity as found by the enquiry. There are provisions for crop loans carrying a low rate of interest to members of reconstructed societies during the period of recovery of the reduced dues according to the scheme. Members are required to execute rent purchase bonds or mortgage bonds in respect of their lands as security for the outstanding loans. The net loss of every society is determined after setting off owned resources except rupee one per head on account of such share-capital as may be available. With a view to starting with a clean slate, the net loss of a reconstructed central bank is to be met by the creditors or by the Government or by both in such proportion as the Government may deem fit. Economy in the cost of management—to be secured in the first instance by the amalgamation, bifurcation, or a combination of both the processes—of reconstructed societies under the different central banks in a district and where necessary, there should be a Government annual subsidy till the amalgamated reconstructed banks are able to stand on their own legs. There are provisions for sufficient long-term capital through a Government loan or through debentures guaranteed by Government and also for short-term accommodation to enable the reconstructed banks to obtain sufficient funds for financing the reconstructed banks and societies and also new societies, organized on sound lines. In view of the increase in the number of liquidation and award cases consequent on reconstruction, a special staff, vested with special powers for the disposal of these cases, will have to be appointed. Necessary safeguards—financial, administrative and legislative—have also been prescribed for the prevention of a recurrence of a crisis similar to what the movement is passing through at present. The efficient functioning of the scheme will require substantial amendment of the existing Act. During the Interim Ministry, Government expressed their great anxiety for securing an early rehabilitation of the movement. The Ministry changed soon after the scheme was submitted for consideration, in August, 1937. The present Ministry have taken up the question in all earnestness. Rehabilitation enquiries in 15 central banks and unions have since been completed and are pending in six banks.

Central Provinces and Berar. There was a decline in both the outturn and prices of the principal crops, namely cotton, rice and wheat, with the result that the recoveries continued to be low. The central banks and societies in Berar, with their 57,000 acres of land with an annual revenue payment of about one lakh of rupees, continued to be the weak spot in the movement.

There was an increase by 442 in the number of societies of all kinds which stood at 4,408 at the end of the year. The number of agricultural credit societies was 4,084 ; 3,414 being in the Central Provinces and 670 in Berar. The working capital of all the societies in the province decreased from Rs. 108·26 lakhs to Rs. 105·39 lakhs. The total cash recovery from members of working societies decreased from Rs. 8·19 lakhs to Rs. 7·89 lakhs in the Central Provinces and from Rs. 4·38 lakhs to Rs. 2·28 lakhs in Berar. The total of loans advanced by societies to members increased from Rs. 7·2 lakhs to Rs. 19·78 lakhs. The largest amount was advanced for purchase of cattle, of which 73 per cent was absorbed in Chhattisgarh where cattle mortality

was reported to be the highest. Out of 609 societies selected for reorganization, 68 societies were finally organized, 59 rejected and the rest kept for further trial. The department paid considerable attention to the work of reorganization. The rates of interest charged by banks to societies varied from 6¼ to 10 per cent while the rates charged by societies ranged between 4 to 10½ per cent. The proportion of overdues was reduced to 69·9 per cent in the Central Provinces while it rose to 92·2 per cent in Berar.

The number of central banks continued to be 35 with a working capital of Rs. 245·81 lakhs as against Rs. 245·46 lakhs in the previous year. The net profits of the central banks decreased from Rs. 2·59 lakhs to Rs. 1·26 lakhs.

The working capital of the provincial bank increased from Rs. 152·33 lakhs to Rs. 164·99 lakhs, the net profits increasing from Rs. 5,790 to Rs. 46,859. It allowed interest at 1¾ to 3½ per cent and was able to maintain public confidence sufficiently so as to have surplus funds ranging between Rs. 7 lakhs to Rs. 33 lakhs during the year. Its cash advance rose to Rs. 2·48 lakhs while recoveries decreased to Rs. 4·88 lakhs.

The number of land mortgage banks increased from 12 to 19 during the year. The total working capital increased from Rs. 4·42 lakhs to Rs. 8·12 lakhs. Loans advanced amounted to Rs. 3·79 lakhs as against Rs. 2·64 lakhs in the previous year, the recoveries being Rs. 54,481 as against Rs. 17,727 in the previous year. The provincial cooperative bank, which is the financing agency for the land mortgage banks, floated the second series of debentures by 3½ per cent for Rs. 3 lakhs in October, 1937, which was over-subscribed. In response to the growing demand for land mortgage banks it has been decided to have a bank of this kind in each district. It has also been decided to take up the question of the establishment of a central land mortgage bank when the business of these banks exceeds Rs. 15 lakhs.

Two hundred and forty-one rallies attended by 13,085 members were organized during the year. The educational staff, consisting of an Education Inspector and three assistants, employed under the scheme of training and education, financed by the Government of India, conducted eight training classes for auditors, group officers, managers and other employees. Thirty-seven training classes were also organized by the educational staff in consultation with the cooperative institutes for members and office-bearers of societies.

ASSAM. The movement passed through another year of crisis. The total number of members decreased from 43,335 to 42,775 in agricultural societies, the number of which increased from 1,296 to 1,320. There is a good field for the expansion of the movement but the work could not be pushed on owing to inadequate staff for the increase of which the Registrar has been pressing for the last two years. The loans advanced and the recoveries made during the year amounted to Rs. 92,777 and Rs. 1,61,814 as against Rs. 66,610 and Rs. 1,67,286 respectively, in the previous year. Out of this total loan outstanding, about Rs. 16·7 lakhs or about 94 per cent was overdue as in the previous year. In the opinion of the Registrar, the position does not show any sign of improvement and it will take years to clear up this position which represents the accumulated overdues of several years. Most of the agricultural credit societies are running at a loss, which will greatly increase as a result of the enforcement of the provisions of the Assam Moneylenders' Act in the co-

operative institutions. Other factors such as remission of interest, reduction in the lending rate and the heavy cost of execution proceedings in liquidation and award cases have been instrumental in increasing the loss. The Registrar apprehends that under the existing conditions the movement may, in the near future, reach a stage in which all the societies, except the new ones, will be working at a loss, which if allowed to continue, will wipe out all the accumulated reserve funds and that unless some preferential treatment is given to co-operative societies exempting them from the operation of these laws, their effect on the movement may be disastrous.

Twenty-four new non-agricultural credit societies were registered during the year. Out of the working capital of about Rs. 26·42 lakhs the owned capital represented 59 per cent as against 57 per cent in the previous year. These societies issued loans to members to the extent of Rs. 8·78 lakhs as against Rs. 8·33 lakhs in the previous year, the recoveries being Rs. 8·03 lakhs against Rs. 7·46 lakhs. The percentage of the overdues was 28·8 as against 40 in the previous year. The profits, however, decreased from Rs. 56,418 in the previous year to Rs. 48,866. The other types of non-credit societies included 11 stores, 20 milk societies, one land improvement society, one execution society, one insurance society, five mutual benefit societies, 13 welfare and better-living societies, one women's cooperative thrift and home savings society and two fishery societies. Apart from one store, which was put under liquidation, the working of the stores was generally satisfactory and they earned a profit of Rs. 5,982 as against Rs. 3,872 in the previous year. The milk societies are on the decline and the progress made by the other societies, most of which have recently been started, was not appreciable. The women's cooperative thrift and home savings society of Sylhet was organized towards the close of the year. Every member of the society was supplied with a home savings box in which she was expected to save something every day from her household money, so that the total savings of a month may not be less than Re. 1. At the end of the month, the savings are collected and deposited in the accounts of the members concerned.

There were 18 central banks as in the previous year. The share capital decreased from Rs. 1·96 lakhs to Rs. 1·94 lakhs. The proportion of the paid-up share capital to the working capital was 8·3 per cent, which is practically the same as in the previous year. Loans and deposits received from individuals and other sources decreased by Rs. 63,201 while loans from the provincial coopertive bank increased by Rs. 47,227. The central banks, being unable to meet the demands of the depositors from their own resources, had to borrow more and more from the provincial cooperative bank. The loans issued to the societies during the year amounted to Rs. 66,326 as against Rs. 39,751 while the corresponding recoveries of principal were Rs. 97,815 as against Rs. 95,601 and the interest realized amounted to Rs. 1·30 lakhs as against Rs. 1·53 lakhs in the previous year. While the recoveries indicate a slight improvement, the overdues continue to be very high, being 100 per cent in some of the central banks. Fresh loans to new societies were advanced very cautiously after due enquiry into the repaying capacity of the members. Profits earned by the central banks decreased considerably during the year and a large number of banks ran at a loss. The figures indicate that the central banks are on the verge of collapse.

Unlike most of the central cooperative banks, the provincial cooperative bank of Assam continued to maintain satisfactory progress and enjoyed sufficient public confidence to be able to obtain current deposits without any interest and fixed deposits at only 4 per cent. Deposits from members and outsiders increased from Rs. 1·89 lakhs to Rs. 2·15 lakhs while the paid-up share capital increased from Rs. 1·08 lakhs to Rs. 1·10 lakhs. The total loans issued during the year amounted to Rs. 1·01 lakhs as against Rs. ·51 lakh in the previous year. Owing to the result of reduction in the rate of interest on loans from 7 per cent to 6 per cent with effect from the 1st of April 1937, there were more demands for loans during the year than in the previous years. It, however, appears that most of those loans were taken by the central banks for refund of deposits bearing higher rates of interest with the result that the position of the central banks with regard to fresh investment remained practically unchanged. The recovery on account of principal and interest amounted to Rs. 50,761 and Rs. 12,263 as against Rs. 63,716 and Rs. 17,769 respectively in the previous year. The decrease in the collection of interest was mainly due to the reduction in the rate of interest on loans and also due to the fact that the amount invested in loans during the earlier part of the year was less than that of the preceding year. The percentage of overdue was 40 against 42 in the previous year. The net profit of the bank amounted to Rs. 9,201 as against Rs. 10,792 and a dividend of 5½ per cent on the preference shares and 4½ per cent on ordinary shares was declared.

The number of land mortgage banks was five as in the previous year. Their condition continued to be unsatisfactory and most of them appear to be in a stagnant condition. The total working capital decreased from Rs. 5·68 lakhs in the previous year to Rs. 4·79 lakhs. The deposits from members and non-members also decreased from Rs. 3·08 lakhs to Rs. 2·56 lakhs. This decrease is the result of repayment to depositors out of collection. As mentioned in the report of the previous year, depositors are being encouraged to take lands in lieu of their deposits. As regards the causes of the decline of these banks the Registrar observes as follows:

'The land mortgage banks, started with the object of enabling the agriculturists to redeem their lands, liquidate their old debts and make further improvements in their activities, made the fundamental mistake of financing members other than the agriculturists without looking into the repaying capacity of the borrowers and issuing long-term loans without securing any corresponding long-term capital.'

In view of the inability of the central banks to obtain financial accommodation from the Reserve Bank, this province will have to obtain the necessary long-term capital from other sources. It is proposed to appoint a special officer for a short period to study the progress of land mortgage banks in other provinces with a view to re-organizing the land mortgage banking system in Assam after a due consideration of the report of the special officer.

North-West Frontier Province. The continuance of unfavourable trend of prices and the disturbed conditions of the Southern circle, comprising Dera Ismail Khan and Bannu made it difficult to affect any appreciable improvement in the condition of the primary societies, particularly agricultural societies.

The total number of societies increased from 692 with 25,078 members to 753 with 28,643 members during the year, the corresponding increase in the

working capital in the whole movement being Rs. 23·99 lakhs to Rs. 26·87 lakhs. The number of agricultural credit societies was 660 with 16,049 members as against 607 with 15,018 members in the previous year. The increase in the number of societies was mainly in the Northern circle, the number of societies in the Southern circle, with its disturbed condition, being practically the same as in the previous year. The loan business during the year decreased by Rs. 8,000 to Rs. 2·46 lakhs, the lending rate being 12 per cent subject to a rebate of $3\frac{1}{8}$ per cent on punctual re-payment in full. Fifty per cent of the loan was for the purchase of cattle, not only for ordinary agriculutral operations but also for trade. Out of the principal demand of Rs. 3·23 lakhs, Rs. 1·87 lakhs was recovered and out of Rs. 2·8 lakhs due on account of interest the recovery amounted to only Rs. 0·85 lakhs. In the Northern circle the percentage of recovery increased from 15·9 to 16·4 while in the Southern circle it showed a heavy fall from 35 to 24.

On the market side the outstanding success was the growth of the Taru Jabba Egg Grading and Sale Association, Ltd., which shifted its headquarters from Pabbi to Peshawar. The number of eggs sold increased from 18·80 lakhs to 42·56 lakhs, the price obtained being Rs. 76,291 and Rs. 1,84,352 respectively. The Sheikh Muhammadi Grape Sale Society marketed about 550 maunds of grapes as compared with 154 maunds in the previous year. The number of societies for consolidation of holdings increased from 16 to 22 and the area consolidated during the year was 4,558 acres as against 6,618 acres in the previous year. The fall in the area consolidated is mainly due to the difficulty of working in the Southern circle.

The three central banks continued to function in a satisfactory manner, the working capital increasing from Rs. 9·06 lakhs to Rs. 10·28 lakhs and the investment in Government securities increasing from Rs. 1·93 lakhs to Rs. 2·26 lakhs. The borrowing rates of the banks for fixed deposits ranged between $2\frac{1}{2}$ and $3\frac{1}{2}$ per cent while their lending rates ranged from 6 to 8 per cent, subject to a rebate of 1 per cent on punctual repayment in the case of the central bank at Dera Ismail Khan. Rupees 1·89 lakhs was advanced as loans to societies. Rs. 1·71 lakhs was recovered as principal and Rs. 49,631 as interest, the overdues on account of principal and interest at the end of the year being Rs. 55,421 and Rs. 18,438 respectively. The Registrar considers the repayment of loans by societies to be on the whole fair under the existing circumstances.

Orissa. North Orissa, which was formerly a part of Bihar, continued to be under the administrative charge of the Registrar, Cooperative Societies, Bihar, while the banks in South Orissa, taken mainly from the Madras Presidency, were administered by the Director of Development, Orissa. The deterioration of the movement in North Orissa continued, while the comparatively more satisfactory condition in South Orissa was maintained in spite of the general unfavourable agricultural condition.

The number of societies decreased by two and stood at 2,686 with 10,386 members at the end of the year. The number of agricultural societies was 1,994 with 65,734 members in North Orissa and 495 with 23,061 members in South Orissa. The working capital of the societies in North Orissa was Rs. 47·04 lakhs as against Rs. 12·04 lakhs in South Orissa. The percentage of collection of principal was 2·58 as against 5·58 in the preceding year in North Orissa, the percentage of collection of interest being 16·38 as against 14·42 in the previous

year. In South Orissa the percentage of collection on account of principal was 5·58, the percentage of collection of interest being 12·57.

The non-credit societies like those of bell-metal workers, purchase and sale societies and weavers' societies did not record any appreciable progress.

There were 13 central cooperative banks and unions in North Orissa and two in South Orissa as in the previous year. The working of banks in North Orissa continued to be unsatisfactory owing to poor recoveries. The proportion between owned and borrowed capital in North Orissa was 1 : 2·6 as against 1 : 2·8 in South Orissa. The percentages of collection of principal were 2·5 in North Orissa and 17 in South Orissa and 5 for the whole province, the corresponding figures for the previous year being 4·7, 15·3 and 6·7. The percentage of collection of interest was 11·5 in North Orissa and 89·8 in South Orissa and 14·9 for the whole province as against 18·4, 91·5 and 22·7 in the previous year. The central banks in North Orissa could advance loans only to the extent of Rs. 0·13 lakh, while the two banks in South Orissa advanced Rs. 2·22 lakhs.

The Orissa Provincial Cooperative Bank, registered in the previous year, could not start work during the year mainly owing to the non-settlement of the dispute regarding the bifurcation of the Bihar and Orissa Provincial Cooperative Bank. The latter continued to function as an apex bank for the central banks in North Orissa while the Madras Provincial Cooperative Bank continued to serve the same purpose for the banks in South Orissa. No loans were, however, granted by these banks to any of the central banks in Orissa, only the cash credit facilities being continued.

Dewan Bahadur K. Deivasikhamoni Mudaliar enquired into the condition of the cooperative movement in Orissa and his report has since been published and Government decision thereon is awaited.

DELHI. Rains were scanty and both the crops failed and even in the canal irrigated areas the cotton and sugarcane crops were not successful. The unfavourable seasonal condition had an adverse effect on the economic condition of the members with the result that in spite of various concessions in the form of remission of overdue interest, reduction in the rate of interest and extension of *kist* in deserving cases, no appreciable improvement in the financial condition of the agricultural societies was noticeable.

The total number of societies increased from 313 with 14,272 members to 328 societies with 15,597 members, the number of agricultural societies increasing from 220 to 228. The number of agricultural credit societies decreased from 200 to 198, the number of members falling from 4,853 to 4,767. The agricultural credit societies advanced Rs. 49,079 as loans to members, the rate of interest being 7½ to 12½ per cent. The recovery of principal and interest amounted to Rs. 74,639 and Rs. 55,557 as against Rs. 72,012 and Rs. 70,300 respectively in the previous year. The percentage of recovery was 11·27 as against 10·6 in the previous year. The overdues on account of principal increased from Rs. 14,493 to Rs. 22,076, while interest overdue amounted to Rs. 2,09,212 as against Rs. 2,17,408.

The number of cattle breeding societies increased from five to seven during the year. An additional field staff was sanctioned for supervision of 23 societies with 1,477 members for the consolidation of holdings. 2,511 acres were con-

solidated during the year, the number of blocks being reduced from 2,515 to 496.

The Delhi Province Central Cooperative Bank, Limited, continued to be the sole financing institution. This bank continued to enjoy public confidence and was able to obtain adequate deposits at 2½ per cent. It had a working capital of Rs. 13·65 lakhs as against Rs. 13·36 lakhs in the previous year and had investments in Government securities to the extent of Rs. 3·71 lakhs. The sum of Rs. 1·43 lakhs was advanced at 7 per cent to the societies. The bank collected Rs. 1·48 lakhs as principal and Rs. 49 lakhs as interest during the year, the percentage of recovery falling from 19·9 in the previous year to 15·9 during the year under report.

HYDERABAD. The agricultural season was unfavourable, the yield of crops being about eight annas as against nine annas in the previous year. The prices of agricultural commodities also did not show any appreciable improvement. The department followed a policy of controlled credit and of restricting it to crop loans.

Out of 298 societies registered during the year only 164 were agricultural societies. Societies of all kinds increased in number from 3,119 to 3,373, the number of agricultural credit societies being 2,693 with 56,561 members as against 2,546 societies with 52,421 members in the previous year. The societies borrowed Rs. 5·35 lakhs from central banks and repaid Rs. 5·25 lakhs as principal and Rs. 2·88 lakhs as interest, the corresponding figures for the previous year being Rs. 5·12 lakhs and Rs. 3·25 lakhs. The slight improvement in the repayment of the principal and the fall in the repayment of interest were due to the fact that in the case of the older societies, the collections were credited to the principal loan account while interest was recovered only to the extent of the accrued amount. The societies advanced loans to the extent of Rs. 6·46 lakhs as against Rs. 4·66 lakhs in the previous year. The collections amounted to Rs. 5·92 lakhs as principal and Rs. 3·88 lakhs as interest as against Rs. 5·84 lakhs and Rs. 4·30 lakhs respectively in the previous year.

The non-credit side did not show any marked expansion. The number of sale societies remained eight as in the previous year.

The number of central cooperative banks continued to be 39 as in the previous year but their working capital increased from Rs. 63·95 lakhs to Rs. 64·56 lakhs. Loans borrowed from the Dominion Bank during the year amounted to Rs. 2·24 lakhs while Rs. 3·26 lakhs was repaid, leaving a balance of Rs. 14·25 lakhs at the end of the year. Loans were advanced to the societies to the extent of Rs. 9·23 lakhs as against Rs. 6·95 lakhs in the previous year, the recoveries falling from 7·92 lakhs in the previous year to Rs. 7·66 lakhs.

The Hyderabad Cooperative Dominion Bank continued to maintain a sound financial condition, paying 3 to 3½ per cent on fixed deposits of one to two years respectively. It received deposits to the extent of Rs. 8·95 lakhs from individuals and Rs. 2·37 lakhs from societies and banks and advanced to banks and societies Rs. 3·71 lakhs as against Rs. 3·35 lakhs in the previous year. Recoveries amounted to Rs. 5·03 lakhs as against Rs. 4·42 lakhs in the previous year. The bank made a profit of Rs. 91,000 and declared a dividend of 6 per cent.

The central cooperative union carried on its educative work through 10 propagandists, who held training classes at 34 centres. It also arranged training classes for supervisors at two centres and rural reconstruction classes in

25 villages. The supervision of village societies entrusted to the union was carried on by a staff of 109 supervisors and four Inspectors. The union is finding difficulty to carry on its work, particularly of supervision of societies without adequate financial assistance from Government.

MYSORE. Owing to the low prices of agricultural produce and of commodities like areca, coffee, groundnut and cotton, the deterioration of the agricultural societies did not stop. The department concentrated its attention on the weeding out of inefficient societies and the improvement of others, the expansion being more in the direction of non-credit activities.

The number of agricultural societies of all kinds was 1,445 as against 1,417 in the previous year and of these 1,365 were credit societies, the rest being supply societies, grain banks and marketing societies. The membership increased from 62,229 to 62,307, the membership of the agricultural credit societies being 60,313. The agricultural credit societies with a working capital of 57·68 lakhs advanced loans to the extent of about Rs. 9·98 lakhs and recovered Rs. 8·69 lakhs during the year. The percentage of overdues to demand decreased from 75·9 to 73·2 mainly as a result of the grant of extension of time in deserving cases.

The agricultural supply societies did not show signs of improvement during the year but the marketing societies did a fairly good business by selling areca, cardamums and cotton. The grain banks, numbering 36, did not function properly for want of adequate facilities for stocking grain and keenness on the part of the members. There were 12 womens' societies with a membership of 698.

The 11 banking institutions included five district banks, three federal banking unions, one central urban bank, the other two being the apex bank and the central cooperative land mortgage bank. The apex and the central land mortgage banks have been organized for issuing short-term and long-term loans to the ordinary credit societies and the land mortgage societies respectively. Steps are being taken to close down the district banks by arranging for the winding up of the societies indebted to them. The apex bank will henceforth be the sole agency for the grant of short-term and intermediate term credit to the primary societies. It advanced loans to societies to the extent of Rs. 1·76 lakhs as against Rs. 1·81 lakhs in the previous year. The recoveries under principal and interest, however, fell from Rs. 2·49 lakhs to Rs. 1·71 lakhs and Rs. 1·43 lakhs to Rs. 1·26 lakhs respectively, the percentage of overdues being 77·96 as against 74·6 in the previous year. The bank offered certain concessions in the form of reduction of future interest and remission of penal interest to 400 societies during the year. Preliminary examination regarding the value of securities for the loans outstanding against individual borrowers of the societies indebted to this bank has been completed in more than half the number of such societies. Side by side with this examination, extension of *kists* is being granted to deserving members so as to bring the annual demand within their repaying capacity. Government have sanctioned the appointment of an Assistant Commissioner to work as the Secretary of the bank, Government meeting half the cost involved in his appointment.

The lending operations of the Mysore Central Cooperative Land Mortgage Bank were further extended during the year, and it is proposed to introduce the land mortgage scheme in every taluka. The working capital of the bank

increased from Rs. 6·36 lakhs to about Rs. 9 lakhs. The bank issued the fourth series of debentures at 3½ per cent and subscriptions to the extent of 2·40 lakhs were received. Up till now debentures to the extent of about Rs. 8 lakhs have been issued. The bank advanced Rs. 2·10 lakhs as loans during the year and out of a demand of Rs. 66,906, recovered Rs. 57,605, the percentage of overdues to demand being 13·91 as against 20·58 in the previous year. The services of an official to work as Secretary of the bank were lent by Government. During the year Government also continued the grant of Rs. 1,500 towards the working expenses of the land mortgage societies.

BARODA. The policy of consolidation and cautious expansion was continued during the year, the number of agricultural societies being only 914 as against 913 in the previous year. Fresh loans to the extent of Rs. 6·8 lakhs were advanced as against about Rs. 6 lakhs in 1936-37. The repayment of loans and the percentage of overdues were Rs. 6·36 and 45·6 lakhs as against Rs. 6·39 and 46·7 lakhs respectively in the previous year. It appears that the overdues decreased owing to the extension of *kists* in many cases. Most of the societies reduced their lending rates from 9⅜ per cent to 6¼ per cent and 7 13/16 per cent. Among the non-credit societies specially good work was done by sale societies and societies for consolidation of holdings. Joint sale of various produce like oil-seeds, groundnuts and cotton was also carried on by several credit banks. In seven out of 77 societies for the consolidation of holdings, lands covering 2,178 *bighas* belonging to 73 members were consolidated.

Apart from the Baroda Central Cooperative Bank, there were two cooperative financing institutions with a total working capital of about Rs. 19·73 lakhs. The outstanding loans at the beginning of the year amounted to Rs. 14·23 lakhs as against Rs. 12·82 lakhs in the previous year and the loans advanced during the year amounted to about Rs. 4 lakhs. The recoveries amounted to Rs. 3·34 lakhs as against Rs. 2·63 lakhs in the previous year. Most of the financing institutions reduced their rates of interest. Government also advised all the banks not to charge more than 6 per cent from societies on fresh loans and not more than 5 per cent on overdue loans and to give instalments to the societies after a thorough enquiry.

The cooperative land mortgage bank at Baroda extended its area of operation. It advanced loans to the extent of Rs. 1·27 lakhs and was able to recover the whole of its dues amounting to Rs. 30,599. During the year, the bank floated debentures for Rs. 3 lakhs at 3 per cent out of which debentures worth Rs. 25,000 were purchased by Government, who also guaranteed repayment of both the principal and the interest of the debentures. Efforts were made to compound the debts of the members and Government met the full cost of a Land Valuation Officer and half the cost of the management of the bank.

The central cooperative institute organized four classes for training secretaries and continued editing the *Gramjiwan*, a monthly journal, and also a bulletin dealing with cooperation, agriculture and other topics of rural interest.

TRAVANCORE. The policy of rectification and consolidation and a cautious policy of expansion was continued during the year. Special attention was given to non-credit activities by the organization of sale societies and by the introduction of the 'Kettuthenga deposit' system. According to this system, each member hands over a number of coconut trees to the society which collects the nuts, auctions them for the best price and credits the value to the accounts

of the member. Where there is no repayment of debt to be made by the member, the amount realized by sale is shown as a deposit in his name. The system is getting very popular specially in areas where coconut trees grow abundantly. Several lakhs of coconuts, collected by this system, were sold for Rs. 1,29,159 during the year.

The number of agricultural societies and the number of members were 1,290 and 137,681 as against 1,346 and 142,809 respectively in the previous year. Of the total principal demand amounting to Rs. 24 lakhs, the collections amounted to Rs. 5·5 lakhs while in interest Rs. 1·60 lakhs was collected. The percentage of balance to demand was 77·1 in the case of principal and 81·2 in the case of interest. Societies were encouraged to accept repayment in kind. Under certain conditions, penal interest was also not demanded.

As a result of the special attention given to developing the non-credit side of the movement, 21 societies, for purposes other than credit, were registered during the year. The non-credit societies included societies for distribution, school stores, dairy farming and cattle breeding, building purposes, poultry and bee-keeping and rural uplift. The Trivandrum Distributive Cooperative Society, with its 14 branches, working in different centres in the town of Trivandrum, sold articles to the value of Rs. 2,51,396. School stores are becoming very popular, the most outstanding store of its kind being the Maharaja's College of Science Cooperative Stores Ltd. at Trivandrum. During the year, this store sold goods worth Rs. 12,180 and made a net profit of Rs. 887. The Marthandam Y. M. C. A. Poultry Society encourages members to rear better poultry. It also collects, tests, grades, packs and sells the eggs of members in outside markets. The society collected 159,713 eggs and sold them for Rs. 8,808. The Marthandam Bee-keepers' Cooperative Society supplied beehives to the members and sold members' honey to the value of Rs. 1,005.

In view of the social status of women in this state, it may be of interest to mention that the total number of women in the movement was 24,096 as against 24,022 in the previous year, the proportion of women to men in the movement being 1 : 8. Educated women take a keen interest in managing some of the societies. There were 10 purely women's societies ; four of these were non-credit societies, while the remaining six were doing credit business.

The working capital of the only central bank was Rs. 15·14 lakhs as against Rs. 17·72 lakhs in the previous year. The demands on account of principal and interest were Rs. 9·08 lakhs and Rs. 23·44 lakhs respectively. Of these only Rs. 3·63 lakhs and Rs. 0·93 lakhs could be collected during the year, the percentage of balance to demand being 60 in the case of the principal and the interest. The central bank advanced Rs. 26 lakhs to societies and Rs. 0·56 lakhs to individuals.

. JAMMU AND KASHMIR. The Registrar observes that deterioration has of late crept into the movement and that the field staff are mostly engaged in consolidating existing societies and in weeding out undesirable societies and members.

The number of agricultural societies stood at 2,584 with 46,518 members as against 2,575 with 46,823 members in the previous year. The decrease in the number of members appears to be due to weeding out of undesirable members and liquidation of certain societies. The working capital also decreased by about Rs. 80,000 and stood at Rs. 55·10 lakhs owing to the same reasons and

also to the refund of share money to those who had been members for 10 to 20 years. The amounts recovered during the year were Rs. 2·50 lakhs on account of principal and Rs. 3·48 lakhs as interest. The percentage of recovery to the total demand was 6·10 as against 4·12 in the previous year. The societies advanced Rs. 1·63 lakhs to members as against Rs. 2·12 lakhs in the previous year. The large amounts appear to have been advanced for unproductive purposes like marriages, and also for payment of debts.

The non-credit societies included 187 societies for consolidation of holdings, 135 societies for compulsory education, and one society for adult education. In seven societies for the consolidation of holdings, 2,215 fields were consolidated into 547 fields. His Highness's Government have initiated the work of adult education in the state and have allotted funds for subsidizing agencies for promoting the work. The compulsory education societies appear to be rather slack in not enforcing the penalty prescribed in the by-laws on members who fail to send their wards to the schools. The Registrar is considering a scheme by which the existing education societies as well as those which may be organized will run in conformity with the general scheme of adult education inaugurated by the Government.

The number of central banks and unions increased from 14 to 15 during the year, the working capital and the owned increasing from Rs. 19·8 lakhs to Rs. 21·7 lakhs and from Rs. 10·4 lakhs to Rs. 11·1 lakhs respectively. The high proportion of owned resources and its appreciable increase in existing circumstances are satisfactory features of the financial administration of these banks.

No refresher course or training class was held during the year. It may be of interst to mention that the inspecting staff are constantly directed to read literature on cooperation so that they may remain in touch with modern theories and give them practical shape whenever possible. They are also required to record in their fortnightly diaries the literature on cooperation they read regularly. One Deputy Registrar and one Assistant Registrar proceeded to Europe on study leave and returned after a course of higher training.

Consolidation of holdings*

Sir John Russell in his report† pointed out that the fragmentation and scattering of holdings is a very serious weakness in Indian agriculture and unless a method is found to consolidate them progress in the introduction of improved methods of farming and improving the general welfare of the agricultural classes as a whole must be extremely slow. This question was considered by a special committee of the Advisory Board of the Imperial Council of Agricultural Research in March 1938 and later by a joint committee of the Governing Body and the Advisory Board of the Council at its meeting held at Simla in July 1938. It was generally recognized that fragmentation of holdings was one of the greatest impediments in land improvement and constituted an important factor in making agriculture in India uneconomic. The committee recommended that, as a first step to improvement in this direction, various provinces and constituent states be asked to send whatever information they possessed on consolidation of holdings in their respective areas and when all the reports were received the information should be collected by the

* This section was prepared by R. B. R. L. Sethi, I.A.S.

† Report on the work of the Imperial Council of Agricultural Research in applying science to crop production in India, pp. 64-5.

Council. It should as far as possible show the methods adopted, the extent of operations, the departments by which carried out and the cost involved. It was further agreed that the information if received in time should be published in *Agriculture and Animal Husbandry in India.*

The answers to the enquiry showed that in the Punjab, the United Provinces, the Central Provinces, the North-West Frontier Province and in the states of Baroda and Jammu and Kashmir, the need for action had been recognized and action taken. In the Punjab the work is carried out by the cooperative societies and in the Central Provinces by the Revenue Department. Consolidation acts have been passed in both the provinces. In the United Provinces the work is carried out by the cooperative societies but a scheme by which consolidation of cropping is effected in the newly developed tube-well areas is in the charge of the Agricultural Department. In the United Provinces the societies are registered after the consolidation has been effected and the possession has actually been transferred while in the Punjab the societies are registered before any other action is taken. In Baroda a consolidation act was passed in 1921 and while 90 per cent work is carried on through cooperative societies 10 per cent is done through Revenue Officers. The work in most of these places is done by persuasion. A detailed account of the work done in these important centres is further given.

In BOMBAY, a small holdings bill was introduced in 1927 but due to keen opposition to the intended alteration in the Hindu law of inheritance and the effect on the smallest holder, the measure was withdrawn. Since 1929 future grants of waste lands are now, under orders of the Government, made on impartible tenure.

In BENGAL, the Government appointed a board of economic enquiry in December 1936, which, after consideration of the question in all its aspects, agreed that no tangible benefits could accrue unless legislation was devised to put a check on further fragmentation of holdings either by altering the laws of inheritance among the Hindus and the Mohammedans or otherwise. The note from Bengal showed an imperfect distinction between fragmentation and sub-division. This distinction was lost to view in many reports. It is worth while explaining this distinction between the two. The sub-divisions indicate the progressive reduction in the total size of each man's farm which results from partition among heirs under the present law of inheritance and produces holdings so small as to be uneconomic. Fragmentation, on the other hand, is not due to the law of inheritance but to the custom which allows each heir to take a share of each field wherever situated.

A large farm may be a fragmented farm, i.e. held in scattered plots, whereas a tiny farm may be and often is held in a single block without fragmentation. In this connection it may be mentioned that the law of inheritance in many peasant countries of Europe is substantially the same as that of Bengal, yet in these countries consolidation has been carried out; fragmentation is now voluntarily avoided by heirs though the law of inheritance and the practice of sub-division remain unaltered.

The board of economic enquiry of Bengal further recommended that the process of consolidation, however, could be tried in the Khas-Mahals or in villages where there is only one landlord. In such cases plots exchanged between one tenant and another could be added to or subtracted from existing tenancies,

leaving the total number of tenancies and rents unaltered. In villages belonging to many different landlords consolidation of holdings was almost impracticable.

ASSAM. The Government of Assam after examining the position have come to the conclusion that fragmentation of holdings has not proceeded to such lengths in the Assam valley as to call for action. Such fragmentation is admittedly of a serious nature in parts of the Surma valley, but the absence of a proper record of rights in the permanently settled areas renders the formation of any simple administrative measure impracticable. Where consolidation measures appear desirable and feasible as in the temporarily settled areas, particularly in the Jaintia Parganas, it is considered that cooperative methods offer the best hope of success and the possibility of encouraging action on cooperative lines is not being lost sight of, but for the present the cooperative movement in such areas is not of sufficient strength. A suggestion, that the principles of the civil court should be applied to partition proceedings under the land revenue regulations to prevent further fragmentation by enabling sale proceeds to be distributed rather than the land and fixtures themselves, was considered but was discarded as likely to be ineffective. The opinion of certain Revenue Officers is that since the system has not been apparently tried in permanently settled areas, an attempt to consolidate holdings in Assam must begin with temporarily settled areas as in the Punjab and the Central Provinces.

MYSORE. The question engaged the consideration of a committee appointed by the Government specially for the purpose as also of a committee on cooperation which among other matters dealt with this question.

The committee confined their investigations to a few talukas and collected statistics for about half a dozen villages in each taluka. They prepared two statements, one showing the size of holding, i.e. the extent to which sub-division had progressed, and the other the extent of fragmentation of lands in the state. According to the first statement, the number of holdings which did not exceed 10 acres was 79·5 per cent. After referring to the various measures adopted in the state for the prevention of sub-division of holdings, the committee came to the conclusion that the evils of sub-division could not be met except by a change of the laws of inheritance which, however, could not be thought of in the present stage of public opinion in the country. As regards the extent of fragmentation of lands in the state, it was observed that it had not progressed to an alarming extent. After examining the schemes and measures adopted in the Central Provinces, the Punjab, Baroda and Bombay and taking into consideration the view expressed by the Royal Commission on Agriculture, the committee recommended that propaganda might be undertaken by the Cooperative Department with a view to familiarizing the rural population with the ideas of consolidation and its advantages; a regulation might be passed on the lines of the Central Provinces Consolidation of Holdings Act, providing for consolidation to be carried out in villages, and might be introduced in two or three talukas to start with and then gradually extended. The staff at the beginning should be one Consolidation Officer with half a dozen subordinates at a cost not exceeding Rs. 500 a month. The view generally held was that fragmentation of holdings in the state had not proceeded to such an extent as to constitute a serious hindrance to economic farming. In these

circumstances the Government considered it best to defer the matter for the present.

TRAVANCORE. The sub-committee of the State Economic Development Board, which was appointed to study the problem, reported that a survey of the nature and extent of the problem of sub-division and fragmentation of holdings should be conducted with reference to one *pakuthy* (village) in each of 12 typical areas, with one member of the committee being in charge of the work in each *pakuthy*. The work would largely consist of taking down, on printed forms, the data relating to different plots of a holding and its tabulation. As this was a task involving great labour and expense, the Government have ordered that this survey may be conducted in conjunction with the ensuing census operations. In the meanwhile the sub-committee of the board has been asked to consider and report whether consolidation should be started throughout the state or only in certain specialized tracts, the relative merits of various methods and the lines on which legislation, if any, should proceed.

BHOPAL. In Bhopal the question is not acute but the Government have made certain rules to check fragmentation below five acres. A copy of these rules is further given.

In COCHIN, no law exists to check fragmentation. Legal measures are advocated as the only effective remedy.

MADRAS, BIHAR, SIND, ORISSA and HYDERABAD have not so far taken any measures to consolidate holdings as the problem in most places has not been found to be very pressing.

The cost of consolidation varies in different provinces ; while in Chhattisgarh (C. P.) it is four annas per acre, in the Punjab, the North-West Frontier Province and Jammu and Kashmir it varies from Rs. 1-8 to Rs. 2-8. In the United Provinces it varies from 9 as. per acre in the eastern districts to 7 as. per *bigha* (one-half of an acre) in the western districts. This variation may be ascribed to difference in conditions in various places and it should not be supposed that the low figure of 4 as. can be reproduced in all places. The variations in level and constitution of soils, the amount and nature of irrigation, the rate of pay of the staff employed in different places and the docility or stubbornness of the peasantry have all to be taken into account. Figures of cost have not been given by the Baroda State for either revenue or co-operative agency. A comparison of the cost needs to be very cautiously made in order that all items included in one case are also included in another.

The advantages of consolidation are manifold and these, as related in reports of important centres, are briefly indicated below :

In the Punjab some of the areas which were hitherto lying uncultivated owing to either being small or unwieldy have now been brought under cultivation. On account of the change brought about in the shape and size of the fields, the interest of cultivators in their land has increased and this has resulted in more efficient management of the fields and better yield of crops. In the *barani* (rain-fed) areas it has now become more convenient to make bunds round the fields for retaining rain water. It has resulted in an increased use of improved implements and better conservation of manures. With the improvement in the level of fields there is greater economical use of the irrigation water

The system of cropping has changed and poor crops are generally giving place to better ones. In the Central Provinces it has improved the general standard of agriculture in the rice-growing tract of the Chhattisgarh division. The removal of bunds between small fields and straightening of field boundaries have added about 2 per cent to the actual area under rice crop. The gross produce of crops in the consolidated village (in the C. P.) is estimated to have increased by about 5 to 10 per cent. In general, consolidation of holdings has saved a good deal of the time and energy of cultivators formerly wasted in going over to scattered plots. With the laying out of footpaths and cattle tracks the chances of the crop being trampled upon and grazed by cattle and of thefts during harvest time are minimized. Chances of boundary disputes and of encroachments on land have considerably decreased with the consequent decrease of litigation between farmers. Arrangements have been made to reserve special blocks for pastures and for other necessities or amenities of village life. Consolidation has reduced the work of village *patwaris* and has made it possible to decrease their number without any sacrifice of quality of work.

A brief account of important centres where measures have been adopted with success is given below :

In the UNITED PROVINCES the work on consolidation of holdings was started in the eastern part of the province in 1926 on a cooperative basis under the supervision of the provincial cooperative union. Since the financial year 1937-38 a recurring grant of Rs. 12,500 has been sanctioned by the local Government to help the union to extend its field of activities. Since 1932 an area of more than 25,000 acres has been consolidated in nearly 93 villages at a total cost of Rs. 15,000 or at the rate of 9 as. per acre. The consolidation of holdings in this area is reported to have improved the standard of agriculture. Cooperative consolidation has also been undertaken in Bijnore, Sahranpore and Moradabad districts where the number of societies has lately increased from 82 to 94. Close upon 39,000 plots have so far been consolidated into about one-tenth of the number. The cost is about 7 as. per *bigha*. The work is done by persuasion and the societies are registered after consolidation has been effected and the possession actually transferred. Persuasion has, however, its limits and it appears it will be necessary before long to supplement it by legislation more or less on the lines of that in force in the Central Provinces.

Another form of consolidation which strictly speaking consists more of consolidation of cropping and which is also advocated as an alternative measure by Sir John Russell in his report* has been in progress in the western districts of the province, particularly in the Meerut division. This became possible with the inauguration of the state tube-wells scheme of the Hydro-Electric Department. In 1935 the provincial Agricultural Department prepared a definite scheme of agricultural development in the tube-well areas and it was launched in October of the same year in the Meerut and Moradabad districts. The area brought under the scheme was divided into five development zones (i.e. three in Meerut and two in Moradabad districts), each zone being worked by one Inspector, three fieldmen and 12 *kamdars*. The scheme was put in charge of a Tube-well Agricultural Development Officer stationed at Meerut. The work at Moradabad was supervised by a senior Inspector designated as Assistant Cane Control Officer. In the beginning 12 tube-wells were included in each

* Page 64.

zone which have since been extended to 36 tube-wells per zone. The main features of the development work consist of (i) remodelling of holdings (including construction of water channels and block roads), (ii) consolidation of crops (block forming), (iii) supplies of seed and manure, and (iv) undertaking other measures of village improvement. The practice followed in remodelling of holdings is that the staff first marks out the *chaks* (blocks) to be brought under control. They then proceed with the straightening of *mainds* (partitions) of the fields coming in the *chaks*. The cultivators are as far as possible induced to draw up the *mainds* in straight lines. If necessary they are induced to exchange land between two fields to straighten the corners in such a way that the area of the fields is not affected. There is no legal compulsion for this purpose ; the cultivators are merely persuaded to do this in their own interest. In the beginning there was some opposition but the improvements effected by the process have gradually created a confidence in cultivators who now willingly carry out the instructions of the department. The cultivators are then induced to grow the same crop in one *chak* thereby effecting consolidation of crops. Here again there is no legal force ; it rests entirely with the cultivator to follow the advice or reject it, but barring a few exceptions practically all carry out the instructions. The successful working of these two operations, i.e. remodelling of holdings and consolidation of crops, depends on the extent of confidence that the staff is able to create among the cultivators. The advantages of consolidation of crops consist in effecting economy in irrigation water, in facilitating performance of agricultural operations and in affording facilities for easy transport of produce. Such consolidated blocks in this area are generally made with two crops, i.e. sugarcane and wheat. Formerly the sugarcane crop in this area was grown haphazard without any definite rotation and second and even third-year ratoon canes were grown. The rotation of crops now followed is, first year—sugarcane, second year—ratoon cane, third year—wheat and fourth year—*sanai* or *kharif* crops. The ratoon has definitely been limited to one year only in the controlled blocks. All agricultural operations in blocks are carried out under the supervision of the departmental staff.

In the PUNJAB cooperative consolidation of holdings societies were first organized in the year 1920 on a voluntary basis, i.e. without special legislation. Some concessions to the peasant's suspicions were made in the earlier period, the members being required only to accept the new consolidated holdings for four years, with the right to revert to their old scattered plots if they then wished. No re-allotment, however, when once approved by the members, has ever been subsequently rejected and the four years limit was soon withdrawn. The staff is specially trained for the purpose, and selected inspectors and sub-inspectors are employed on the responsible duty of repartition and work in collaboration with the elected committees of the cooperative consolidation societies. This staff was previously paid by the Government but in recent years arrangements have been made by the villages which apply for consolidation to make a contribution towards the cost. The Government of the Punjab passed a consolidation act in 1936 similar to that of the Central Provinces whereby not less than two-thirds of landowners in an estate holding not less than three-fourths of the cultivated area are required to make an application for consolidation of their holdings before any action is taken. When it is settled that a scheme should be introduced in any village, a cooperative society is formed for the purpose

and is registered. It is now usual to demand also a payment of 8 as. per acre from the owners towards the cost of operation and this sum is readily paid. The by-laws bind every member to accept a scheme of partition which is approved by two-thirds of the members and to submit all disputes to arbitration and to subject any future partition or rearrangement of the consolidated area to the decision of the society. Up till July 1937 a total area of 800,000 acres had been consolidated and an area of at least 100,000 acres is now being completed annually. A statement showing the progress made annually in the number of societies, the number of members, the area consolidated in acres per year and the cost per acre annually from 1921 up to 1938 is given below. It should be clearly understood that no pressure, official or other, is exerted on the peasantry either to initiate a demand for consolidation or to accept a re-allotment plan when drawn up. The demand is voluntary in all cases and the applications exceed the capacity of the allotted staff. It is for this reason that the condition of a levy per acre has been imposed. The size of plots is, in any case, greatly increased and much economy secured. The 120,295 acres consolidated in 1936-37 were reduced from nearly 200,000 plots to 29,400 and the area of each was proportionately increased. Access to each member's holding is given by the laying-out of new roads, the space for which is found by the removal of superfluous boundaries dividing the former tiny plots. Special sites are often also assigned by the villagers for a school play-ground or similar amenities. It has sometimes been supposed that the owners of small plots are ousted in the course of consolidation and given compensation in cash or in land in other districts. This is not the case. No attempt is made to eliminate any right-holder and each person is given the same area of land which he formerly held.

Progress made by the cooperative consolidation of holdings societies in the Punjab since 1921

Particulars	1921	1922	1923	1924	1925	1926
1. Societies	60	107	133	154	174	237
2. Members	1,698	3,397	5,225	7,078	8,412	10,928
3. Area consolidated (in acres per year)	7,571	6,983	5,376	8,120	11,707	21,258
4. Cost per acre (in rupees per year)	0-12-5	2-1-4	3-0-6	2-2-9	2-8-10	3-5-1

Particulars	1927	1928	1929	1930	1931	1932
1. Societies	314	428	543	654	795	911
2. Members	15,387	20,495	28,305	35,778	47,948	58,803
3. Area consolidated (in acres per year)	38,071	64,699	48,709	50,105	72,821	60,348
4. Cost per acre (in rupees per year)	2-7-2	1-12-0	2-12-10	3-0-6	1-11-8	2-0-7

Progress made by the cooperative consolidation of holdings societies in the Punjab since 1921—contd.

Particulars	1933	1934	1935	1936	1937	1938	Grand total
1. Societies . .	1,011	1,097	1,167	1,210	1,270	1,360	11,625
2. Members .	67,992	78,319	89,429	103,584	119,875	141,929	796,634
3. Area consolidated (in acres per year)	62,062	56,148	63,534	92,689	120,295	132,313	922,809
4. Cost per acre (in rupees per year)	1-13-2	1-14-0	1-11-8	1-10-0	1-10-1	1-11-5	..

CENTRAL PROVINCES. The outstanding example of consolidation through the revenue staff is in the Chhattisgarh division. The common term used for these operations is *chakbandi*. Before the British occupation a system of annual redistribution of the fields in each village of the Chhattisgarh division among cultivators was in vogue. The object of the system, which was known as *Lakhabhata*, was to ensure that every cultivator in a village obtained a share in rotation of the different types of land in his village. This system encouraged the fragmentation of land and the formation of fields of small dimensions. The operation of the ordinary law of inheritance during later years brought in further fragmentation of the already scattered holdings, and it has long been recognized that this extreme fragmentation of land in Chhattisgarh was a serious obstacle to the economic cultivation of holdings throughout the whole of the rice area in this division. Revenue and Settlement officers endeavoured from time to time in the past to evolve some simple system of consolidation of holdings in these areas. No real progress could, however, be made, as the cultivators themselves were backward and the voluntary exchange of fields was the only way in which a holding could be consolidated. Government decided some nine years ago to legislate in regard to consolidation and the 'Consolidation of Holdings Act' was passed in 1928. The act and the rules thereunder now provide the necessary machinery for the consolidation of holdings. The Consolidation Officer can proceed to prepare a scheme of consolidation in a village when he receives an application from not less than one-half of the permanent holders in the village, holding not less than two-thirds of the occupied area. The Consolidation Officer is assisted in his work by a *panchayat* of five villagers representing the different interests in the village. The rules provide for the hearing of objections, the submission of voluntary schemes agreed to by the villagers and various other matters, in which the villagers are closely associated with the Consolidation Officer and his staff at every stage. The ultimate decision in case of objections lies with the Settlement Commissioner. Before April 1938 there were two Consolidation Officers and 40 Inspectors and over 1,100,000 acres had been repartitioned in 1,172 villages of Drug and Raipur districts, the average size of a plot being raised from $\frac{1}{2}$ acre to $3\frac{1}{5}$ acres, and the total number of plots brought down from 2,370,000 to 354,000. The average size of a rice field in these consolidated villages is now six times the size of former rice *dolis*. Intervening *bunds* are being demolished and compact holdings have now come into being.

The most encouraging feature of consolidation is its growing popularity. The Chhattisgarh tenant is now fully alive to the benefits of consolidation, and the work is making remarkable progress. The strength of the consolidation staff had to be increased in order to cope with the increasing number of applications for consolidation, and the whole cost of the operations is now met by the holders themselves. The average cost of consolidation is 4 as. an acre and the entire cost of consolidating a village is willingly deposited by the villagers in advance. A statement showing rate of progress through successive years is given on page 292 :

NORTH-WEST FRONTIER PROVINCE. Consolidation of holdings began in 1930 and about 26,000 acres have been repartitioned, the plots being brought down from 38,000 to 7,500. The cost, consisting almost entirely of the pay of staff, varies from Rs. 1-8 to Rs. 3 per acre depending on local circumstances. The share of this cost which falls on the Government is more than compensated by the extension of irrigation (from canals or old wells or from the sinking of new wells) to land formerly dry, by the cultivation of waste land, diminution of partition proceedings and of futile litigation and the reduction of violent crime. The landowners and cultivators show their appreciation by their readiness to make voluntary contributions.

JAMMU AND KASHMIR. The measure of consolidation of holdings was introduced in the Jammu and Kashmir State in 1926 and the progress made so far in this direction is noted as under :—

No. of villages consolidated	Area consolidated in acres	No. of blocks before consolidation	No. of blocks after consolidation
189	36,047	85,576	11,498

The movement for consolidation of holdings is proving advantageous to zemindars in many respects. Re-stripping of scattered fields into blocks of economic size has rendered the ploughing, sowing, irrigation, protection and harvesting much easier and less expensive. The cost is almost the same as in the North-West Frontier Province.

BARODA. An act for consolidation of scattered holdings to be worked by the Revenue Department was passed in 1921 and a further measure (XXVII of 1933) to allow to neighbours a right of preemption in order to prevent fragmentation. Under this act two-thirds of the *khatedars* (cultivators) of a village, holding not less than half of the total land, can apply to the *Suba* (District Magistrate) for consolidation of their land and the act is made applicable to the whole village. Individual consolidation work is not done through this act. Although it is considered desirable to amend rules so that individual *khatedars* may also be allowed to consolidate their small and scattered holdings by mutual exchange. The work of consolidation of individual *khatedars* was, however, started through cooperative effort in 1925 by the Department of Cooperation. The work done through these cooperative societies is on a voluntary basis. Ten or more persons of any village willing to consolidate their lands can form a society which after due enquiry is registered. A board of directors is then formed and is empowered to consolidate the lands of the members of the societies by transfers and a transfer statement is prepared. Documents of transfers are prepared

Progress of Chakbandi *in Chhattisgarh division (Central Provinces) from December 1926 to September 1936*

—	No. of villages for which schemes prepared	Area consolidated	No. of permanent holders	*Khasra* No. before *Chakbandi*	*Khasra* No. excluded from *Chakbandi*, i.e. *Baris-Kharra*, etc.	Net *Khasra* No. after *Chakbandi*	Percentage reduction of column 6 on 4. 4 *minus* 5	Expenditure	Rate per cent	Cost levied @ 4 as per acre (if any)
	1	2	3	4	5	6	7	8	9	10
		Acres.						Rs.	Rs. A. P.	Rs.
Voluntary basis under the act : .	9	6,242	387	15,825	570	2,174	..	..	..	..
December 1926 to September 1928 .	10	10,051	769	25,804	1,641	4,373	82	23,369	1 7 0	
October 1928 to September 1929 .	22	19,677	1,352	56,558	2,783	6,680	88	15,671	0 12 8	Free
October 1929 to September 1930 .	79	53,752	5,179	1,01,834	7,469	20,524	73	19,501	0 5 10	
October 1930 to September 1931 .	58	59,723	4,740	1,08,057	5,724	15,489	85	19,866	0 5 6	
October 1931 to September 1932 .	103	1,13,364	9,763	2,81,209	13,631	24,808	91	22,696	0 3 8	22,700
October 1932 to September 1933 .	121	1,15,464	10,860	2,97,565	12,438	29,627	90	24,598	0 3 5	28,866
October 1933 to September 1934 .	127	1,18,154	10,246	1,84,912	11,705	40,359	77	26,738	0 3 7	29,572
October 1934 to September 1935 .	179	1,75,959	14,528	3,56,080	20,810	60,414	82	41,798	0 3 10	44,045
October 1935 to September 1936 .	220	2,22,285	19,774	4,97,739	27,580	76,563	84	45,867	0 3 4	55,640
TOTAL .	928	8,94,671	77,598	19,25,583	1,04,351	2,81,011	..	2,40,104	..	1,80,823

from this statement which are then registered before the Sub-Registrar. After the documents are registered the transfer statement is sent to *Mahal Vahivatdar* concerned for transfers of names and for necessary changes in the registers. After the lands are transferred in the revenue records consolidation is permanently effected. Mutation, however, in the settlement registers is left to the will of the members. Thus land consolidated is not always compulsorily brought under one survey number, although the holder is allowed to get his several numbers in a block turned into one single holding even in survey papers. The work of consolidation of holdings has been well begun in the Kadi, Kalol, Sinor, Mahuva and Padra talukas. A total of almost 48,000 acres has been consolidated under the act of 1921 of which 90 per cent was done through the agency of cooperative societies and the remainder through revenue officers. A statement showing the rate of progress made through successive years is given on page 294. The success of this work largely depends on the efforts of the honorary organizers and local revenue officers interested in cooperation. The honorary organizers and the Government auditors who help in the consolidation work are given a remuneration of Rs. 5 and Rs. 3 respectively for each block reduced. Small pamphlets explaining the advantages of consolidation are distributed among members of societies which are 74 in number.

The difficulties experienced in getting cultivators to agree to consolidate their holdings are their poverty, indebtedness, difficulty of obtaining in exchange the same type of land and complicated processes required to be undertaken for effecting change of holdings. To popularize the movement the Government give amongst others the following special concessions :—

(1) When a *Barkhali* alienated land is transferred with one under *Sarkari* (Government) or *Chakariat* (village service) head the original *sanad* is issued for the lands so transferred.

(2) Same concessions are given when a *Chakariat* land is transferred with the *Sarkari* land.

(3) Exemption of registration fees.

(4) Instead of separate transmutation for every *khatedar's* land, all such transmutations are entered in a single form, and sanctioned collectively. It is also exempted from stamp duty.

(5) Exemption of stamp duty on documents of transfers of lands.

(6) Members have not to go to the Sub-Registrar's Office at the taluka town, but the Sub-Registrar goes to the village when a sufficient number of transfers of holdings are to be registered.

BHOPAL. The question of fragmentation and scattering of holdings is not at all acute. Holdings are generally large and fairly compact and it is therefore not necessary to take any immediate steps towards consolidation. Some rules, however, are framed by the Revenue Department to prevent fragmentation in such a way as to minimize this evil. The main provisions of these rules entitled ' Rules governing Partition of Holdings ' are noted below :

(1) Every person, who enjoys the rights of a tenant in a holding as prescribed in the Bhopal State Land Revenue Act (IV of 1932) and whose name is entered in the register of rights as a tenant or co-sharer, can apply for the partition of his holding.

The work done regarding the consolidation of scattered holdings in the Baroda State.

Serial No.	Year	Number of societies	Number of members	Number of members whose land is consolidated	Total land consolidated	Before consolidation		After consolidation		Total number of blocks reduced
						Survey number	Blocks	Survey number	Blocks	
1	1924-25	2	95	53	779—12	267	214	272	149	65
2	1925-26	2	65	5	193—19	81	47	81	43	4
3	1926-27	1	30	13	1,007—10	184	43	188	37	6
4	1927-28	2	91	91	7,266—4	2007	1,597	1990	1,373	224
5	1928-29	4	152	39	1,494—2	471	358	453	309	49
6	1929-30	7	176	69	4,817—8	725	515	746	483	32
7	1930-31	9	457	214	7,054—4	2848	1,929	2860	1,744	185
8	1931-32	13	300	94	2,348—13	811	574	794	496	78
9	1932-33	26	691	337	10,694—10	3852	2,720	3831	2436	284
10	1933-34	4	229	210	6,299	2423	1,557	2426	1,407	150
11	1934-35	2	187	84	2,236—2	1076	698	1074	638	60
12	1935-36	2	121	89	3,774—9	1537	850	1537	775	75
13	1936-37	..	..	38	917—12	549	325	549	298	27

Such application shall be submitted in writing to the Tehsildar and shall mention, among other things which the applicant deems necessary, the following facts :

(i) Name of village, tehsil and district in which the land to be partitioned is situated ;

(ii) *Khasra* number giving area of each number as well as the total area of the holding ;

(iii) Land revenue of each *khasra* number and total land revenue of the holding ; and

(iv) Names of all the co-sharers with their fathers' name, caste and residence and area of each share.

An attested extract from the *jamabandi* of the preceding year shall accompany the application for partition.

2. (*a*) If the partition for which an application is made results in a holding of less than five acres, the application shall be dismissed without any action being taken on it.

(*b*) If the partition creates small holdings or holdings scattered in different places over a large area and the co-sharers are thereby prevented from deriving any benefit from such holdings owing to their being small or scattered, the Tehsildar shall be entitled to dismiss the application giving reasons thereof in writing.

3. When the application for partition is not dismissed under rule 2 above, the Tehsildar shall issue a notice, giving information of the partition, in the village where the land mentioned in the application is situated or in the village from where it is cultivated. Notices shall also be issued to all the co-sharers of the holding, binding them to be present on a specified date (falling 30 days or at the most 60 days after the issue of the notice) and to file any objection which they may desire to make. If the above notice is not served on any co-sharer for some reason, the issue of the notice shall be considered to be equivalent to the service of the notice. Besides the co-sharers of the land, the mortgagees of, and persons having permanent or temporary rights in the same, also shall be entitled to file objections.

4. After hearing the claims of the applicant or applicants and the objections of the objectors, if the Tehsildar does not find sufficient grounds for partition or there be some other hindrance to the same, he shall dismiss the application by a written order giving reasons thereof. If the Tehsildar finds sufficient grounds for the partition and there be no hindrance to the same, he shall start proceedings of partition.

5. The partition shall be made in one of the following ways :

(i) By mutual agreement.

(ii) By arbitrators appointed by the parties to the partition.

(iii) By the Tehsildar.

6. (*a*) (i) When the applicants agree to partition by mutual agreement, the Tehsildar shall direct them to submit, within a specified time, a *razinama* (deed of agreement) giving details of the partition.

(ii) When the applicants desire partition by arbitration, the Tehsildar shall direct them to nominate their arbitrators. The arbitrators so nominated shall submit their award giving details of partition within the period specified by the Tehsildar.

(iii) When the Tehsildar himself partitions the land, he shall, after necessary enquiry, inspection and measurement of the land on the spot, prepare a *robkar* of the partition.

(*b*) It shall be obligatory to take the following facts into consideration :

(i) Kind of land ;

(ii) Nature of land, e.g., *bir*, *charokhar*, etc. ;

(iii) Sources of irrigation, if any ;

(iv) So far as possible, no fragments of *khasra* numbers should be made ;

(v) A *khasra* number, except enclosure of *gattas* or such number which may be under irrigation at the time of partition or had been irrigated during the preceding five years, should not be partitioned in such a way as to form a piece of less than five acres in area ;

(vi) Partition should be made in such a way so as to make every share a profitable holding ; and

(vii) All the numbers which fall to the share of a person should, so far as possible, adjoin, or be adjacent to one another.

7. If the applicants do not submit the *razinama* mentioned in Rule 6 (*a*) (i) or the arbitrators fail to send their award as provided in Rule 6 (*a*) (ii) within the specified time, the Tehsildar shall himself make the partition.

8. When a holding is divided into shares by partition, it shall be incumbent to proportionately fix the land revenue of each share.

9. The Tehsildar shall generally accept the partition made either by mutual agreement or an arbitration award under Rule 6 above. But if in the case of mutual agreement, the applicants, or in the case of arbitration, the arbitrators, did not observe the limitations imposed by the rule just following, the Tehsildar shall reject the mutual agreement or the arbitration award, as the case may be, and shall himself make the partition.

10. If the Tehsildar accepts the original agreement or the arbitration award and issues orders accordingly, no appeal shall lie to such an order passed by him. All the other orders which may be passed under these rules shall be appealable under Chapter IV of the Bhopal State Land Revenue Act (No. IV of 1932).

CHAPTER XIV

PUBLICATIONS OF THE AGRICULTURAL DEPARTMENTS

A COMPLETE list of the agriculture and animal husbandry publications issued in India during the year under review is given in Appendix XVI. A brief account of the publications of the central, provincial and state Agricultural and Veterinary Departments is given below :

Central Government publications.—The Imperial Council of Agricultural Research continued the publication of the three journals, viz. *Agriculture and Livestock in India, the Indian Journal of Agricultural Science and the Indian Journal of Veterinary Science and Animal Husbandry,* all of which reached the eighth volume. The first two were issued bimonthly and the last one quarterly. In addition to the three journals, the following publications were issued :

(*a*) *Scientific Monograph No. 11.—Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and the formation of the Phrenic Nerve in the Ox, with observations on certain Anatomical Deviations,* by H. N. Chelva Ayyangar.

(*b*) *Miscellaneous Bulletin No. 15.—Selected Clinical Articles, Part II,* by G. K. Sharma, R. L. Kaura, S. Ganapathy Iyer, G. S. Khan and S. Mangrulkar.

Miscellaneous Bulletin No. 16.—Indian Grazing Conditions and the Mineral Contents of some Indian Fodders, by Dr. P. E. Lander.

Miscellaneous Bulletin No. 17.—A Brief Survey of some of the Important Breeds of Cattle in India, by Col. Sir Arthur Olver.

Three miscellaneous bulletins and one scientific monograph were in the press at the end of the year.

Provincial and state publications.—In addition to ordinary leaflets in Indian languages on matters of agricultural interest, the wide distribution of which is a feature of all provincial Agricultural Departments, leaflets in more popular form are now being issued in some provinces. Their effectiveness is limited by the illiteracy of the bulk of the cultivating classes.

In MADRAS the Department of Agriculture issued 11 leaflets, eight broad hint series, five pamphlets and two notes. About 20,000 copies of the *Villager's Calendar for 1937-38* (in English and four provincial languages) were printed and distributed. A monograph on the coconut and a popular English handbook on rice in Madras were published. A popular account of the activities of the Agricultural Department from 1922 to 1935 was published. Twenty-nine short notes on the activities of the department were issued to the local papers. *The Madras Agricultural Journal,* issued by the Madras Agricultural Students' Union, continued to be popular.

In BOMBAY the Agricultural Department contributed articles dealing with local agricultural problems to newspapers and magazines in the districts. A special leaflet showing how to organize gun-clubs and a poster to show how the

Forest, Police and Agricultural Departments can cooperate in the protection of crops were printed and distributed. A bulletin on the development of the *kagdi* lime industry in Western India and a leaflet on the grading of grapes in the Nasik district were published. *The Poona Agricultural College Magazine* was as usual issued quarterly. The Deccan Agricultural Association published its monthly Marathi magazine, the *Shetki and Shetkari*. The new Gujarati monthly magazine, *Khedut, Kheti and Sahakar*, continued publication with the joint efforts of both Cooperative and Agricultural Departments and is stated to be growing in popularity.

In BENGAL all the leaflets and bulletins published previously by the Department of Agriculture were reprinted for wide circulation amongst cultivators. A bulletin on the open pan system of white sugar manufacture was published.

In the UNITED PROVINCES the Department of Agriculture issued 24 leaflets; six pamphlets and seven bulletins. The departmental magazines *Kisan Upkark* and *Mufid-ul-Mazarain* continued to be published. The fortnightly issue of *The Bulletin of the United Provinces Fruit Development Board* was continued as usual by the provincial Marketing Officer, the bulletin gives, among other things wholesale and retail prices of fruits in some of the important markets of the United Provinces.

The PUNJAB Department of Agriculture continued to issue half yearly *Seasonal Notes*. *The Lyallpur Agricultural College Magazine* completed the fifth year of its existence. *The Punjab Fruit Journal*, issued by the Punjab Fruit Development Board, Lyallpur, published an annual number during the year, which contained English and Urdu sections dealing with various aspects of the fruit industry in the country.

The Department of Agriculture, BIHAR, issued nine bulletins and three leaflets. The Provincial Agricultural Association journal *Kisan* continued to be published. The journal is issued quarterly in Hindi and is stated to be very widely appreciated.

In the CENTRAL PROVINCES AND BERAR bulletins and leaflets are published in English, Marathi and Hindi. The leaflets generally deal with agricultural subjects in a popular way and are distributed free at all important fairs and shows. Besides other publications, the department issued nine leaflets. *The Nagpur Agricultural College Magazine*, published quarterly, continued to be popular.

The ASSAM Department of Agriculture issued 12 leaflets and three bulletins.

The Agricultural Department of the NORTH-WEST FRONTIER PROVINCE issued *Quarterly Notes* (i.e., January, April, July and October) from the Agricultural Station, Tarnab. The periodical is intended to give information about different aspects of agricultural developments in the province.

The Department of Agriculture, SIND, issued seven new leaflets, 10 revised leaflets and 48 press notes during the year. These publications are issued in English and Sindhi and keep the zemindars and the literate *haris* (tenants) well informed of agricultural developments. Leaflets written in simple dialogue are read out to *haris*.

In BALUCHISTAN a leaflet on the control of codling moth in Baluchistan was distributed free to cultivators.

In HYDERABAD leaflets on improved varieties of crops, methods of cultivation, manures, implements, cultivation of fruits, poultry keeping and important

insect pests were distributed free in large numbers. The Hyderabad Farming Association continued to issue its quarterly magazine, *The Hyderabad Farmer*, which is an important medium for agricultural propaganda. The English quarterly and the Kannada monthly published by the Agricultural Experimental Union, Mysore, continued to be popular. In BARODA six messages to farmers were issued during the year. A number of other publications in English and in the local language were also published on different subjects. A publication entitled *Fifty Years Onward: History of the Department of Agriculture for the last 50 Years* was also published. The Department of Agriculture and Fisheries, TRAVANCORE, published four pamphlets during the year. In COCHIN three leaflets and two bulletins dealing with cultivation, manuring and insect pests were issued during the year. In BHOPAL leaflets with parallel Urdu and Hindi texts on typical subjects were published for distribution to cultivators.

CHAPTER XV

RECEIPTS AND EXPENDITURE OF THE AGRICULTURAL AND VETERINARY DEPARTMENTS

THE financial aspects of the Agricultural and Veterinary Departments of the central, provincial and state Governments during 1937-38 are summarized in Statements I and II. Statements IIIA and IIIB show the figures analyzed under various sub-heads.

The total gross expenditure of the central and provincial Departments of Agriculture has risen from Rs. 145·09 lakhs in 1936-37 to Rs. 150·57 lakhs in 1937-38. The total gross expenditure of the central and provincial Veterinary Departments has increased from Rs. 66·1 lakhs in 1936-37 to Rs. 71·4 lakhs in 1937-38. There is thus a rise of nearly Rs. 5 lakhs each in the total expenditure of the Agricultural and Veterinary Departments during the year.

STATEMENT I

Receipts and expenditure of the Agricultural Departments in India for 1936-37 and 1937-38

Central institute, province or state	1936-37		1937-38	
	Receipts	Expenditure	Receipts	Expenditure
British India				
Imperial Agricultural Reserach Institute, New Delhi.	62,436	8,74,050	73,217	7,38,037
Imperial Dairy Department, Bangalore	1,14,481*	2,06,044*	1,16,528	2,21,367
Madras	1,88,792	19,54,180	3,54,945	22,30,769
Bombay	1,68,835*	11,43,333*	1,90,720	11,60,477
Bengal	72,800*	10,90,000*	76,700	9,47,700
United Provinces	4,52,067*	25,08,039*	4,24,810	26,69,775
Punjab	11,78,271*	32,66,167*	12,25,308	35,63,560
Bihar	1,26,351	10,22,521	1,29,429	8,68,519
Central Provinces and Berar	2,33,992	10,71,338	2,00,340	10,22,360
Assam	58,570*	4,81,112	66,420	4,97,815
North-West Frontier Province	45,268*	1,14,940*	81,722	2,18,056
Orissa	25,435	1,00,013*	23,094	1,60,840
Sind	79,055	5,61,272*	1,19,533	7,09,228
Baluchistan	7,760	56,038	5,970	53,441
TOTAL FOR BRITISH INDIA	28,14,122	1,45,09,056	30,88,736	1,50,67,944
Indian States				
Hyderabad	42,770*	8,93,586*	23,221	8,85,609
Mysore	49,983*	7,38,507*	55,765	7,95,376
Baroda	28,157*	3,90,117*	47,188	4,75,017
Travancore	9,331	1,24,841*	8,217	1,34,085
Cochin	21,033	84,948	28,978	1,12,923
Bhopal	10,903	64,181*	7,221	47,852
Jammu and Kashmir	71,445*	1,82,087*	61,702	1,28,703
TOTAL FOR INDIAN STATES	2,33,631	24,78,267	2,32,292	25.79.745
TOTAL FOR BRITISH INDIA AND INDIAN STATES.	30,47,753	1,69,87,323	33,21,028	1,76,47,689

* Revised figures.

STATEMENT II

Receipts and expenditure of the Civil Veterinary Departments in India during 1936-37 and 1937-38

Central Institute, province or state	1936-37		1937-38	
	Receipts	Expenditure	Receipts	Expenditure
British India.				
Imperial Veterinary Research Institute, Mukteswar.	5,22,699	7,28,591	5,13.329	8.22 073
Madras	82,042*	11,47,843*	94,013	12,41.814
Bombay	30,769*	5,22,915*	34,688	5,36,721
Bengal	1,26,411*	4,17,371*	1,46,688	4,28,254
United Provinces	1,30,525	4,49,707	1,33,347	4,36,118
Punjab	1,42,160	21,47,472	2,03,801	23,52,028
Bihar	1,80,559	4,59,277*	1,87,522	4,45,887
Central Provinces and Berar	54,810*	1,06,141*	34,148	77,903
Assam	1,333	1,83,894	1,544	1,91,677
North-West Frontier Province	5,000*	1,41,100*	12,685	2,73,480
Orissa	19,024	89,396	25,191	1,03,101
Sind	9,171*	1,22,282	21,405	1,39.894
Baluchistan	*Nil*	63,389	*Nil*	60,067
Coorg	62	21,878	65	22,600
Ajmer-Merwara	*Nil*	11,546	1,141	10,467
TOTAL FOR BRITISH INDIA	13,04,565	66,12,802	14,09,567	71,42,693
Indian States				
Hyderabad	13,597*	4,96,694*	24,434	†
Mysore	23,154	2,62,300	20,445	2,92,135
Baroda	9,992*	1,27,260*	19,288	1,51.679
Travancore	270*	36,282*	369	38,636
Cochin	*Nil*	9,252*	*Nil*	10,334
Bhopal	*Nil*	15,511	*Nil*	34,959
Jammu and Kashmir	151*	56,614*	279	78,587
TOTAL FOR INDIAN STATES	47,164	10,04,003	64,815	6,06,330
TOTAL FOR BRITISH INDIA AND INDIAN STATES.	13,51,729	76,16,805	14,74,382	77,49,023

* Revised figures.
† Figures not available.

STATEMENT III-A

Receipts and expenditure of Agricultural Departments in India during 1936-37 and 1937-38 (classified)

Central institute, province or state	Expenditure									
	Crops and soils		Education		Animal husbandry		Miscellaneous		Total.	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India										
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial Agricultural Research Institute, New Delhi.	7,64,564	6,53,779	(a)	(a)	1,09,486	84,258	..	..	8,74,050	7,38,037
Imperial Dairy Department, Bangalore.	..	..	..	..	..	..	..	..	2,06,044*	2,21,367
Madras	16,98,216	9,01,829	1,49,818	1,49,039	1,06,146	1,38,829	..	10,46,672	19,54,180	22,36,769
Bombay	8,25,894	7,85,769	1,62,915	1,46,800	1,54,524	1,65,798	..	62,110	11,43,333	11,60,477
Bengal	5,40,300	5,29,700	11,400*	12,500	2,28,500*	80,200	3,09,800*	3,26,400	10,90,000*	9,47,700
United Provinces	..	..	3,66,673	3,63,212	1,47,254	1,66,622	20,54,112*	21,39,941	25,68,039*	26,69,775
Punjab	30,59,019*	33,42,845	1,95,792	2,09,977	11,356	10,738	..	..	32,66,167*	35,63,560
Bihar	10,22,521	8,68,519	..	..	..	..	..	..	10,22,521	8,68,519
Central Provinces and Berar	8,72,139	9,00,905	98,581	1,21,455	1,00,618	..	..	..	10,71,338	10,22,360
Assam	3,51,452	3,80,126	9,021	11,707	1,20,638	1,05,982	..	..	4,81,112	4,97,815
North-West Frontier Province	1,14,349	77,781	600	2,150	..	..	..	1,38,125	1,14,949	2,18,056
Orissa	77,438*	1,36,816	..	..	2,181*	2,232	20,394*	21,792	1,00,013*	1,60,840
Sind	5,40,205	5,73,191	1,954	2,339	19,113	15,311	..	1,18,387	5,61,272	7,09,228
Baluchistan	56,038*	53,441	..	..	..	..	..	..	56,038*	53,441
Indian States										
Hyderabad	7,27,301*	7,54,047	22,466*	22,466	37,893*	3,152	1,05,926*	1,06,032	8,93,586*	8,85,699
Mysore	3,87,329	4,10,474	26,561	28,424	3,09,597	3,37,650	15,020*	18,822	7,38,507*	7,95,376
Baroda	1,41,208*	2,21,387	14,027*	10,968	87,121*	1,06,754	1,47,761*	1,35,908	3,90,117*	4,75,017
Travancore	81,010	89,229	9,108	8,704	34,723	36,152	..	..	1,24,841	1,34,085
Cochin	83,660*	1,07,167	..	..	1,288*	5,756	..	..	84,948*	1,12,923
Bhopal	47,670	46,852	1,000	1,000	15,511	..	..	..	64,181	47,852
Jammu and Kashmir	..	..	..	..	..	..	..	..	1,82,087*	1,28,793

(a) As the research and education activities are combined, it is not possible to separate figures for education.
* Revised figures.

Receipts and expenditure of Agricultural Departments in India during 1936-37 and 1937-38 (classified)—contd.

Central institute, province or state.	Receipts							
	Crops and soils		Animal husbandry		Miscellaneous		Total	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India								
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial Agricultural Research Institute, New Delhi.	32,285	31,292	24,926	34,400	(*b*) 5,225	(*b*) 7,525	62,436	73,217
Imperial Dairy Department, Bangalore.	..	..	..	..	..	..	1,14,481*	1,16,528
Madras	1,72,885	2,47,541	15,907	16,881	..	90,523	1,88,792	3,54,945
Bombay	97,524	94,425	63,068	72,509	..	23,786	1,68,835*	1,90,720
Bengal	57,500*	62,260	7,800	7,140	7,500*	7,300	72,800*	76,700
United Provinces	..	..	62,386	62,065	3,89,681*	3,62,745	4,52,067*	4,24,810
Punjab	10,12,404*	10,70,167	674	734	1,65,193*	1,54,407	11,78,271*	12,25,308
Bihar	1,26,351	1,29,429	..	..	..	..	1,26,351	1,29,429
Central Provinces and Berar	1,68,455	1,91,026	55,368	..	10,169	9,314	2,33,992	2,00,340
Assam	33,975	41,179	24,604	25,241	..	..	58,579	66,420
North-West Frontier Province	45,268	50,320	..	..	..	31,402	45,268	81,722
Orissa	22,641*	21,357	2,794*	1,737	..	..	25,435	23,094
Sind	75,555	93,820	3,500	..	..	25,713	79,055	1,19,533
Baluchistan	7,760*	5,970	..	..	..	..	7,760*	5,970
Indian States								
Hyderabad	36,288*	22,767	6,491*	454	..	..	42,779*	23,221
Mysore	19,719	26,265	30,264*	29,500	..	..	49,983*	55,765
Baroda	13,648*	18,996	1,699*	19,288	12,811*	8,905	28,157*	47,188
Travancore	9,109	7,848	222	369	..	..	9,331	8,217
Cochin	19,776*	23,502	1,257*	5,476	..	..	21,033*	28,978
Bhopal	10,903	7,221	..	..	..	..	10,903	7,221
Jammu and Kashmir	..	..	..	..	..	..	71,445*	61,702

(*b*) Receipts derived from education.
* Revised figures.

STATEMENT III-B

Receipts and expenditure of Veterinary Departments in India during 1936-37 and 1937-38 (classified)

Province or state	EXPENDITURE.									
	Disease control		Education		Livestock Improvement		Miscellaneous		Total.	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India										
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial Veterinary Research Institute, Mukteswar.	..	..	..	..	..	..	..	..	7,28,591	8,22,673
Madras	(a)9,08,405	9,70,753	(a)1,20,633	1,31,079	(a)1,06,146	1,29,868	(a) 12,659	10,114	(a)11,47,843	12,41,814
Bombay	4,56,519	4,72,774	66,396	63,947	..	..	..	..	5,22,915	5,36,721
Bengal	(a)2,60,252	2,83,470	(a)1,47,862	1,37,692	..	..	(a)9,257	7,092	(a)4,17,371	4,28,254
United Provinces	..	..	..	..	..	..	..	..	4,49,707	4,36,118
Punjab	(a)11,56,595	12,39,760	1,58,025	1,69,184	(a)8,32,852	9,43 084	..	..	21,47,472	23,52,028
Bihar	(a)3,12,992	3,04,610	83,183	68,025	53,915	64,292	(a) 9,187	8,960	(a)4,59,277	4,45,887
Central Provinces and Berar (b)	(a)86,712	81,794	(a)5,358	2,309	1,01,955*	77,903	(a)4,186	..	(a)1,06,141	77,903
Assam	1,80,522	1,86,691	3,372	4,986	..	..	..	..	1,83,894	1,91,677
North-West Frontier Province	1,65,100	1,88,246	7,000	8,800	29,000	76,434	..	..	1,41,100	2,73,480
Orissa	89,396	90,913	..	688	..	11,500	..	..	89,396	1,03,101
Sind	(a)1,15,894	1,33,225	(a)673	1,358	(a)5,715	5,311	..	..	(a)1,22,282	1,39,894
Baluchistan	5,961	6,885	..	..	4,000	3,500	(a)53,428	49,682	(a)63,389	60,067
Coorg	19,363	19,306	..	..	2,514	3,303	..	..	21,878	22,609
Ajmer-Merwara	(a)10,507	9,482	..	..	..	..	(a)1,039	985	11,546	10,467
Indian States										
Hyderabad	(a)3,51,018	..	(a)4,166	..	(a)1,32,488	..	(a)8,954	..	(a)4,96,694	..
Mysore	..	..	..	..	..	..	..	..	2,62,390	2,02,135
Baroda	(a)87,121	91,400	..	..	(a) 30,909	37,085	(a)9,230	23,194	(a)1,27,260	1,51,679
Travancore	(a)35,036	37,136	(a)77	..	(a)1,169	1,500	..	..	(a)36,282	38,636
Cochin	(a)8,100	9,200	..	..	..	..	(a)1,152	1,134	(a)9,252	10,334
Bhopal	5,196	4,824	..	514	10,315	29,621	..	..	15,511	34,959
Jammu and Kashmir	(a)51,569	69,502	..	..	(a)5,045	9,085	..	..	(a)56,614	78,587

Receipts and expenditure of Veterinary Departments in India during 1936-37 and 1937-38 (classified)—contd.

Province or state	Receipts.					
	Livestock Farms		Miscellaneous (Other sources)		Total	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India						
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial Veterinary Research Institute, Mukteswar.	..	..	..	..	5,22,699	5,13,329
Madras	(*a*) 15,907	14,738	(*a*) 66,135	79,275	(*a*) 82,042	94,013
Bombay	..	..	(*a*) 30,769	34,688	(*a*) 30,769	34,688
Bengal	..	..	(*a*) 1,26,411	1,46,688	(*a*) 1,26,411	1,46,688
United Provinces	..	..	..	..	1,30,525	1,33,347
Punjab	1,02,877	1,46,575	39,283	57,226	1,42,160	2,03,801
Bihar	(*a*) 37,458	62,164	(*a*) 1,43,101	1,25,358	(*a*) 1,80,559	1,87,522
Central Provinces and Berar (*b*)	54,810†	34,148	..	..	(*a*) 54,810	34,148
Assam	..	..	1,333	1,544	1,333	1,544
North-West Frontier Province	..	..	5,000	12,685	5,000	12,685
Orissa	..	..	19,024	25,191	19,024	25,191
Sind	..	..	(*a*) 9,171	21,405	(*a*) 9,171	21,405
Baluchistan	..	..	..	..	..	..
Coorg	..	..	62	65	62	65
Ajmer-Merwara	..	..	..	1,141	..	1,141
Indian States						
Hyderabad	(*a*) 13,597	..	(*a*) 10,837	..	(*a*) 13,597	24,434
Mysore	..	..	..	..	23,154	20,445
Baroda	8,057	10,171	1,935	9,117	(*a*) 9,992	19,288
Travancore	(*a*) 204	307	(*a*) 66	62	(*a*) 270	369
Cochin	..	..	..	..	..	..
Bhopal	..	..	..	..	..	..
Jammu and Kashmir	..	..	(*a*) 151	279	(*a*) 151	279

(*a*) Revised figures

(*b*) The livestock improvement work in this province was under the control of the Agricultural Department during 1936-37.

* This includes expenditure of the Ellichpur Cattle Breeding Farm which was under the control of the Department of Agriculture during 1936-37.

† This includes receipts of the Ellichpur Cattle Breeding Farm which was under the Control of the Department of Agriculture during 1936-37.

APPENDICES

APPENDIX I

Areas under new and improved varieties of crops in India during 1937-38

Province or state	Name of crop	Area in acres					
		1936-37			1937-38		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
Imperial Dairy Department.							
(*a*) Imperial Dairy Institute, Bangalore.	Guinea grass	7·99	..	7·99	8·25	..	8·25
	Napier grass	·59	..	·59	·59	..	·59
	Sudan grass	..	..	..	·16	..	·16
	Rhodes grass	·21	..	·21	·21	..	·21
	Lucerne	·92	..	·92	·66	..	·66
	Jowar	70·81	..	70·81	70·81	..	70·81
	Oats	·16	..	·16	..	..	..
	Green soya beans	..	..	..	·11	..	·11
(*b*) Wellington Milk Depot, Wellington (Nilgiri District), Madras.	Rhodes grass	2·00	..	2·00	2·00	..	2·00
	Guinea grass	2·50	..	2·50	2·00	..	2·00
	Lucerne	·30	..	·30	·50	..	·50
	Berseem	·20	..	·20	·50	..	·50
	Oats, peas and maize	5·50	..	5·50	10·50	..	10·50
	Oats	16·75	..	16·75	..	..	..

Madras	*Jowar*	..	..	..	9·75	..	9·75
	Ragi and *bajra*	2·00	..	2·00	2·00	..	2·00
	Potatoes	2·25	..	2·25	2·00	..	2·00
	Paddy	23,758	1,371,285	1,395,043	59,408	1,711,778	1,771,186
	Cotton	48,864	553,875	602,739	78,735	598,967	677,702
	Sugarcane	1,711	48,805	49,516	1,616	59,768	61,411
	Miscellaneous	7,814	91,193	99,007	9,612	227,902	237,514
Bombay	Cotton	427,675	185,734	613,409	657,679	253,647	911,326
	Groundnut	465	49,734	50,199	360	55,732	56,092
	Wheat	5,581	44,836	50,367	7,693	66,530	74,133
	Sugarcane	431	18,108	18,539	934	22,010	22,944
	Bajri (Akola)	591	2,650	3,241	1,672	3,200	4,872
	Paddy	7,340	14,155	21,495	10,629	56,813	67,442
	Tobacco	107	2,500	2,607	734	1,500	2,234
	Sann seed	167	2,817	2,984	3,008	1,025	4,033
	Soya bean	123	150	273	156	75	231
	Lucerne	200	1,586	1,786	..	2,500	2,500
	Nilwa	4	100	104	120	150	270
	Fruit	456	10,235	10,691	453	18,534	18,987
	Nagli	220	4,000	4,220	190	4,599	4,689
	Jowar	2,613	6,880	9,493	5,892	9,860	15,752
	Potato	1,235	1,990	3,225	60	2,490	2,550
	Spanish peanut	..	..	..	159	755	914
	Castor	..	..	..	41	50	91
	Daincha	..	..	..	25	115	140
	Berseem	..	..	..	6	5	11
	Miscellaneous	2	..	2	..	..	..

Areas under new and improved varieties of crops in India during 1937-38—contd.

Province or state	Name of crop	AREA IN ACRES					
		1936-37			1937-38		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
Bengal	Paddy	13,295	762,989	776,284	9,345	476,723	486,068
	Jute	1,167	1,300,277	1,301,444	339,202	1,424,545	1,763,747
	Sugarcane	2,745	325,071	327,816	523	285,679	286,202
	Other crops	5,302	59,017	64,319	3,058	60,406	63,464
United Provinces	Wheat	236,000	2,637,000	2,873,000	153,311	340,904	494,215
	Cotton	48,000	397,000	445,000	10,261	26,963	37,224
	Sugarcane	111,000	1,862,500	1,973,500	141,053	1,264,255	1,405,308
	Barley	15,000	104,500	119,500	9,952	179,423	189,375
	Gram	19,000	152,200	171,200	12,643	59,937	72,580
	Paddy	(included under miscellaneous)			20,781	205,452	226,233
	Miscellaneous	44,000	287,000	331,000	13,844	115,184	129,028
Punjab	Cotton (American & improved *desi*)	573,600	1,654,600	2,228,200	580,900	1,915,000	2,495,900
	Wheat (8A., Pb. 11, etc.)	370,000	3,890,900	4,260,900	404,800	4,532,900	4,937,700
	Sugarcane	2,900	299,700	302,600	400	318,800	319,200
	Wheat	..	..	58,350	5,579	59,172	64,751
	Sugarcane	..	..	473,524	6,320	651,320	657,640
	Paddy	..	..	42,554	1,102	37,415	38,517

Bihar	Jute	..	..	300	..	2,700	2,700
	Barley	..	..	3,903	420	3,015	3,435
	Groundnut	..	..	1,852	138	1,829	1,967
	Tobacco	..	..	30	..	..	..
	Gram	..	..	4,274	522	6,227	6,749
	Miscellaneous	..		4,302	1,252	5,238	6,490
Central Provinces	Wheat	..	..	649,687	..	..	568,415
	Paddy	..	..	667,733	..	..	702,562
	Cotton	..	..	476,923	..	..	389,773
	Jowar	..	..	218,672	..	..	166,302
	Groundnut		..	98,166	..	..	151,466
	Other crops	.	.	83,626	..	..	52,578
Assam	Paddy	5,274	47,224	52,498	3,265	48,433	51,698
	Sugarcane	90	17,452	17,551	313	15,294	15,607
	Potato	55	8,837	8,892	296	12,008	12,304
	Jute	..	13,765	13,765	406	13,985	14,391
Orissa	Sugarcane	170	30,830	31,000	50	32,950	33,000
	Paddy	122	21,584	21,706	322	24,710	25,032
	Oil-seeds	54	7,164	7,218	37	8,645	9,682
	Potato	12	2,844	2,856	20	3,030	3,050
	Onion	5	6,609	6,614	10	6,990	7,000
	Wheat	12	398	410	10	430	440
	Beans and Pulses	38	3,028	3,066	57	3,559	3,616
	Miscellaneous	160	4,621	4,781	192	6,161	6,353

Areas under new and improved varieties of crops in India during 1937-38—contd.

Province or state	Name of crop	Area in acres					
		1936-37			1937-38		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
North-West Frontier Province—Southern circle.	Wheat	28,096	105,523	134,519	8,926	38,532	47,458
	Maize	4,560	33,080	37,640	209	1,180	1,689
	Sugarcane	10	2,500	2,510	3	50	53
	Gram	37	55	92	125	300	425
	Cotton	1,162	250	1,412	125	5,280	5,405
	Bajra	..	..	..	15	..	15
	Berseem	..	..	..	50	30	80
	Shaftal	..	..	..	..	35	35
North-West Frontier Province—Northern circle.	Wheat	..	..	..	20,534	240,554	261,088
	Sugarcane	..	..	..	13,872	18,366	32,238
	Maize	..	..	..	8,970	77,509	86,479
	Barley	..	..	..	150	108,670	108,827
	Potatoes	..	..	..	20	3,066	3,086
Sind	Cotton	71,888*	421,894*	496,782*	205,494	578,978	784,472
	Wheat	69,460*	240,751*	310,211*	105,793	279,058	384,851
	Paddy	84,186*	176,116*	260,302*	94,614	233,454	328,068
	Miscellaneous	63,207*	84,145*	147,352*	83,744	89,746	173,490
	Sugarcane	531	8,620	9,151	419	5,017	5,436
	Groundnut	1,331	125,359	126,690	5,188	169,231	174,419
	Bajra	238	831	1,069	447	1,358	1,805

Hyderabad (Deccan)	Wheat	253	1,127	1,380	494	1,064	1,558
	Paddy	236	1,307	1,543	551	2,071	2,622
	Jowar	5	10	15	35	4	39
	Cotton	27,704	79,368	107,072	239,845	8,136	247,981
	Castor	187	232	419	123	360	483
	Guinea grass	1	3	4	..	..	..
	Linseed	..	..	..	8	211	219
	Tobacco	..	..	..	1	..	1
	Potatoes	1	..	1	..	..	..
	Daincha	1	..	1	..	..	..
Mysore	Paddy	6,858	102,346	109,204	9,064	38,057	47,121
	Ragi	8,034	224,017	232,051	4,002	104,467	108,469
	Sugarcane	14,094	16,420	30,514	12,829†	3,139	15,968
	Groundnut	3,046	16,474	19,520	3,140	23,668	26,808
	Sunn-hemp	50	302	352	163	354	517
	Tobacco	..	967	967	275	..	275
	Jola	..	46,898	46,898	985	48,781	49,766
	Cotton	6,880	15,108	21,988	15,094	36,504	51,598
	Vegetable seeds	12	21	33	3	39	12
	Pepper cuttings	..	20	20	..	..	.
	Chillies	1	3	4	1	20	21
	Java wheat	1	..	1	..	..	..
	Sunflower	..	..	..	3	2	5
	White *til*	..	..	..	95	160	255
	Coconut	..	..	..	1	..	1
	Plantain	..	..	..	1	..	1
	Miscellaneous		5	5	..	..	..

* Revised figures.
† Figs. of natural spread cannot be correctly ascertained and are not reliable.

Areas under new and improved varieties of crops in India during 1937-38—concld.

Province or state	Name of crop	Area in acres					
		1936-37			1937-38		
		Departmental seed	Natural spread	Total	Departmental seed	Natural spread	Total
Baroda	Cotton	40,030*	19,701*	59,731*	41,446	20,008	61,454
	Paddy	187*	6,252*	6,439*	570	6,896	7,466
	Wheat	227*	12,418*	12,645*	455	23,004	23,459
	Sugarcane	13*	87*	100*	14	142	156
	Bajri	60*	259*	319*	25	259	284
	Potato	..	..	..	6	..	6
	Miscellaneous	9*	10*	19*	452	5	457
Travancore	Paddy	304	..	304	218	..	218
Cochin	Paddy (Cochin I)	108*	3,940*	4,048*	112	4,585	4,697
	Coconuts	32	46	78	26	78	104
	Sugarcane	1*	165*	166*	1	213	214
	Pine-apple	..	50	50	..	50	50
	Cotton Cambodia	..	6,919*	6,919*	..	8,542	8,542
	Groundnut A. H. 25	..	4	4	..	40	40
	Daincha	..	10*	10*	35	5	40

Bhopal	Wheat	3,000	59,196	62,196	2,000	70,000	72,000
	Gram	1,000	1,200	2,200	1,200	2,400	3,600
	Linseed	250	1,000	1,250	200	1,200	1,400
	Oats	..	..	..	5	15	20
	Peas	100	100	200	100	150	250
	Masoor	8*	40*	48*	9	20	29
	Cotton	17	30	47	20	60	80
	Tobacco	7	25	32	10	30	40
	Soyabean	10*	10*	20*	..	..	..
	Turmeric	7*	25*	32*	8	32	40
	Castor	5	5	10	6	30	36
	Groundnut	50	40	90	60	180	240
	Moong and urd	5*	25*	30*	6	10	16
	Tuar	40*	30*	70*	45	100	145
	Jowar	5*	150*	155*	6	24	30
	Paddy	2	8	10	4	12	16
	Til	100	1,500	1,600	..	..	..
	Sugarcane	2,000 (canes)	1,800 (canes)	3,800 (canes)	..	..	..
Jammu and Kashmir	Wheat, rice, sugarcane, etc.	2,470	..	2,470	3,590	..	3,590

*Revised figures.

APPENDIX II

List of agricultural research stations in India in 1937-38

Province or State	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Imperial Department of Agriculture in India.	New Delhi (Imperial Agricultural Research Institute Farm).	380	Assistant Agriculturist .	Imperial Agriculturist .	General Agriculture and Cattle breeding.
	Karnal (Imperial Agricultural Research Institute, Sub-station).	1,175	Cattle Superintendent .	Ditto . . .	Agricultural Sub-station and Cattle Breeding Farm.
	Coimbatore	90	Farm Manager . .	Sugarcane Expert . .	Sugarcane Breeding, Station.
	Pusa (Bihar)	200	Superintendent . .	Imperial Economic Botanist.	Botanical Sub-station, financed by the Imperial Council of Agricultural Research.
	Guntur	20	Ditto . . .	Ditto . . .	Tobacco Sub-station, financed by the Imperial Council of Agricultural Research.
	Simla	23	Ditto . . .	Ditto . . .	Potato Breeding Sub-station, financed by the Imperial Council of Agricultural Research.
	Karnal	50	Assistant . . .	Sugarcane Expert . .	Sugarcane Sub-station, financed by the Imperial Council of Agricultural Research.
	Samalkota (East Godavari) . .	57	Farm Manager . .	Assistant Director of Agriculture, Rajahmundry.	
	Anakapalle (Vizagapatam) . .	104	Superintendent . .	Deputy Director of Agriculture, I Circle, Coconada.	
	Maruteru (West Godavari) . .	50	Ditto . . .	Paddy Specialist, Coimbatore.	
	Guntur	150	Farm Manager . .	Assistant Director of Agriculture, Guntur.	
	Hagari (Bellary)	225	Superintendent . .	Deputy Director of Agriculture, II Circle, Cuddapah.	

Madras	Nandyal (Kurnool)	88	Farm Manager	Assistant Director of Agriculture, Cuddapah.
	Kodur (Cuddapah)	50	Superintendent	Deputy Director of Agriculture, II Circle, Cuddapah.
	Gudiyatham (North Arcot)	35	Farm Manager	Superintendent, Agricultural Research Station, Anakapalle.
	Kalahasti (Chittoor)	30	Ditto	Assistant Director of Agriculture, Nellore.
	Erayanur (South Arcot)	49	Superintendent	Oilseeds Specialist, Coimbatore.
	Palur (South Arcot)	52	Farm Manager	Assistant Director of Agriculture, Cuddalore.
	Adutural (Tanjore)	50	Superintendent	Deputy Director of Agriculture, III Circle, Trichinopoly.
	Pattukkottai (Tanjore)	36	Assistant Director of Agriculture, Pattukkottai.	Ditto.
	Kollpatti (Tinnevelly)	140	Superintendent	Ditto.
	Pattambi (Malabar)	82	Ditto	Paddy Specialist, Coimbatore.
	Taliparamba (Malabar)	86	Farm Manager	Assistant Director of Agriculture, Tellicherry.
	Kasaragod and Nileswar (South Kanara).	178	Superintendent	Oilseeds Specialist, Coimbatore.
	Nanjanad (The Nilgiris)	160	Farm Manager	Assistant Director of Agriculture, Coimbatore.
	Pomological Station, Coonoor, Barliar and Kallar (The Nilgiris).	30	Ditto	Curator, Government Botanic Gardens, Ootacamund.
	Coimbatore	400	Superintendent	Principal, Agricultural College, Lawley Road P. O., Coimbatore.
	Hosur (Salem)	1,600	Ditto	Livestock Development Officer, Hosur Cattle Farm P. O.
	Buchireddipalem (Nellore)	10	Farm Manager	Assistant Director of Agriculture, Nellore.
	Ambasamudram (Tinnevelly)	10	Ditto	Assistant Director of Agriculture, Tinnevelly.

List of agricultural research stations in India in 1937-38—contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Bombay	Jalgaon (District East Khandesh)	107	Superintendent, Jalgaon Farm.	Deputy Director of Agriculture, North Central Division, Nasik.	
	Bhadgaon (District East Khandesh)	230	Superintendent, Bhadgaon Farm.		
	Dhulia Agricultural School (District West Khandesh).	28	Head Master, Dhulia Agricultural School, Dhulia.	Ditto.	
	Karjat (District Kolaba)	15	Rice Specialist, Karjat, District Kolaba.	Ditto.	
	Kopargaon (District Ahmednagar)	110	Superintendent, Kopargaon Farm, Kopargaon.	Deputy Director of Agriculture, South Central Division, Poona.	Sugarcane Experimental and Confirmation Station.
	Ratnagiri (District Ratnagiri)	22	Superintendent, Ratnagiri Farm, Ratnagiri.	Ditto	Rice and *Nagli* Breeding Station.
	Hatkhamba (District Ratnagiri)	71	Ditto	Ditto	
	Mohol (District Sholapur)	55	Superintendent, Mohol Farm.	Ditto	This farm is maintained for testing and showing method of dry farming and land development in famine area.
	Dharwar (District Dharwar)	146	Superintendent, Dharwar Farm, Dharwar	Deputy Director of Agriculture, South Division, Dharwar.	
	Gokak Canal Farm, Arbhavi (District Belgaum).	62	Superintendent, Gokak Canal Farm, Arbhavi, District Belgaum.	Ditto	
	Kumta (District North Kanara)	68	Superintendent, Kumta Farm.	Ditto.	
	Rice Breeding Station, Mugad (District Dharwar).	8	Rice Breeder, Mugad	Ditto.	
	Cattle Breeding Farm, Tegur (District Dharwar)	370	Manager, Cattle Breeding Farm, Tegur.	Ditto.	
	Surat (District Surat)	294	(i) Superintendent, Agricultural Station, Surat.	Deputy Director of Agriculture, Gujarat, Surat.	

			(ii) Cotton Breeder, South Gujarat, Surat.	Ditto.	
	Nadiad (District Kaira) . .	22	Tobacco Breeder, Nadiad	Ditto	
	Broach (District Broach and Panch Mahals).	22	(i) Superintendent, Broach Farm.	Ditto.	
			(ii) Cotton Breeder, Broach	Ditto.	
	Dohad (District Broach and Panch Mahals)	68	Superintendent, Dohad Farm, Dohad.	Ditto.	
	Viramgam (District Ahmedabad) .	13	Cotton Breeder, North Gujarat, Viramgam	Ditto.	
	Agricultural College Farm, Poona (District Poona)	275	Superintendent, Agricultural College Farm, Poona.	Professor of Agriculture, Agricultural College, Poona.	
	Agricultural College Dairy, Kirkee (District Poona).	362	Manager, Agricultural College, Kirkee.	Ditto.	
	Rice Breeding Station, Karjat (District Kolaba)	3*	Superintendent, Rice Breeding Station, Karjat.	Crop Botanist to Government, Bombay Presidency, Karjat.	* Area under actual cultivation.
	Cereal Breeding Station, Niphad (District Nasik)	16*	Superintendent, Cereal Breeding Station, Niphad.	Ditto .	Ditto.
	Northcote Cattle Breeding Farm, Chharodi (District Ahemdabad).	2,278	Manager, Northcote Cattle Breeding Farm, Chharodi.	Livestock Expert to Government Bombay Presidency, Poona.	
	Cattle Breeding Farm, Bankapur (District Dharwar).	248†	Manager, Cattle Breeding Farm, Bankapur.	Ditto. .	† 96 acres farm area and 152 acres grazing area at Kalasgeri attached to the farm.
	Ganeshkhind Fruit Experiment Station, Kirkee (District Poona)	80	Superintendent, Ganeshkhind Fruit Experiment Station, Kirkee, District Poona.	Horticulturist to Government, Bombay Presidency, Poona.	
	Modibag, Agricultural College, Poona (District Poona).	12	Superintendent, Modibag, Agricultural College, Poona	Ditto . .	This is now converted into commercial fruit farm.
	Samarkh, Kasor and Nisaraya via Anand (District Kaira)	223	Investigator in Agricultural Economics, Agricultural College, Poona.	Professor of Agricultural Economics, Agricultural College, Poona	Cost accounting for mixed farming with livestock raising.
Lengal	Government Agricultural Farm Ranganati (Chittagong Hill Tract).	36	District Agricultural Officer, Chittagong Hill Tracts.	Assistant Director of Agriculture, Bengal.	

List of agricultural research stations in India in 1937-38—contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Bengal—*contd.*	Dacca Central Farm (Dacca)	354	Chief Superintendent, Dacca Farm.	Deputy Director of Agriculture, Eastern Circle.	About 300 acres of land acquired extra for Agricultural Institute. Low land is under cultivation on *barga* system and part of high land is used for cane breeding. The rest are used for grazing by the Dairy herd.
	Jaidebpur Farm, Dacca	13	Agricultural Demonstrator	District Agricultural Officer, Dacca.	Farm and the Agricultural Demostrator maintained by the Court of Wards Estate, Jaidebpur.
	Mymensingh Farm, Mymensingh	20	District Agricultural Officer, Mymensingh.	Deputy Director of Agriculture, Eastern Circle.	
	Jamalpur Farm, Mymensingh	35	Agricultural Officer, Jamalpur.	Ditto	Run on *barga* system-crop sharing basis.
	Kishoreganj Farm, Mymensingh	83	District Agricultural Officer, Mymensingh.	Ditto	Ditto.
	Phanbari Farm, Mymensingh	7	Agricultural Officer, Mymensingh.	Ditto	Ditto.
	Gayhatta Farm, Mymensingh	6	Agricultural Demonstrator, Gayhatta.	District Agricultural Officer, Mymensingh.	Farm and the Agricultural Demonstrator maintained by the Mymensingh Court of Wards Estate.
	Baratia Farm, Mymensingh	8	Agricultural Demonstrator, Baratia.	Agricultural Officer, Jamalpur.	Farm and the Agricultural Demonstrator maintained by the Zemindar of Santosh, Six Annas Estate.
	Mahinanda Farm, Mymensingh	20	....	....	Run on *barga* system under supervision of the Sub-Divisional Officer, Kishoreganj; it is on Khasmahal land. The District Agricultural Officer, Mymensingh gives necessary advice.

Faridpur Farm, Faridpur . . .	20	District Agricultural Officer, Faridpur.	Deputy Director of Agriculture, Eastern Circle.	
Rajbari Farm, Faridpur . . .	10	Ditto . .	Ditto . .	Run on *barga* system-crop sharing basis.
Barisal Farm, Barisal . . .	20	District Agricultural Officer, Barisal.	Ditto.	
Charbanda Farm, Barisal . .	62	Ditto . .	Ditto . .	Run on *barga* system-crop-sharing basis.
Comilla Farm, Tipperah . . .	20	District Agricultural Officer, Comilla.	Ditto.	
Brahmanbaria Farm, Tipperah . .	5	Agricultural Demonstrator, Brahmanbaria.	District Agricultural Officer, Comilla.	It is a private farm maintained by the Proprietor of Sarail Estate. The Demonstrator is maintained by the Department.
Rajshahi Farm, Rajshahi . . .	63	Superintendent, Rajshahi Farm.	Ditto.	
Rangpur Demonstration Farm, Rangpur.	19	District Agricultural Officer, Rangpur.	Deputy Director of Agriculture, Northern Circle.	
Dinajpur Farm, Dinajpur . .	24	District Agricultural Officer, Dinajpur.	Ditto.	
Pabna Farm, Pabna . . .	18	District Agricultural Officer, Pabna.	Ditto.	
Bogra Main Farm, Bogra . . .	22	District Agricultural Officer, Bogra.	Ditto.	
Bogra Branch Farm, Bogra . .	6	Ditto . .	Ditto.	
Mainaguri Farm, Jalpaiguri . .	25	District Agricultural Officer, Jalpaiguri.	Ditto.	
Maldah Farm, Maldah . . .	16	District Agricultural Officer, Maldah.	Ditto.	
Government Tobacco Farm, Rangpur	72	Superintendent, Government Tobacco Farm, Rangpur.	Agricultural Chemist, Bengal.	
Kalimpong Farm, Darjeeling . .	73	Superintendent of Agriculture, Darjeeling.	Director of Agriculture, Bengal.	
Chinsurah Farm, Hooghly . .	210	Farm Superintendent .	Deputy Director of Agriculture, Western Circle.	
Suri Farm, Birbhum . . .	35	District Agricultural Officer, Birbhum.	Ditto	

List of agricultural research stations in India in 1937-38— contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Bengal—*concld.*	Krishnagar Farm, Nadia	53	District Agricultural Officer, Nadia.	Deputy Director of Agriculture, Western Circle.	
	Fruit Research Station, Krishnagar, Nadia.	14	Horticultural Officer	Economic Botanist, Bengal.	
	Berhampore Farm, Murshidabad	44	District Agricultural Officer, Murshidabad.	Deputy Director of Agriculture, Western Circle.	
	Burdwan Farm, Burdwan	24	District Agricultural Officer, Burdwan.	Ditto.	
	Bankura Farm, Bankura	29	District Agricultural Officer, Bankura.	Ditto.	
	Jessore Khasmahal Farm, Jessore	5	District Agricultural Officer, Jessore.	Ditto.	
	Government Sugarcane Research Station, Shahjahanpur.	165	Economic Botanist (Sugarcane and Paddy) to Government United Provinces, Shahjahanpur.	Economic Botanist (Sugarcane and Paddy) to Government. United Provinces, Shahjahanpur	The Physiological work on sugarcane in progress at this station has been financed by the Imperial Council of Agricultural Research.
	Rice Research Station, Nagina (District Bijnor).	76	Assistant Paddy Specialist, Nagina.	Ditto	The Rice Research Scheme, Nagina is mainly financed by the Imperial Council of Agricultural Research with a provincial contribution of Rs. 5,000 per year.
	Sugarcane Research Station, Muzaffarnagar.	105	Cane Agronomist, Muzaffarnagar.	Research (Agronomic): Economic Botanist (Sugarcane and Paddy) to Government, United Provinces, Shahjahanpur. *Entomological*: Entomologist to Government, United Provinces, Cawnpore. *Funds and Finances and General Administration*: Deputy Director of Agriculture, Western Circle, Aligarh.	The agronomic and entomological work on sugarcane in progress at this station has been financed by the Imperial Council of Agricultural Research.

United Provinces . .	Government Cotton Research Station, Raya (District Muttra).	154	Farm Superintendent .	Economic Botanist (Cotton).	
	Government School of Agriculture, Gorakhpore.	52	Ditto .	The Head Master, Agricultural School, Gorakhpur.	
	Ditto	25*	Garden Superintendent .	Ditto . .	* Under garden and buildings
	Students Instructional Farm, Cawnpore.	71	Professor of Agriculture, Agricultural College, Cawnpore	Principal, Agricultural College, Cawnpore.	
	Agricultural Dairy Farm, Cawnpore .	39	Ditto . .	Ditto	
	Instructional Farm, Agricultural School, Bulandshahr.	86	Farm Superintendent .	Head Master, Agricultural School, Bulandshahr.	
	Government Research Farm, Cawnpore.	97	Ditto . . .	Officer-in-charge, Government Research Farm.	Research work on oil-seeds, millets, pulses, fibre crops, cotton and cereals is centralised on this farm.
	Kalai (District Aligarh) . . .	142	Ditto . .	Deputy Director of Agriculture, Western Circle, Aligarh.	
	Bulandshahr	25	Ditto . .	Ditto.	
	Muzaffarnagar	105	Cane Agronomist . .	Ditto.	
	Meerut	76	Farm Superintendent .	Ditto.	
	Mainpuri	53	Ditto . .	Ditto.	
	Farrukhabad	10	Ditto . .	Ditto.	
	Partabgarh	90	Ditto . .	Deputy Director of Agriculture, Eastern Circle, Partabgarh.	
	Fyzabad	206	Ditto . .	Ditto .	Out of this 102·42 acres has been transferred to 10 students under practical training.
	Benares	78	Ditto . .	Divisional Superintendent of Agriculture, Eastern Circle, Benares.	
	Atarra Farm (Banda) . . .	171	Ditto . .	Divisional Superintendent of Agriculture, Jhansi.	
	Belatal Farm (Hanairpur) . .	31	Ditto . .	Ditto.	

List of agricultural research stations in India in 1937-38— contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
United Provinces—*concld.*	Bichpuir, Agra	100	Farm Superintendent	Divisional Superintendent of Agriculture, Agra.	
	Eastern Farm, Etawah	61	Ditto	Divisional Superintendent of Agriculture, Etawah.	
	Cattle Farm, Bharari, Jhansi	2,241	Ditto	Divisional Superintendent of Agriculture, Jhansi.	
	Madhurikund, Muttra	1,396	Ditto	Divisional Superintendent of Agriculture, Agra.	
	Manjhra Kheri	550	Ditto	Deputy Director.	
	Hempur, Nainital	7,192	Ditto	Ditto.	
	Nawab Ganj Farm (Bareilly)	120	Ditto	Deputy Director of Agriculture, R. K. Circle. Bareilly.	
	Kisarawa Farm (Badaun)	19	Farm Overseer-in-charge	Ditto.	
	Nigohi Model Farm (Shahjahanpur)	35	Ditto	Ditto.	
	Jeolikote (hill) Farm, Nainital	51	Ditto	Ditto.	
	Tarikhet (Almora)	36	Ditto	Ditto.	
	Government Experimental Farm, Kunraghat (Gorakhpur District).	110	Farm Superintendent	Ditto	North-eastern circle, Gorakhpur.
	Government Demonstration Farm (District Bahraich).	102	Farm Superintendent and Divisional Superintendent of Agriculture.	Ditto.	
	Government Seed Farm, Kalianpur (District Cawnpore).	262	Farm Supdrintendent	Ditto	Sarda circle, Lucknow.
	Government Experimental Farm, Hardoi.	55	Ditto	Ditto	Ditto.
	Government Model Farm, Haider Garh, District Bara Banki.	28	Ditto	Ditto	Ditto.
	Government Model Farm, Bara Banki	30	Ditto	Ditto	Ditto.
	Government Model Farm, Unao	42	Ditto	Ditto	Ditto.
	Turner Farm, Rae Bareli	12	Ditto	Ditto	Ditto.

Punjab	Lyallpur Agricultural Station, Lyallpur	431	Agricultural Assistant	Deputy Director of Agriculture, Lyallpur.	Experimental Farm.
	Cereals Breeding Farm, Lyallpur	35	Cerealist	Cerealist, Punjab Agricultural College, Lyallpur.	Breeding and yield comparison experiments with wheat and barley.
	Cotton Research Station, Lyallpur	18	Cotton Research Botanist, Lyallpur.	Cotton Research Botanist, Lyallpur.	Breeding plot.
	Cotton Research Farm, Risalewala (Lyallpur District).	230	Assistant to Cotton Research Botanist, Lyallpur.	Ditto	Agronomic and extensive trials.
	Cotton Research Sub-station, Multan	25	Agricultural Assistant	Ditto	Breeding and agronomic trials.
	Students' Farm, Lyallpur	82	Assistant Professor of Agriculture II.	Associate Professor of Agriculture and Professor of Agriculture, Lyallpur.	For practical training to students.
	Dairy Farm, Lyallpur	38	Dairy Manager	Ditto	Ditto.
	Botanical Farm, Lyallpur	10	Professor of Botany	Professor of Botany, Punjab Agricultural College, Lyallpur.	For Root Rot Experiments, spice crops and various diseases. Besides, there are seven acres under teaching collection area as botanical garden.
	Fruit Farm, Lyallpur	33	Agricultural Assistant	Fruit Specialist, Lyallpur	Experiments with fruits
	Risalewala Farm (Lyallpur District)	721	Ditto	Deputy Director of Agriculture, Lyallpur.	Mainly a seed farm
	Jhang Farm (Jhang)	200	Ditto	Ditto	District Farm.
	Rice Farm, Kala Shah Kaku (Sheikhupura District).	625	Assistant Cerealist	Cerealist, Punjab Agricultural College, Lyallpur.	Comparison experiments with rice.
	Montgomery Agricultural Station (Montgomery).	681	Agricultural Assistant	Deputy Director of Agriculture, Montgomery.	Experimental Farm.
	Shergarh Farm (Montgomery District)	1,549	Ditto	Ditto	Seed Farm.
	Fatna Farm (Montgomery District)	528	Ditto	Ditto	Ditto.
	Yusafwala Farm (Montgomery District)	3,137	Ditto	Ditto	Ditto.
	Multan Farm (Multan)	528	Ditto	Deputy Director of Agriculture, Multan.	Experimental and Seed Farm.
	Vihari Farm (Multan District)	500	Ditto	Ditto	Seed Farm.
	Gurdaspur Agricultural Station (Gurdaspur).	263	Ditto	Deputy Director of Agriculture. Gurdaspur.	Experimental Farm.
	Beas Farm (Amritsar District)	36	Ditto	Ditto	District Farm.

List of agricultural research stations in India in 1937-38—contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Punjab—*contd*	Attari Farm (Amritsar District)	101	Agricultural Assistant	Deputy Director of Agriculture, Gurdaspur.	District Farm.
	Gujranwala Farm (Gujranwala)	107	Ditto	Ditto	Ditto.
	Rawalpindi Agricultural Station (Rawalpindi).	252	Ditto	Deputy Director of Agriculture, Rawalpindi.	Experimental Farm.
	Campbellpur Farm (Campbellpur)	105	Ditto	Ditto	District Farm.
	Gujrat Farm (Gujrat)	47	Ditto	Ditto	Ditto.
	Chillianwala Farm (Gujrat District)	250	Ditto	Ditto	Seed Farm.
	Sargodha Old Farm (Sargodha)	155	Ditto	Ditto	Ditto.
	Sargodha New Farm (Sargodha)	492	Ditto	Ditto	Ditto.
	Mianwali Farm (Mianwali)	162	Ditto	Ditto	District Farm.
	Hansi Agricultural Station (Hissar District)	589	Ditto	Deputy Director of Agriculture, Hansi	Experimental Station.
	Botanical Sub-station, Sirsa (Hissar District).	145	Millet Botanist and Fodder Specialist.	Professor of Botany, Punjab Agricultural College, Lyallpur.	Botanical experiments.
	Gurgaon Farm (Gurgaon)	100	Agricultural Assistant	Deputy Director of Agriculture, Hansi.	District Farm.
	Rohtak Dry Farming Research Station (Rohtak).	100	Agriculturist	Ditto	Dry Farming Research Station.
	Ambala Farm (Ambala)	100	Agricultural Assistant	Ditto	District Farm.
	Karnal Farm (Karnal)	100	Ditto	Ditto	Ditto.
	Ludhiana Farm (Ludhiana)	54	Ditto	Deputy Director of Agriculture, Jullundur.	Ditto.
	Kangra Agricultural Plot (Kangra)	10	Ditto	Ditto	Agricultural plot.
	Jullundur Agricultural Station (Jullundur City).	121	Ditto	Ditto	Experimental Farm.
	Ferozepore Farm (Ferozepore)	100	Ditto	Ditto	District Farm.

Bihar	Sepaya (District Saran)	379	Manager	Deputy Director of Agriculture, Tirhut Range, Pusa.
	Pusa (District Darbhanga)	1,279*	Inspector	
	Siwan (District Saran)	20	Overseer	
	Darbhanga (District Darbhanga)	26	Ditto	
	Byreah (District Champaran)	316	Superintendent of Betiah Estate Farms.	
	Patna (District Patna)	200	Manager	Deputy Director of Agriculture, Patna Range, Patna.
	Gaya (District Gaya)	95	Overseer	
	Nawadah (District Gaya)	88	Ditto	
	Bikramganj (District Shahabad)	24	Ditto	
	Siris (District Gaya)	35	Ditto	
	Kanke (District Ranchi)	340	Manager	Deputy Director of Agriculture, Chota Nagpur Range, Kanke (Ranchi).
	Neterhat (District Ranchi)	193	Overseer	
	Purulia (District Purulia)	58	Ditto	
	Chianki (District Palamau)	32	Ditto	
	Chaibasa (District Singhbhum)	38	Ditto	
	Sabour (District Bhagalpur)	150	Manager	Deputy Director of Agriculture, Bhagalpur Range, Sabour.
	Eanka (District Bhagalpur)	26	Overseer	
	Jamui (District Monghyr)	38	Ditto	
	Purnea (District Purnea)	60	Assistant Director of Agriculture.	
Central Provinces and Berar	Experimental Farm, Akola (District Akola).	272	Superintendent	Economic Botanist for Cotton.
	Experimental Farm, Tharsa (District Nagpur).	116	Ditto	Deputy Director of Agriculture.
	Experimental Farm, Chhindwara (District Chhindwara).	69	Ditto	Ditto.
	Experimental Farm, Powarkhera (District Hoshangabad).	528	Ditto	Ditto.
	Experimental Farm, Adhartal (District Jubbulpore).	299	Ditto	Ditto.

* Of which 80 acres have been allotted for the Sugarcane Research Station.

List of agricultural research stations in India in 1937-38—contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Central Provinces and Berar—*contd.*	Experimental Farm, Nagpur (District Nagpur).	286	Superintendent . .	Principal, Agricultural College, Nagpur.	
	Experimental Farm, Labhandi (District Raipur).	229	Ditto . .	Deputy Director of Agriculture.	
	Seed and Demonstration Farm, Waraseoni (District Balaghat)	63	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Betul (District Betul).	160	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Bilaspur (District Bilaspur).	253	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Buldana (District Buldana).	135	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Drug (District Drug).	281	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Khandwa (District Nimar).	177	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Chandkhuri (District Raipur).	119*	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Seoni (District Chhindwara).	170	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Yeotmal (District Yeotmal).	106	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Saugor (District Saugor).	161	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Dindori (District Mandla).	510	Ditto . .	Ditto.	
	Seed and Demonstration Farm, Sindewahi (District Chanda).	213	Ditto .	Ditto.	
	Seed and Demonstration Farm, Borgaon (District Akola).	379	Ditto .	Ditto.	
	Seed and Demonstration Farm, Ellichpur (District Amraoti).	300	Ditto . .	Ditto.	

Assam	Upper Shillong Experimental Station (Khasi and Jaintia Hills).	521	Farm Manager	Deputy Director of Agriculture and Livestock.	Cattle breeding, potato and fodder crops.
	Khanapara Cattle Breeding Farm (Kamrup).	197	Ditto	Ditto	Cattle breeding and fodder crops.
	Sylhet Cattle Breeding Farm (Sylhet)	210	Ditto	Ditto	Ditto.
	Jorhat Experimental Station (Sibsagar)	59	Ditto	Deputy Director of Agriculture, Upper Assam Valley and Economic Botanist, Assam.	Cattle breeding and sugarcane crop.
	Titabar Experiment Station (Sibsagar)	125	Ditto	Economic Botanist, Assam	Paddy.
	Karimganj Experiment Station (Sylhet)	80	Ditto	Deputy Director of Agriculture, South Valley.	Ditto.
	Habiganj Deep Water Paddy Research Farm (Sylhet).	54	Ditto	Economic Botanist, Habiganj.	Deep water paddy.
	Shillong Fruit Experimental Station (Khasi and Jaintia Hills).	62	Fruit Inspector	Director of Agriculture, Assam.	Fruit.
Orissa	Cuttack Farm (District Cuttack)	135	Manager	Deputy Director of Agriculture, Orissa.	
	Kujang Farm (District Cuttack)	30	Agricultural Overseer	Ditto.	
	Angul Farm (District Cuttack)	47	Ditto	Ditto.	
	Aul Farm (District Cuttack)	5	Agricultural Sardar	Ditto.	
	Balia Farm (District Balasore)	75	Agricultural Overseer	Ditto.	
	Khurda Farm (District Puri)	33	Ditto	Ditto.	
	Puri Farm (District Puri)	47	Agricultural Sardar	Ditto.	
	Sambalpur Farm (District Sambalpur).	32	Agricultural Overseer	Ditto.	
	Cuttack Rice Research Station (District Cuttack).	12	Fieldman Overseer	Paddy Specialist.	
	Berhampur Rice Research Station (District Ganjam).	33	Research Assistant	Ditto.	
	Jeypur Rice Research Sub-Station (District Koraput).	15	Ditto	Ditto.	

* Cropped area.

List of agricultural research stations in India in 1937-38—contd.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
North West Frontier Province	Tarnab Research Station (Peshawar)	200	Farm Manager . .	Agricultural Officer.	
	Experimental Farm, Serai Naurang (Bannu).	100	Ditto . . .	Extra Assistant Director of Agriculture, South Circle.	
	Noel Garden (Dehra Ismail Khan) .	12	Agricultural Assistant (D. I. K.).	Ditto.	
	Lotus Farm Mawya, Kili (Bannu) .		Agricultural Assistant (Bannu).	Ditto.	
	Haripur Experimental Farm (Hazara)	16	Agricultural Assistant (Haripur).	Extra Assistant Director of Agriculture, North Circle.	
Sind	Government Fruit Farm, Mirpurkhas (District Thar Parkar).	60	Horticulturist in Sind .	Director of Agriculture, Sind.	
	Fruit Sub-station, Larkana (District Larkana).	60	Manager, Fruit Sub-station, Larkana.	Horticulturist in Sind, Mirpurkhas.	
	Government Auxiliary Farm, Shahdadkote (District Larkana).	212	Manager, Government Auxiliary Farm, Shahdadkote.	Deputy Director of Agriculture, Right Bank, Larkana.	
	Government Auxiliary Farm, Nasirabad (District Larkana).	311	Manager, Government Auxiliary Farm, Nasirabad.	Ditto.	
	Agricultural Research Station, Dokri (District Larkana).	420	Officer in charge, Agricultural Research Station, Dokri.	Director of Agriculture, Sind.	
	Government Auxiliary Farm, Dadu (District Dadu).	585	Manager, Government Auxiliary Farm, Dadu.	Deputy Director of Agriculture, Right Bank, Larkana.	
	Rice Research Station, Larkana (District Larkana).	57	Superintendent, Rice Research Station, Larkana.	Botanist, Agricultural Research Station, Dokri.	
	Agricultural Research Station, Sakrand (District Nawabshah).	368	Officer in charge, Agricultural Research Station, Sakrand.	Director of Agriculture, Sind.	
	Government Seed Farm, Mirpurkhas (District Thar Parkar).	189	Cotton Breeder and Officer in charge, Seed Farm, Mirpurkhas.	Botanist, Agricultural Research Station, Sakrand.	

	Jamesabad Sub-station (District Thar Parkar).	29	Inspector of Agriculture, Jamrao.	Deputy Director of Agriculture, Left Bank, Hyderabad.
	Deh 257 (District Thar Parkar) .	74	Ditto . .	Ditto.
	Nawabshah Sub-station (District Nawabshah).	16	Inspector of Agriculture, Nawabshah.	Ditto
	Government Auxiliary Farm, Oderolal (District Hyderabad).	362	Manager, Government Auxiliary Farm, Oderolal.	Ditto.
	Government Auxiliary Farm, Lundo (District Nawabshah).	457	Manager, Government Auxiliary Farm, Lundo.	Ditto.
	Government Auxiliary Farm, Pad Idan (District Nawabshah).	295	Manager, Government Auxiliary Farm, Pad Idan.	Ditto.
Baluchistan . . .	Fruit Experiment Station, Quetta .	25	Assistant Pomologist .	Agricultural Officer in Baluchistan.
	Government Seed Farm, Usta (Sibi District).	300	Agrilcutural Assistant .	Ditto.
Hyderabad (Deccan) . .	Main Experimental Farm, Himayatsagar (District Atraf-e-Balda).	299	Farm Superintendent .	Deputy Director of Agriculture, West Telingana.
	Main Experimental Farm, Warangal .	104	Ditto .	Deputy Director of Agriculture, East Telingana.
	Main Experimental Farm, Raichur .	116	Ditto .	Deputy Director of Agriculture, Karnatak Division.
	Main Experimental Farm, Parbhani	265	Ditto .	Deputy Director of Agriculture, Godavari Division.
	Experimental Farm, Sangareddy (District Medak).	78	Ditto	Deputy Director of Agriculture, West Telingana.
	Experimental Farm, Sangareddy Rudrur (District Nizamabad).	65	Ditto .	Ditto.
	Poultry Farm, Himayatsagar (District Atraf-e-Balda).	Suitable plot reserved on the farm.	Fieldman . .	Ditto.
	Poultry Farm, Parbhani . . .	Ditto. .	Farm Superintendent .	Deputy Director of Agriculture, Godavari Division.
Mysore	Government Experimental Farm, Hebbal (District Bangalore).	229	Vice Principal in charge, Hebbal Farm.	Deputy Director of Agriculture, Bangalore.

List of agricultural research stations in India in 1937-38—concld.

Province or state	Agricultural research station	Area in acres	Officer in immediate charge	Supervising officer	Remarks
Mysore—*contd.*	Irwin Canal Farm, Mandya Taluka, Mandya Circle (District Mysore).	650	Superintendent	Assistant Director of Agriculture, Mandya Circle.	
	Paddy Breeding Station, Nagenahalli, Mysore Circle (District Mysore).	63	Agricultural Inspector	Assistant Director of Agriculture, Mysore Circle.	
	Kar Ragi Breeding Station, Hunsur, Mysore Circle (District Mysore).	44	Manager		
	Jeevanrayankatte Demonstration Plot, Mysore Circle (District Mysore).	2	Agricultural Inspector		
	Government Coffee Experimental Station, Balehonnur, Chikmagalur Circle (District Kadur).	290	Manager	Senior Assistant Director of Agriculture, Chikmagalur Circle.	
	Government Experimental Farm, Marthur, Sagar Taluk, Shimoga Circle (District Shimoga).	116	Ditto	Assistant Director of Agriculture, Shimoga Circle.	
	Government Experimental Farm, Hiziyur, Chitaldrug Circle (Chitaldrug District).	220	Junior Assistant Botanist in charge of Babbur Farm.	Assistant Director of Agriculture, Chitaldrug.	
	Singapur Kaval Farm (District Chitaldrug).	18	Agricultural Inspector, Chitaldrug Range.		
	Yellachihalli Sheep Farm	500	Agricultural Inspector.		
	Cattle Breeding Station, Ajjampur	6,020	Manager	Livestock Expert, Bangalore.	
	Cattle Breeding Sub-station, Basur		Ditto		
	Sheep Farm, Ajjampur		Veterinary Inspector		
Baroda	Agricultural Experimental Station, Baroda (District Baroda).	104	Superintendent	Deputy Director of Agriculture, Southern Circle, Baroda.	
	Agricultural Experimental Station, Dabboi (District Baroda).	68	Ditto	Ditto.	
	Sugarcane Experimental Station, Vijara (Navsari District).	27	Ditto	Ditto.	
	Cotton Experimental Station, Veswa (District Navsari).	62	Ditto	Ditto.	

	Agricultural Experimental Station, Jagudan (District Mehsana).	40	Ditto . .	Deputy Director of Agriculture, Northern Circle, Mehsana.	
	Agricultural Experimental Station, Amreli (District Amreli).	62	Ditto . .	Ditto.	
Travancore	Paddy Farm, Nagercoil . . .	40	Agricultural Inspector .	Director of Agriculture and Fisheries.	
	Fruit Farm, Cape Comorin . .	16	Agricultural Sub-Inspector		
	Agricultural School, Kottarakara .	200	Head Master, Agricultural School.		
	Pepper Farm, Koni	150	Agricultural Inspector .	Agricultural Inspector, Kottarakara.	
	Demonstration Farm, Puliyara .	35	Ditto .	Ditto.	
	Coconut Farm, Cachira . . .	4	Agricultural Demonstrator	Agricultural Inspector, Mavelikara.	
	Coconut Farm, Alleppey . . .	9	Ditto . .	Agricultural Inspector, Valkom.	
	Kari Experimental Station, Proakad	25	Field Assistant . .	Bio-Chemist, Quilon .	Only 5 acres are being cultivated.
	Demonstration Farm, Alwaye . .	13	Agricultural Sub-Inspector	Director of Agriculture and Fisheries.	
Cochin	Government Central Farm, Ollukkara, Trichur.	418	Manager, Government Central Farm, Ollukkara, Trichur.	Director of Agriculture, Cochin.	
	Government Experimental Cocoanut Station, Viattila, Ernakulam.	24	Agricultural Inspector, Cochin Kanayannur Talua.	Ditto.	
Bhopal	Research Farm, Nabi Bagh . .	154	Farm Incharge . .	Director of Agriculture and State Chemist.	
	Cotton Research Experimental Farm, Bhilkheri.	100	....	Ditto.	
	Paddy Farm, Chiklod Retreat . .	..	....	Ditto.	
	H. H.'s Model Farm, Semri . .	..	....	....	
	Sugarcane Farm, Sehore . . .	..	....	....	
Jammu and Kashmir . .	Pratap Model Farm . . .	80	Manager . . .	Director of Agriculture.	
	Gul Samandar Farm . . .	28	Agricultural Assistant .	Assistant Director of Agriculture.	

APPENDIX III

Staffs of the central, provincial and state departments of agriculture in India during 1937-38

Province or state	RESEARCH AND TEACHING STAFF						DISTRICT STAFF					
	SUPERIOR SERVICE		PROVINCIAL SERVICE		SUBORDINATE SERVICE		SUPERIOR SERVICE		PROVINCIAL SERVICE		SUBORDINATE SERVICE	
	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively
British India												
Imperial Dairy Institute, Bangalore	1	1	3	3	14	13	..	..	..	..	18	18
Imperial Agricultural Research Institute, New Delhi, and its sub-stations (excluding I.C.A.R. schemes).	10	8(*a*)	16	15(*b*)	37	35	..	..	..	..	..	..
Madras	3	2	25	23	110	108	6	5	16	13	265	253
Bombay	2	2	18	18	107	107	3	3	8	8	121	121
Bengal	1	1	12	10	25	14	2	2	6	6	29	28
United Provinces	7	7	16(*c*)	16	89(*c*)	89	13	11	23(*c*)	23	848(*d*)	848
Punjab	12	12	28	28	218	218	10	9	20	20	526	526
Bihar	..	..	10	7	3	2	2	2	14	9	106	105
Central Provinces and Berar	2	2	7	6	23	23	3	3	13	12	119	119
Assam	..	..	4	4	19	19	..	..	4	4	24	24
North-West Frontier Province	1	1	3	3	15	15	..	..	1	1	10	10

Sind	..	..	8	3	41	30	..	..	3	3	124	124
Orissa	..	..	1	1	10	9	..	..	3	3	25	..
Baluchistan	1	1	..	..	..	..	..	..	..	..	16	16
Indian States												
Hyderabad	2	2	3	3	9	9	5	5	5	5	53	52
Mysore	..	..	19	16	63	67	..	..	18	18	120	120
Baroda	..	..	11	11	9	9	4	4	9	9	46	45
Travancore	8	8	..	..	4	4	11	11	..	..	14	14
Cochin	4	4	..	..	16	16	8	8	..	..	6	6
Bhopal	1	1	..	..	6	6	The same staff, works in districts as well.					
Jammu and Kashmir	1	1	4	4	28	28	1	1	4	4	29	28

(*a*) Post of the Cattle Superintendent vacant.
(*b*) Supernumerary Agriculturist and Second Botanist's post vacant.
(*c*) Includes the staff sanctioned by I. C. A. R. and Indian Central Cotton Committee
(*d*) Includes the staff sanctioned by the Government under the Rural Development Scheme

APPENDIX IV

Results of well-boring in India during 1937-38

Province or state	1936-37		1937-38	
	Number of bores	Number successful	Number of bores	Number successful
British India				
Madras	1,034	775	971	673
Bengal	314	309	181	175
United Provinces	3,065	2,637	2,297	2,047
Punjab	479	381	353	266
Bihar	189	135	242	193
Orissa	11	10	7	7
North-West Frontier Province	1*	..	..	..
Sind	3	2	5	2
Indian States				
Hyderabad	35	26	..	..
Mysore	22	14	14	10
Baroda — Bores	100	60**	73	45
Baroda — Blastings	93	78	103	75

* The Boring Section has been transferred during the year, to the local Funds Department, under Government orders.
** Revised figures.

APPENDIX V

Sale of improved implements through departmental agency in India during 1937-38

Province or state	Ploughs		Cane mills		Fodder cutters		Hoes		Other implements		Spare parts	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India												
Madras	2,918	3,173	293	119	9	9	37	105	1,179	1,318	4,528	5,257
Bombay	535	272	27	78	4	2	42	167	1,778	946	612	1,291
Bengal	224	275	11	10	..	1	22	6	42	20	5	4
United Provinces	6,454	7,174	355	110	8,319	5,447	1,082	948	599	3,726	20,601	25,750
Punjab	6,806	6,716	2,396	1,426	36,057	22,154	1,160	1,682	7,353*	4,647	11,897	17,248
Bihar	373*	643	30*	44	4	5	431*	624	1,496*	931	618*	610
Central Provinces and Berar	2,753	1,279	229	193	9	4	427	44	1,432	1,569	23,019	17,090
Assam	2	7	109	109	..	..	3	2	71	36	153	147
North-West Frontier Province	57	43	198	142	50*	59	3	8	12	14	11	59
Orissa	2	..	3	29	1	..	4	..	9	28	..	..
Sind	783	1,265	..	..	..	..	..	..	254*	205	33	6
Baluchistan	..	1	..	..	..	..	..	1	..	..	..	..
Indian States												
Hyderabad	188	127	93	3	3	3	28	16	442	37	1,304	1,735
Mysore	701	1,049	72	14	..	..	32	..	103	139	6,468	2,774
Baroda	217*	426	1*	..	1*	5	154*	723	[5,712*	[2,395	1	50
Travancore	2	..	..	..	..	..	..	..	68	45	..	..
Cochin	14	7	..	1	..	..	..	..	65*	96	..	..
Bhopal	..	..	..	..	..	..	20	..	100	75	75	125
Jammu and Kashmir	..	10	..	..	..	..	..	..	..	15	..	..

* Revised figure.

APPENDIX VI

Improved seeds and manures distributed through departmental agency in India during 1937-38

Province or state	SEED DISTRIBUTED						MANURES DISTRIBUTED			
	SEED GRAIN IN CWT.		NO. OF WHOLE CANES EXCEPT WHERE OTHERWISE STATED		FRUIT PLANTS No.		COMMERCIAL FERTILIZERS IN CWT.		OIL CAKES IN CWT.	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India										
Madras	16,546	19,608	159,769	206,246 (*a*)	142,859	133,296	..	..	..	..
Bombay	34,738	60,094	3,390,359	8,237,211	243,827	147,001	21,097	25,566	10,413	8,649
Bengal	8,322	5,211	6,028,420 (*b*)	687,480 (Canes) and 1,096 550 (*b*)	17,118	13,202	3,281	468	2,371	488
United Provinces	229,753	270,187	2,054,798	584,492	10,694	15,983	59,911	25,335	9,388	5,717
Punjab	312,960 (Mds.)	408,200 (Mds.)	(*c*)	(*c*)	20,900	34,100	(*d*)	(*d*)	..	..
Bihar	6,746	8,512	24,415	27,009 (cwt.)	..	..	1,422	12,971	2,381	3,183
Central Provinces and Berar	308,335	296,622	4,248,761	3,120,136	78,069	115,545	7,248	18,069	1,138	1,348
Assam	1,225	1,128 (cwt.) and 10,818 (packets)	480,175 (*e*) 173 (cwt.)	91,080 (*e*) 469 (cwt.)	21,043	10,266	48	17	2	14

North-West Frontier Province	7,693	6,746	2,820	20,000	10,044	6,466	237	136	..	..
Orissa	3,619	161	80,300	33,000	3,698	5,538	36	58	7	1
Sind	81.135 (Revised)	73,755 (Revised)	527 (Mds.)	143 (Mds.)	27,660	30,116	6	6	..	..
Baluchistan	261 (Mds.)	139 (Mds.)	..	..	2,000	20,187	..	..	..	..

Indian states

Hyderabad	12,125	29,163	770 (seeds) cwt.	673 (seeds) cwt.	4,553	8,496	2,423	1,851	144	271
Mysore	4,819	6,868	761,700 (*e*) and 28,084,437 (Canes)	313,328 (*e*) and 23,003,000 (Canes)	1,671	11,064	1,146	78,334	..	99,009
Baroda	480	902	46,475	397,750	17,417	43,560	18	57	11	10
Travancore	163	117	21,350 (*e*)	25,077 (*e*)	1,304	695	No direct sales by the department.			
Cochin	165	154	28,041	17,253	7,893	58,007	390	386	629	386
Bhopal	700	486 (Mds.)	2,000	2,100	200	300	300	310	10	20
Jammu and Kashmir	1,150 (Mds.)	1,689(Mds.)	221,400	96 (bundles)	170,862	137,609	..	..	..	..

(*a*) 16,425,000 setts also distributed from Vizagapatam district from ' Short Crop '.
(*b*) Cuttings.
(*c*) The department does not stock sugarcane seed for sale apart from such as is available from its seed farms.
(*d*) Artificial manures are supplied to zemindars directly by manufacturers and no record of their sale is available with the Department of Agriculture, Punjab.
(*e*) Setts.

APPENDIX VII

Demonstration and propaganda work in India during 1937-38

Province or state	Number of agricultural shows held		Number of practical demonstrations carried out		Number of illustrated lectures given	
	1936-37	1937-38	1936-37	1937-38	1936-37	1937-38
British India						
Madras	470	354	25,407	33,981	649	777
Bombay	53	77	2,714	3,450	1,107	1,178
Bengal	56	76	6,243	5,852	347	385
United Provinces	198	138	19,840	2,480	1,650	851
Punjab	432	365	13,824	15,459	762	1,653
Bihar	25	23	22,333	21,508	..	97
Central Provinces and Berar	101	86	8,987	10,608	448	710
Assam	7	19	1,754	2,687	17	57
North-West Frontier Province	5	6	1,497	1,870	786	313
Orissa	8	5	5,164	6,344	75	90
Sind	54	49	(revised) 690	915	58	93
Baluchistan	2	2	*	6 plots	†	‡

Indian States

Hyderabad	60	77	573	952	151	359
Mysore	402	137	2,371	3,271	364	231
Baroda	6	16	2,109	3,651	314	646
Travancore	7	4	217	172	50	47
Cochin	3	5	319	393	18	19
Bhopal	8	9	57	60	20	22
Jammu and Kashmir	3	5	..	60	..	200

* Insecticidal spraying, *tid* control and rat killing demonstrations carried throughout the province.
† A discourse on *tid* control at Usta show.
‡ A lantern slide lecture on locust control was given in July 1938.

APPENDIX VIII

Agricultural colleges and schools in India during 1937-38

College or school	Course of instruction	1936-37				1937-38			
		Applications for admission	Admissions made during the year	Total No on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total No on the roll	Number passed in final examination
BRITISH INDIA									
Agricultural colleges									
Imperial Agricultural Research Institute, New Delhi.	Two-year post-graduate course.	68	13	30	9	52	11	39*	9
	One-year post-graduate course in farm management.		3	6	3		5	8	3
	Special short course in flue-curing of tobacco.	..	4	4	4	..	7	7	7
Imperial Dairy Institute, Bangalore.	Fifteen-month post-graduate course.	6	5	5	5	12	7	13(*a*)	6 (completed).
	Indian Dairy Diploma course (Two years).	..	4(*b*)	27	..	58	23	50(*c*)	23
	Short course, ordinary .	32	10	10	10	52	10	10	8 (completed).
	Short course, post-graduate character.	1	1	1	..	2	2	3(*d*)	1 (completed).
	Vocational training . .	15	15	15	15	11	11	13(*e*)	23
Agricultural College, Coimbatore	B.Sc. (Ag.) degree course of the Madras University.	156	47	108	28	184	48†	124	26
	Short course of practical training in Agriculture Farm Management	..	..	.	..	26	20	15	14(*g*)
	Special courses in insect pests and diseases	..	..	..	..	4	4	3	3

	Horticulture and vegetable gardening	..	..	..	..	3	3	2	2
	Dairying and malt making .	..	..	..	..	7	7	4	4
	Care of animals . .	..	..	..	..	4	4	2	2
	Beekeeping and jaggery-making	..	..	.	..	7	7	2	2
	Farm implements, machinery and manures	..	..	..	..	7	7	2	2
Agricultural College, Poona .	Three year degree course .	138	78	166	42 + 1 M Sc	141	86‡	172	49
Agricultural College, Cawnpore .	B. Sc (Agri.)	131	56	155	37	167	58	153	30
Allahabad Agricultural Institute	Indian Dairy Diploma Course.	52	31	40	6	68	*Nil*	42	§
	Intermediate in Agriculture	140	38	69	27	180	36	68	28
	B. Sc. in Agriculture . .	25	23	41	18	28	22	44	19
Punjab Agricultural College, Lyallpur.	Four-year B Sc. Degree course.	180	68	206	21*	258	82	250	27 ‖
	1½-year M. Sc. Degree course.	3	3	3	1	5	5	5	1
	Two-years Leaving Certificate course.	..	..	16	15	1	1	1	1
	Ten months' Teachers' Training course.	52	32	32	24	37	37	37	37
	One-year vernacular class .	(*f*)	52	43	20**	(*f*)	52	43	40***

(*a*) Includes six students admitted in January 1937 who completed training in March 1938.
(*b*) Repeat course students.
(*c*) Includes 27 final year batch examined in October, 1937 and 23 first year batch admitted in November 1937.
(*d*) Includes also one student admitted last year and who completed training this year.
(*e*) Includes 12 soldiers admitted last year and 11 students admitted this year. No fresh batches taken as this course was discontinued by the Defence Department.
* 3 left without completing the course.
† Includes four failed students of class I readmitted.
(*g*) The Farm Management course students, viz. 14 had their training along with other special students in special courses. The students completed the courses. There is no examination.
‡ Of which 71 actually joined.
§ No I. D. D. Class was admitted in 1937.
¶ Including three compartment students.
‖ Including seven who appeared in the supplementary examination.
** Number who qualified from the winter vernacular class admitted on the 1st October 1936.
*** Including two compartment students.
(*f*) Applications are received by the Deputy Directors of Agriculture.

Agricultural colleges and schools in India during 1937-38—contd.

College or school	Course of instruction	1936-37				1937-38			
		Applications for admission.	Admissions made during the year	Total No. on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total No. on the roll	Number passed in final examination
Agricultural colleges—*contd.*									
Punjab Agricultural College, Lyallpur—*contd.*	Six months' vernacular course in Dairying.	20	10	6	6	26	8	4	4
	Two months' Beekeeping class at Nagrota.	21	12	8	8	22	15	11	11
	Six weeks' course in *Lohar* class.	18	16	16	15	20	19	19	19
	Seven months' advanced course in Fruit and Vegetable preservation.	..	7	6	6	17	7	7	7
	Two weeks' summer course in Fruit and Vegetable preservation.	105	29	28	28	37	37	31	31
	Two weeks' Fruit culture course.	27	18	17	17	45	23	23	23
	Ten days' winter Fruit and Vegetable preservation course.	23	21	21	21	40	28	16	16
	One-year *Mali* class . .	287	35	30	30	(*a*)	30	27	26
	Two months' Beekeeping class at Raison (Kulu).	13	10	10	10	35	27	27	27
	Two weeks' Estate Managers Class.	..	..	..	..	57	33	22	22
	Jail Warders' Course . .	..	..	..	..	*	20	20	20
Agricultural College, Nagpur .	Four-year Degree course	157	58	151	15	127	58	163	16
† Islamia College, Peshawar .	B. Sc. (Agri.) . .	..	..	..	..	24	24	61	2

Agricultural schools

Madras.									
School for juveniles at Coimbatore.	3 R's, I and II standard .	40	40	27	6	11	11	20	2
School for juveniles at Palur Station near Nellikuppam. (South Arcot district).	3 R's, I to V standard .	12	12	31	3	23	23	38	..
School for juveniles at Anakapalli Station (Vizagapatam district).	3 R's, I to V standard .	19	19	24	14	7	7	24	16
Bombay.									
Marathi Agricultural School, Dhulia (District W. Khandesh).	Two years' course . .	50	15	30	15	84	18	33	16
Sirsangikar Memorial Kannad Agricultural School, Devihosur (District Dharwar).	Two years' course . .	35	20	30	8	30	13	32	17
Bengal.									
Dacca Secondary Agricultural School, P. O. Tejgaon, Dacca.	Two years. Agriculture, Botany, Dairying, Animal Husbandry, Poultry, Veterinary Science, Insect and Fungus Pests, Farm bookkeeping and Co-operation, Mensuration, Surveying, Levelling and Estimating, Carpentry and Smithy.	410	20	42	14	318	29	31	18
Bhuthnath Pal Agricultural School, Chinsurah, District Hooghly.	Two years. Agriculture, Botany, Dairying, Poultry, Mensuration, Surveying simple levelling, and simple estimating, Entomology, Veterinary, Rural organisation, and Accounts.	35	17	19	9	36	15	17	7
United Provinces.									
Agricultural School, Bulandshahr.	Two years' course . .	101	25	21	21	100	34	30	30
	Field man's course . .	85	14	14	14	95	23	23	23
	Farm Mechanic class . .	31	15	15	13	31	9	9	9
Agricultural School, Gorakhpur	Two years' course . .	116	43	36	25	308	87	87	36

(a) Applications are received by the Deputy Directors of Agriculture.
*Selection made by the jail Department.
†Islamia college, Peshawar, is a national college. It is not primarily meant for teaching agriculture, but the Agricultural classes have recently come into existence, i.e. since 1933.

Agricultural colleges and schools in India during 1937-38—concld.

College or school	Course of instruction	1936-37				1937-38			
		Applications for admission	Admissions made during the year	Total No on the roll	Number passed in final examination	Applications for admission	Admissions made during the year	Total No on the roll	Number passed in final examination
Agricultural schools—*contd.*									
Central Provinces.									
Agricultural Anglo-vernacular Middle School, Powarkhera, District Hoshangabad.	Four-year course . . .	36	36	85	12	23	23	75	13
Ditto Betul Bazar	Ditto . . .	..	..	..	..	17	17	58	14
Hyderabad.									
Oil Engine Class, Machinery Section.	Two classes of 3 months each in the year.	28	19	19	14	27	22	25	17 163*
Gardeners' Class, Himayatsagar Main Farm.	Two years	4	4	9	4	5	4	9	6 26*
Farmers' Class, Himayatsagar Main Farm.	Ditto	41	12	22	11	29	12	22	10 21*
Farmers' Class, Parbhani Main Farm.	Ditto	36	12	23	10	20	12	19	7 17*
Farmers' Class, Rudrur Experimental Farm.	Ditto	10	6	6	..	18	6	9	4 4*
Mysore.									
Agricultural School, Hebbal .	Three years . . .	38	37	74	20	26	10	56	21
Ramakrishnapur Krishisala, Anekal Taluka.	Two years. . . .	61	16	15	15	41	31	31	28
Sri Krishnarajendra Vyavasaya Dharma Patasala, Chickanahalli, Sira Taluka.	One year	89	18	18	18	73	18	18	18

District Board Vernacular Agricultural School, Hassan.	One year (both theory and practical in Agriculture in Kannada)	64	23	22	22	Not available	19	19	17
Baroda.									
Sheth Dosabhai Maganlal Agricultural Institute, Baroda.	....	100	25	25	24	117	29	29	28
Travancore.									
Agricultural School, Kottarakara	Two years . . .	..	..	17	15	32	22	22	..
Agricultural School, Koni . .	Ditto	75	30	30	15	..	..	29	..
Jammu and Kashmir.									
Agricultural Class . . .	One year	..	20	20	15	60	10	10	..
Cochin.									
Horticultural Schools—									
1. Government Central farm .	Two years . . .	60	60	60	48	60	60	46	..
2. Trichur									
3. Tripunithura . .									

* Total number passed since inauguration of the class.
† The class is on, and 10 more have to be taken.

APPENDIX IX

Operations of non-credit agricultural co-operative societies in India during 1937-38

(A) PURCHASE, SALE AND PRODUCTION

Province or state	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit (+) and loss (—) for the year
				Rs.	Rs.	Rs.	Rs.
Madras	Purchase and purchase and sale	133	1,876 societies and 18,398 individuals	2,44,360	2,51,653	45,49,318	+40,094
	Production and sale	35	155 societies and 1,973 individuals	..	72,210	1,40,416	—5,319
	Others	376	47 societies and 25,719 individuals	74,642	4,48,171	31,33,377	—4,16,716
	TOTAL	544	2,078 societies and 46,090 individuals	3,19,002	7,72,034	78,23,111	—3,81,941
Bombay	Purchase and purchase and sale	71	8,713	23,792	2,35,556	2,60,245	+7,678
	Production	19	647	..	..	8,200	+329
	Production and sale	87	18,596	6,55,976	16,109	17,11,571	+53,744
	Others	138	34,671	76,508	38,089	6,17,929	+2,231
	TOTAL	315	62,627	7,56,276	2,89,754	25,97,945	+63,982

Bengal	Purchase and purchase and sale	64	13,114	2,84,972	1,77,100	7,29,447	(+)8,461
	Production (irrigation)	979	21,645	..	..	5,07,691	(—)5,569
	Production and sale	244	13,986	1,30,848	2,83,602	9,57,953	(+)45,009
	Others	39	9,604	64	..	1,46,539	(—)6,512
	TOTAL	1,326	58,349	4,15,884	4,60,702	23,41,630	+41,389
United Provinces	Purchase and sale	14	943	753	9,444	11,609	+288
	Production and sale	772	92,740	28,61,244	24,54,101	6,96,061	+65,839
	TOTAL	786	93,683	28,61,997	24,63,545	7,07,670	+66,127
Punjab	Purchase and purchase and sale	17	1,447	80,796	72,115	68,891	+2,269
	Production	314	6,991	..	..	8,426	—76
	Production and sale	1,592	1,51,560	26,04,306	26,89,117	6,36,035	+5,711
	Others	107	2,181	..	..	1,04,203	+2,039
	TOTAL	2,030	1,62,179	26,85,102	27,61,232	8,17,555	+9,943
Bihar	Purchase and sale	9	271	1,01,105	98,680	3,374	+5,164
	Production and sale	204	4,212	1,03,421	1,08,622	12,521	+1,324
	TOTAL	213	4,483	2,04,526	2,07,302	15,895	+6,488

Operations of non-credit agricultural co-operative societies in India during 1937-38—contd.

(A) PURCHASE, SALE AND PRODUCTION—*contd.*

Province or state	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital.	Profit (+) and loss (—) for the year
				Rs.	Rs.	Rs.	Rs.
Orissa	Purchase and purchase and sale	9	5,480	28,526	23,226	71,040	+3,106
Sind	Purchase and sale	3	987	..	..	4,49,272	+13,114
	Production and sale	17	996	..	..	4,12,475	+8,794
	TOTAL	20	1,983	..	..	8,61,747	+21,908
Central Provinces and Berar	Purchase and sale	54	2,278	1,27,488	1,09,700	3,45,633	+10,379
	Production	16	363	1,969	..	8,977	+1,250
	Production and sale	9	535	22,993	31,676	15,773	+1,667
	TOTAL	79	3,176	1,52,450	1,41,376	3,70,383	+13,296
Assam	Production	1	209	..	..	5,542	—930
	Production and sale	20	342	8,558	5,483	4,339	+330
	TOTAL	21	551	8,558	5,483	9,881	—600

North-West Frontier Province	Purchase, sale and production	33	8,552	1,84,460	1,58,333	7,791	2,871
Delhi	Production	7	149	..	..	86	57
	Production and sale	23	1,477	..	..	417	40
	TOTAL	30	1,626	..	..	503	97
Hyderabad State	Purchase and sale	99	2,445	97,235	84,573	2,79,458	+3,709
	Sale and production	16	2,016	2,00,086	1,98,028	1,06,461	+4,801
	TOTAL	115	4,461	2,97,321	2,82,601	3,85,919	+8,510
Mysore	Purchase and sale	21	689	3,504	3,503	75,252	—461
	Production and sale	25	677	20,056	16,834	22,332	+946
	TOTAL	46	1,366	23,560	20,337	97,584	+485

Operations of non-credit agricultural co-operative societies in India during 1937-38—concld.

(A) PURCHASE, SALE AND PRODUCTION—*concld.*

Province or state	Class of societies	Number of societies	Number of members	Sale of goods to members	Purchase of members' products	Working capital	Profit (+) and loss (—) for the year
				Rs.	Rs.	Rs.	Rs.
Boroda	Purchase and sale	8	402	12,640	14,325	7,603	+618
	Production	29	1,191	2,753	3,955	1,63,771	+10,712
	Production and sale	23	1,761	4,69,211	3,91,355	1,41,726	—806
	Others	103	5,860	55	288	9,192	+295
	TOTAL	163	9,214	4,84,659	4,09,923	3,22,292	+10,819
Travancore	Purchase and purchase and sale	1	44	6,795	6,837	1,575	+80
	Production	1	49	..	..	231	+1
	Production and sale	7	1,220	27,654	26,040	80,197	—1,402
	TOTAL	9	1,313	34,449	32,877	82,003	—1,321
Jammu and Kashmir	Purchase and purchase and sale	3	877	573	267	2,347	108

(B) Cattle insurance

Province or state	Number of societies	Amount of risk insured	Premia collected during the year	Supplementary contributions collected	Number of animals		Claims paid	Cost of management	Funds in hand at the end of the year	Amount of risk re-insured	Amount of premia paid for re-insurance
					Insured	Lost					
		Rs.	Rs.	Rs.			Rs.	Rs.	Rs.	Rs.	Rs.
Bombay . . .	1	230	12	..	3	..	..	45	325	..	..

APPENDIX X

Working of the Veterinary Departments in India during 1937-38

Province or state	Reported mortality from contagious diseases			Dispensaries and hospitals			District work					
	Rinderpest	Other diseases	Total	Number of institutions	Cases treated	Castrations performed	Cases treated	Castrations performed	Outbreaks in which inoculation was undertaken	Deaths uninoculated	Inoculations	Deaths after inoculation
Madras	7,983	34,695	42,678	113	258,791	27,378	128,981	55,824	2,840	24,126	717,834	459
Bombay	5,239	13,174	18,413	116	241,756	36,539	47,803	12,782	1,054	8,056	115,198	175
Bengal	16,462	2,981	19,443	58	153,797	1,178	373,884	12,534	1,059	17,320	434,346	1,482
United Provinces	17,288	11,417	28,705	187	568,734	105,248	82,366	17,756	2,037	19,376	325,303	476
Punjab	17,239	16,457	33,696	304	1,967,142	395,837	520,245	268,437	5,508	21,791	1,473,404	1,106
Bihar	3,182	9,608	12,790	132	103,527	22,637	280,703	93,500	646	2,638	374,203	26
Orissa	1,587	1,165	2,752	8	66,060	3,042	97,910	24,930	99	1,236	156,572	76
Central Provinces and Berar	8,015	12,282	20,297	104	247,011	29,397	614,107	136,732	4,568	8,483	1,013,832	..
Assam	24,697	15,184	39,881	3	6,552	558	139,618	28,717	759	20,291	131,838	1,126
North-West Frontier Province	155	1,685	1,840	73	306,054	53,206	115,621	38,380	85	..	71,002	14
Sind	3,931	11,564	15,495	19	31,713	3,253	54,003	869	272	2,254	28,683	130
Baluchistan	..	6,835	6,835	10	38,030	591	44,465	12	..	1,646	6,028	175
Ajmer-Merwara	158	618	776	3	7,924	829	1,743	57	7	91	2,144	..

Coorg	61	517	578	8	55,109	716	3,468	1,225	95	309	3,642	2
TOTAL FOR BRITISH INDIA	105,997	138,182	244,179	1,138	4,052,200	680,409	2,504,917	691,755	19,029	127,617	4,854,029	5,247
Indian States.												
Hyderabad	1,974	1,115	10,176	107	294,916	8,507	80,156	30,777	459	7,018	245,458	157
Mysore	..	..	..	..	..	..	..	..	..	..	..	..
Baroda	181	671	852	35	28,402	6,655	13,222	1,450	53	679	47,976	15
Travancore	..	79	79	15	32,059	2,192	4,000	868	737	227	..	..
Cochin	..	7	7	9	27,972	1,274	1,912	682	..	10	1,023	..
Bhopal	..	..	..	4	31,473	..	2,588	3,267	72	..	7,609	..
Jammu and Kashmir	1,237	802	2,039	27	126,078	14,180	46,010	9,246	99	1,831	23,566	15
TOTAL FOR INDIAN STATES	3,392	2,674	13,153	197	540,900	32,808	147,888	46,290	1,420	9,765	325,632	187
GRAND TOTAL	109,389	140,856	257,332	1,335	4,593,100	713,217	2,652,805	738,045	20,449	137,382	5,179,661	5,434

APPENDIX XI

Working of the veterinary colleges and schools in India during 1937-38

Veterinary college or school	Length of course	NUMBER OF STUDENTS						EDUCATIONAL QUALIFICATIONS OF STUDENTS ADMITTED		
		ADMITTED DURING THE YEAR		Passed final examination	Failed in final examination	UNDER INSTRUCTION AT THE END OF YEAR		Intermediate and above	Matriculate or S. L. C.	Lower qualifications
		Scholarship-holders	Others			Ordinary course	Failed students			
Madras Veterinary College—										
Diploma course	3 years	3 (*a*)	47 (*b*)	19 (*c*)	2	103	15	41	9 (*d*)	..
B. Sc. Degree course	3 years and one term.				11					
Bombay Veterinary College	3 years	13	43	19	11	113	25	4	52	..
Bengal Veterinary College	3 years	21	56	44	16	108	45	10 (*e*)	62	5
Punjab Veterinary College	4 years	18	69	10	1	194	1	77	10	..
Bihar Veterinary College	3 years	8	30	17	8	81	24	1	37	..

(*a*) Two in the Degree lass and one in the Diploma class.
(*b*) Degree 39, Diploma 8.
(*c*) October 1937 examination 7, March 1938 examination 12.
(*d*) Consisting of three S. L. C. holders, one senior I. A., three junior I. Sc's and two High School final of Burma.
(*e*) Intermediate 5, Graduate 5.

APPENDIX XII

Cattle issued from the Government farms during 1937-38

Province or state	Bulls	Cows	Male buffaloes	She buffaloes	Young stock	Total for 1937-38	Total for 1936-37
Imperial Agricultural Research Institute, New Delhi	2	21	..	..	14	37	68
Agricultural Sub-station, Karnal.	5	101	..	..	166	272(a)	87
Imperial Dairy Institute, Bangalore.	1	19	..	5	67	92	35
Madras	52	59	4	..	5	120	111
Bombay	47	44	35	22	57	205	104
Bengal (b) . . .	..	12	.	4	8	24	63
United Provinces . .	523	2	105	14	..	644	1,037
Punjab	775	136	..	..	453	1,364	1,132
Bihar	18	36	..	..	35	89	65
Central Provinces and Berar	36	95	1	12	77	221	336
Assam	18	16	..	..	8	25	15
Sind	20	..	..	..	..	20	34
Indian States							
Hyderabad . . .	7	53	..	..	107	172	180
Mysore	168	21	..	..	35	224	170
Baroda	13	..	..	..	..	13	..
Cochin	9	11	2	1	28	51	33

(a) Includes animals of the Hariana herd transferred to the Animal Nutrition Institute, Izatnagar.
(b) In addition to the above, 1,380 bulls were purchased from the Punjab and issued free for stud during the year 1937-38.

APPENDIX XIII (A)*

Imports into India by sea of animals and animal products for the five years ending March 1938

Description of articles	Quantity					Value in rupees				
	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.
1. Live animals—										
Horses . . . . No.	3,697	3,061	2,941	2,197	3,969	26,51,952	23,15,501	24,20,852	13,26,999	33,29,751
Other animals . . . ,,	2,664	6,360	6,838	7,776	8,008	1,60,346	1,78,340	2,21,680	2,40,678	2,02,773
Total ,,	6,361	9,421	9,779	9,973	11,977	28,12,298	24,93,841	26,42,532	15,67,677	35,32,524
2. Hides and skins—										
Hides, raw . . . Tons	869	650	559	522	1,164	2,95,592	2,29,708	2,13,710	2,33,644	4,26,259
Skins, raw . . . ,,	1,353	1,361	1,368	1,040	1,619	8,95,653	8,07,327	7,86,651	9,69,701	15,44,406
Total raw hides and skins ,,	2,222	2,011	1,927	1,562	2,783	11,91,245	10,37,035	10,00,361	12,03,345	19,70,665
Tanned hides . . . ,,	14	11	3	53	3	61,954	49,630	49,179	57,938	29,785
Tanned skins . . . ,,	166	188	135	132	184	13,06,582	14,55,784	11,03,292	11,67,718	17,47,299
Total tanned hides and skins ,,	180	199	138	185	187	13,68,536	15,05,414	11,52,471	12,25,656	17,77,084
Total hides and skins . ,,	2,402	2,210	2,065	1,747	2,970	25,59,781	25,42,449	21,52,832	24,29,001	37,47,749

3. Wool, and woollen products—										
Raw wool . . . Lb.	5,098,862	5,985,124	7,485,249	6,773,726	8,173,058	34,09,579	41,35,017	44,10,193	59,52,313	84,80,425
Knitting wool . . . „	809,966	1,858,144	1,038,579	1,224,657	1,196,248	13,44,041	31,59,817	17,12,190	23,31,374	29,22,638
Worsted yarn for weaving . „	886,505	1,638,438	1,086,197	950,805	1,629,150	12,17,885	28,80,098	18,26,576	18,33,415	37,93,174
Blankets and rugs . . „	5,119,678	6,665,145	4,610,205	3,528,138	5,211,839	40,02,294	54,98,736	35,12,792	25,48,609	39,37,933
Braids . . . . „	11,813	39,849	8,640	4,837	6,132	28,372	30,359	22,007	15,120	20,797
Carpets and floor rugs . „	135,036	160,574	201,742	212,877	157,242	2,35,297	3,41,712	3,92,012	4,13,075	4,04,826
Hosiery . . . . „	281,136	408,833	..	..	..	8,82,362	12,25,354	..	..	..
Knitted apparel . . „	..	..	435,504	356,256	259,666	..	..	11,10,567	10,11,652	8,73,506
Piecegoods . . . Yds.	11,535,916	10,516,080	5,259,596	5,445,328	6,722,866	1,30,26,788	1,39,82,375	81,09,665	84,29,171	1,12,51,516
Shawls and *lohis* . . No.	331,615	415,963	500,259	494,760	492,815	9,48,147	11,96,519	11,46,114	12,89,836	18,30,688
Total .	..	..	.	..	..	2,50,94,765	3,24,49.087	2,22,42,116	2,38,24,565	3.35,15,503
4. Dairy products—										
Butter . . . . Cwt.	5,106	6,265	7,708	8,430	7,674	5,78,346	6,23,654	6,95,706	8,28,314	7,28,681
Cheese . . . . „	9,871	10,924	10,546	11,569	10,295	8,07,268	8,43,392	7,64,438	7,97,155	7,48,430
Milk foods, etc. . . „	12,027	9,174	10,395	8,666	8,687	16,41,497	13,67,711	16,50,947	15,44,261	17,08,688
Milk condensed and preserved. „	171,870	180,942	209,214	210,370	59,115	45,51,052	48,36,976	54,21,165	54,43,618	19,37,175
Ghee . . . . „	276	339	371	217	347	14,621	14,911	16,430	9,001	18,869
Total „	199,150	207,644	238,234	239,252	86,118	75,92,784	76,86,644	85,48,686	86,22,349	51,41,843

* Extracted from the Annual Sea-borne Trade Returns of British India published by the Director General of Commercial Intelligence and Statistics, Calcutta,

Imports into India by sea of animals and animal products for the five years ending March 1938—contd.

Description of articles.	Quantity.					Value in rupees.				
	1933-34.	1934-35.	1935-36.	1936-37.	1937-38	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.
5. Other animal products—										
Animal oils . . Gallons.	860,701	..	..	..	..	7,93,561	3,77,238	3,90,014	3,44,301	3,03,895
Fish canned . . . Cwt.	26,593	46,780	64,087	83,505	12,850	8,51,116	10,80,623	14,16,801	16,39,328	6,30,310
Fish, excluding canned . „	102,609	96,672	110,202	99,292	76,370	15,05,129	16,56,845	19,34,212	17,80,084	6,70,266
Isinglass . . . . „	399	880	591	801	395	48,483	1,01,264	82,922	1,11,459	78,435
Bacon and ham . . „	15,284	15,838	17,090	18,246	16,895	12,28,986	11,48,932	12,36,255	13,20,958	12,47,681
Cod liver oil . . . Lb.	115,521	99,106	106,431	196,351	164,924	57,561	45,349	45,435	85,704	92,717
Fish manure . . . Tons	1,007	1,143	1,479	2,616	1,783	60,888	92,746	1,12,846	1,73,313	58,239
Hair . . . . Cwt.	1,588	1,855	2,179	6,619	2,312	34,970	42,860	56,281	1,75,802	58 864
Manufactures of hair . „	..	..	..	..	..	19,347	24,067	32,463	52,159	45,794
Lard . . . . „	1,009	784	695	571	213	38,829	31,590	38,947	30,910	15,182
Total .	..	..	..	..	..	46,38,870	46,01,514	53,46,176	57,14,518	32,01,383
GRAND TOTAL .	..	..	..	..	..	4,26,98,498	4,97,74,435	4,09,32,342	4,21,58,110	4,91,39,002

APPENDIX XIII (B)

Exports from India by sea of animals and animal products for the five years ending March 1938

Description of articles	Quantity					Value in rupees				
	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.
1. Animals—										
Cattle . . . . No.	779	778	407	87	1,848	72,103	61,771	31,905	8,215	1,16,199
Horses . . . . ,,	53	69	28	16	14	50,050	2,16,230	32,400	22,300	20,540
Sheep and goats . . ,,	40,429	47,338	39,913	35,774	33,465	7,85,045	8,39,428	7,23,472	6,03,180	6,29,352
Other animals . . . ,,	92,021	119,510	227,689	180,652	194,655	78,475	1,06,849	1,38,421	1,97,773	1,13,042
Total . ,,	133,282	167,695	268,037	216,529	229,982	9,85,673	12,24,278	9,26,198	8,31,468	8,79,133
2. Hides and skins—										
Buffalo hides, raw . . Tons	2,947	2,838	2,693	4,480	4,385	12,35,338	11,61,590	10,64,413	21,57,032	29,67,983
Cow hides, raw . . ,,	16,866	19,271	19,462	19,417	16,771	86,55,596	95,59,034	98,12,544	1,09,41,622	1,22,75,667
Calf skins . . . ,,	451	480	522	314	453	2,41,051	2,30,321	3,39,338	2,36,165	4,57,111
Other hides . . . ,,	11	..	..	35	2	1,610	..	510	4,000	640
Total hides, raw . ,,	20,275	22,589	22,677	24,246	21,611	1,01,33,595	1,09,50,945	1,12,16,805	1,33,38,819	1,57,01,401
Goat skins, raw . . ,,	18,183	13,873	20,108	17,985	18,573	2,76,65,688	1,80,72,991	2,78,31,671	2,78,13,439	3,07,27,194
Sheep skins, raw . . ,,	1,244	1,176	933	603	800	11,33,083	15,71,812	14,31,716	14,59,046	13,71,680

Exports from India by sea of animals and animal products for the five years ending March 1938—concld.

Description of articles	Quantity					Value in rupees				
	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.
Other skins . . . Tons	482	110	154	245	364	35,24,741	6,04,813	5,27,889	8,63,782	15,70,831
Total skins, raw . ,,	19,909	15,159	21,195	18,833	19,737	3,23,23,512	2,02,49,616	2,97,91,276	3,01,36,267	3,26,69,705
Total raw . ,,	40,184	37,748	43,872	43,079	41,348	4,24,57,107	3,12,00,561	4,10,08,081	4,34,75,086	4,93,71,106
Hides, tanned or dressed . ,,	13,156	11,370	14,029	17,897	16,958	2,40,80,141	1,97,63,385	2,29,06,363	3,17,56,941	3,20,72,727
Skins, tanned or dressed . ,,	6,566	6,546	6,275	7,472	6,724	3,23,76,610	3,24,50,744	2,91,10,870	3,56,53,263	3,24,63,062
Total tanned or dressed ,,	19,722	17,916	20,304	25,369	23,682	5,64,56,751	5,22,14,129	5,20,17,233	6,74,10,204	6,45,35,789
Total hides and skins . ,,	59,906	55,664	64,176	68,448	65,030	9,89,13,858	8,34,14,690	9,30,25,314	11,08,85,290	11,39,06,895
3. Wool—										
Raw wool . . . Lb.	55,864,599	34,075,204	49,352,285	51,937,719	37,989,319	1,98,37,511	1,27,49,752	2,09,66,129	2,86,08,005	2,64,55,835
Carpets and rugs . . ,,	8,452,443	10,093,364	9,347,108	9,897,803	11,061,354	72,66,750	89,81,365	80,64,638	85,63,699	1,02,47,274
Piecegoods . . . Yds.	4,489	60,542	26,820	29,693	87,410	13,240	80,531	34,470	25,795	89,663
Shawls . . . . No.	4,860	9,662	21,842	21,810	39,176	28,366	37,810	76,500	77,775	1,20,924
Other sorts . . . Lb.	159,181	149,075	268,704	234,271	329,806	91,196	77,905	1,14,114	1,14,199	3,23,698
Total .	..	..	..	..	..	2,72,37,063	2,19,27,363	2,92,55,851	3,73,89,473	3,72,37,394

4. Dairy products—										
Butter	Cwt	1,911	1,898	2,289	1,776	6,221	1,77,436	1,71,965	2,04,378	1,58,273	5,98,955
Cheese	„	29	29	31	15	31	2,180	2,495	2,601	921	2,002
Ghee	„	24,418	25,526	24,030	26,998	45,220	13,31,077	14,04,001	14,92,074	16,15,247	28,76,432
Total .	„	26,358	27,453	26,350	28,789	51,472	15,10,693	16,38,461	16,99,053	17,74,441	34,77,389
5. Other products—										
Bones for manufacturing .	Tons	39,191	52,378	53,193	74,279	61,253	24,37,912	31,95,535	32,19,484	46,45,437	43,82,558
Bones for manure . .	„	4,263	8,368	14,418	25,518	31,910	3,36,074	5,92,457	10,05,344	20,34,019	31,98,132
Bonemeal . . .	„	20,556	28,106	28,476	31,729	36,920	11,12,105	14,31,159	13,94,100	15,82,941	19,98,750
Casein	Cwt.	8,209	7,952	11,452	12,577	7,507	1,55,530	1,55,541	2,24,572	3,32,667	1,79,093
Fish, dry, salted . .	„	126,360	135,949	147,164	152,636	121,292	23,38,879	23,05,666	24,11,789	23,40,548	23,01,243
Fish, dry, unsalted . .	„	92,331	96,746	105,781	116,049	208,076	13,91,708	14,59,715	14,94,007	15,28,459	40,64,090
Fishmaws and sharkfins .	„	7,331	7,370	6,344	6,709	5,066	6,91,132	6,00,185	5,89,236	5,91,205	5,03,695
Fish, wet, salted . .	„	10,261	11,027	8,195	4,365	4,090	65,406	89,023	64,727	35,572	38,670
Fish manures . . .	Tons	4,881	5,164	6,165	6,583	6,398	3,25,937	3,80,062	4,35,113	4,69,634	5,59,178
Guano	„	2,346	1,219	139	923	519	1,50,504	97,772	8,214	86,306	48,686
Horn tips and pieces of horn.	Cwt.	41,765	34,821	37,237	69,525	59,540	3,21,513	2,47,377	2,82,347	4,37,391	4,09,084
Lard	„	..	16	..	..	..	..	150	..	..	..
Total .		..	..	..	..	..	93,26,700	1,05,54,642	1,11,28,934	1,40,84,179	1,76,83,179
GRAND TOTAL .		..	..	..	..	..	13,79,73,987	11,87,59,434	13,60,35,350	16,49,64,851	17,31,83,990

APPENDIX XIII (C)*

Inter-provincial trade in livestock and livestock products during 1937-38

Provinces, states and ports	ANIMALS—LIVESTOCK							
	CATTLE—EXCLUDING SHEEP AND GOATS		HORSES, PONIES AND MULES		SHEEP AND GOATS		OTHERS	
	Import	Export	Import	Export	Import	Export	Import	Export
	No.	No.	No.	No.	No.	No.	No.	No.
1. Assam	2,250	984	208	280	638	553	525	476
2. Bengal	23,051	6,147	1,374	265	8,633	112,946	5,439	4,359
3. Bihar	14,210	40,911	1,515	2,422	7,286	195,917	25,323	8,967
4. Orissa	615	22,127	30	7	115	5,993	472	546
5. United Provinces	33,791	10,407	4,365	2,734	5,558	111,755	5,129	39,017
6. Punjab	5,728	104,425	2,289	6,710	11,853	4,911	8,166	6,296
7. Delhi	4,428	7,904	3,014	2,104	7,344	2,087	2,919	2,406
8. North-West Frontier Province.	7,651	727	796	795	506	4,195	1,587	1,786
9. Sind and Baluchistan	623	2,347	233	475	87	9,158	589	1,243
10. Central Provinces	2,786	2,391	620	378	3,969	23,084	739	726
11. Bombay	20,385	24,616	2,254	1,835	376,552	1,121	4,641	3,704
12. Madras	2,581	4,996	592	355	23,555	60,169	24,160	240,547
13. Rajputana	3,555	8,245	651	736	185	308,879	3,209	692
14. Central India	723	3,471	692	451	15,012	26,452	644	556
15. Nizam's Territory	221	130	480	544	46	40,274	761	864
16. Mysore	309	1,130	1,056	799	33,612	21,488	16,632	11,854
17. Jammu and Kashmir	195	..	202	49	4	15	119	137
18. Calcutta	71,555	8,185	1,116	1,396	401,770	765	16,856	5,058
19. Bombay Port	60,189	10,146	3,032	2,391	483	254	2,893	3,552
20. Karachi	863	91	326	159	6,717	60	672	437
21. Madras Chief Port	1,376	454	474	457	364	191	201,430	4,183
22. Madras Ports (excluding Chief Port).	3,530	781	40	17	26,224	246	29,283	14,782
TOTAL	260,615	260,615	25,359	25,359	930,513	930,513	352,188	352,188
1936-37	..	..	..	..	..	..	..	..

* The figures in this Appendix relate to quantities carried by railways and steamers and exclude trade by roads or country boats.

Inter-provincial trade in livestock and livestock products during 1937-38—contd.

Provinces, states and ports	BONES		HIDES, RAW		SKINS, RAW	
	Import	Export	Import	Export	Import	Export
	Maunds	Maunds	Maunds	Maunds	Maunds	Maunds
1. Assam . . .	3	10,672	124	60,117	4	3,771
2. Bengal . . .	875,620	525,127	51,791	370,214	4,421	74,489
3. Bihar	605	303,068	4,019	297,806	3,113	68,254
4. Orissa . . .	358	62,349	8,090	96,719	68	13,517
5. United Provinces .	36,169	616,997	145,198	210,015	20,188	112,663
6. Punjab . . .	3,608	775,834	84,366	116,824	53,472	168,761
7. Delhi	9,643	36,814	31,616	23,749	71,687	77,484
8. North-West Frontier Province.	..	43,966	1,396	78,012	1,060	32,773
9. Sind and Baluchistan .	555,356	554,710	4,994	61,402	3,013	56,045
10. Central Provinces .	13,245	226,379	4,484	53,403	6,877	44,963
11. Bombay . . .	159,440	486,724	29,751	77,498	8,970	132,872
12. Madras . . .	294,874	370,720	321,071	54,172	273,179	95,354
13. Rajputana . . .	174	386,378	10,801	19,904	2,786	50,733
14. Central India .	4,619	116,380	484	13,398	2,590	21,882
15. Nizam's Territory .	3,012	226,835	1,084	8,883	6,061	27,475
16. Mysore . . .	5,237	67,184	88,391	2,385	23,076	77,288
17. Jammu and Kashmir .	..	6,171	178	4,569	28	852
18. Calcutta . . .	969,717	56,000	695,221	161,664	224,112	9,895
19. Bombay Port . .	391,476	8,866	57,424	44,903	121,831	14,655
20. Karachi . . .	1,222,001	101,573	132,249	744	179,483	329
21. Madras Chief Port .	189,623	21,035	134,056	32,142	148,361	32,736
22. Madras Ports (excluding Chief Port).	302,119	33,117	5,634	23,899	1,868	39,457
TOTAL .	5,036,899	5,036,899	1,812,422	1,812,422	1,156,248	1,156,248
1936-37	4,672,117	4,672,117	1,996,383	1,996,383	1,160,550	1,160,550

Inter-provincial trade in livestock and livestock products during 1937-38—concld.

Provinces, states and ports.	HIDES AND SKINS, TANNED AND LEATHER		GHEE		WOOL, RAW	
	Import	Export	Import	Export	Import	Export
	Maunds	Maunds	Maunds	Maunds	Maunds	Maunds
1. Assam . . .	552	28	5,950	1,508	..	11
2. Bengal . . .	10,702	200	95,124	4,972	870	56,144
3. Bihar	6,993	3,365	25,520	87,399	9,383	2,350
4. Orissa . . .	117	2,382	19,834	598	..	1,171
5. United Provinces .	36,670	55,768	63,962	234,773	56,920	31,048
6. Punjab . . .	16,115	45,883	14,886	106,188	69,359	83,235
7. Delhi	3,128	4,305	11,822	1,084	899	3,270
8. North-West Frontier Province.	33,069	827	36,767	8,025	85	19,863
9. Sind and Baluchistan .	11,466	426	24,521	7,089	1,740	95,617
10. Central Provinces .	3,473	5,695	4,267	39,306	180	543
11. Bombay . . .	21,422	38,574	19,637	23,107	35,853	35,139
12. Madras . . .	20,844	241,040	3,126	150,978	9,875	47,869
13. Rajputana . . .	9,389	5,151	19,279	33,027	16,353	105,479
14. Central India . .	4,988	1,424	2,976	40,984	1,402	4,064
15. Nizam's Territory .	1,603	47,142	647	2,970	16	26,527
16. Mysore . . .	4,828	33,913	8,480	951	25,322	6,471
17. Jammu and Kashmir .	281	285	51	271	19	337
18. Calcutta . . .	39,065	50,843	284,230	10,885	54,473	35,921
19. Bombay Port . .	58,812	25,090	60,360	2,313	88,181	12,437
20. Karachi . . .	919	4,114	23,741	3,729	168,940	3,875
21. Madras Chief Port .	322,219	42,711	15,768	1,171	32,827	2,524
22. Madras Ports (excluding Chief Port).	3,444	933	21,262	882	1,214	16
TOTAL .	610,099	610,099	762,210	762,210	573,911	573,911
1936-37	586,826	586,826	692,237	692,237	770,426	770,426

Source of data.—Accounts relating to the Inland (Rail and River-borne) Trade of India for March 1938.

NOTE.—The trade recorded is that between 22 principal blocks: 12 British Provinces as shown in serial numbers 1 to 12, five Indian States (13-17) and five principal port towns (18-22). It may be noted that trade shown against Bengal, Madras, Bombay and Sind excludes that of ports within them.

For greater details the original may be referred to.

APPENDIX XIV

Staff of central, provincial and state Veterinary Departments in India during 1937-38

Province or state.	SUPERIOR STAFF				SUBORDINATE STAFF			
	ADMINISTRATIVE		RESEARCH AND TEACHING.		RESEARCH AND TEACHING.		FIELD STAFF.	
	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively	Sanctioned cadre	Filled substantively
Imperial Veterinary Research Institute, Mukteswar.	1	1	21	17	29	24	..	..
Madras . . .	15	12	8	7	14	11	296	210
Bombay . . .	2	2	8	6	2	2	140	139
Bengal . . .	7	7	21	21	3	3	162	162
United Provinces .	4	2	1	1	..	..	247	220
Punjab . . .	25	22	14	13	11	11	405	385
Bihar . . .	4	4	7	6	6	5	96	96
Central Provinces and Berar.	7	6	1	1	2	2	150	150
Assam . . .	1	1	1	1	..	..	70	66
North-West Frontier Province.	1	1	1	1	2	2	101	101
Sind	1	1	2	2	..	..	22	22
Baluchistan . .	1	1	..	..	..	..	..	..
Ajmer-Merwara . .	..	..	..	..	..	..	3	3
Coorg . . .	..	..	..	..	..	..	7	7
			INDIAN STATES					
Hyderabad . .	5	5	1	1	..	..	130	130
Mysore . . .	..	..	..	..	..	..	..	..
Baroda . . .	3	3	..	..	..	..	35	35
Travancore . .	14	14	1	1	..	..	14	14
Cochin . . .	11	11	..	..	..	..	..	..
Bhopal . . .	2	2	..	..	..	..	14	14
Jammu and Kashmir .	3	3	..	..	..	..	30	30

Administrative and research work in Ajmer-Merwara is carried out by the Sind Officers in addition to their own charge.

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	TOTAL NUMBER OF LIVESTOCK				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
Imperial Veterinary Research Institute, Mukteswar.	Mukteswar Dairy Farm.	..	Estate Manager.	Director	Mixed breed.	One stud bull.	26	9	1
					Hill breed.	..	24	5	5
					Plain buffalo.	..	2	7	5
					Nili buffalo.	..	5	..	..
Imperial Veterinary Research Institute, Izatnagar.	Izatnagar Dairy .	..	Cattle Superintendent.	Do.	Harnana	3	45	31	32
Imperial Department of Agriculture.	Imperial Agricultural Research Institute, New Delhi.	380	Do.	Imperial Agriculturist.	..	13	71	65	44
	Agricultural Sub-Station, Karnal.	1,175	Do.	Do.	..	9	94	85	60
	Imperial Dairy Institute, Bangalore.	213	Superintendent.	Imperial Dairy Expert.	Sindhi	7	81	91	39
					Gir	3	18	22	8
					Ayr.	1	..	..	..
					Cross breed	..	80	79	1
					Murrah buffalo.	2	23	..	..
					Buffalo	..	..	21	134
	Milk Depot, Wellington.	69	Supervisor in charge	Do.	Sindhi	1	..	..	..
					Cross breed	..	26	..	3
Madras. . .	Livestock Research Station, Hosur Cattle Farm, P. O.	1,659	Farm Manager.	Livestock Development Officer, Hosur Cattle Farm, South India.	Kangayams.	73	107	66	90
					Hallikars	18	23	15	18
					Sindhi	43	60	49	39
					Cross breed	23	20	21	17
					Buffaloes	1	..	..	..
	Livestock Research Station, Guntur.	258	Superintendent.	Do.	Ongole breed.	23	16	9	11
					Buffaloes (Delhi and graded Delhis).	4	7	7	5

* From October

DIX XV

livestock farms in India during 1937-38

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	..	..	..	..	....	9,667	1,02,222
..	..	..	..	..	....	2,886*	11,593*
..	..	..	..	..	....	15,187	1,33,874
..	..	..	..	..	....	37,964	66,516
..	..	10 ponies	..	..	....	74,404	1,34,584
..	..	..	..	..	....	41,035	40,060
..	..	..	..	White Leghorn 58			
..	..	..	..	Rhode Island Red 52			
..	..	..	..	Light Sussex 88			
..	..	..	..	Black Minorca 66			
81 (Bellary)	..	..	..	..	52 bulls, 20 rams, 510 birds, 3,964 eggs	15,555	89,586
..	..	..	..	Chittagong 39			
				Country 6		2,647	8,415

1937 to March 1938.

Activities of cattle and other

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	Total number of livestock				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
Bombay . .	Northcote Cattle Breeding Farm, Chharodi.	2,279	Manager	Livestock Expert to Government, Bombay, Poona.	Kankrej	83	93	101	76
	Cattle Breeding Farm, Bankapur.	249	Do.	Do.	Amrit Mahal.	41	39	37	25
	Government Central Poultry Farm, Kirkee.	4	Do.	Do.	..	..	..		..
	Imperial Council of Agricultural Research, Poultry Research Scheme, Kirkee Centre.	2	Do.	Do.	..	..	..	..	..
	Imperial Council of Agricultural Research Poultry Research Scheme, Vadala Centre.	..	Do.	Do.	..	..	..	..	..
	Imperial Council of Agricultural Research Poultry Scheme, Ankleshwar Centre.	..	Principal	..	..	..	..	..	..
	Sheep Breeding Scheme, Imperial Council of Agricultural Research.	289	Manager	..	Deccani	..	..	..	..
					Merino	..	..	..	..
Bengal . .	Cattle Breeding Section, Dacca Farm.	3	Livestock Expert to Government, Bengal.	Officer incharge, Cattle Breeding Section, Dacca Farm.	Hariana	2	30	28	18
					Sindhi	1	13	17	13
					Murrah buffalo.	1	11	18	8
United Provinces .	Madhurikund . .	1,396	Mr. Baburam Sing.	Deputy Director of Agriculture, Incharge, Cattle Breeding Operations, United Provinces, Jhansi.	Hissar	142	124	65	219
					Murrah	10	48	25	45
	Bharari . . .	2,241	Mr. Vishwaram Singh.	Do.	Hissar	104	107	30	169
					Ken Katha.	7	..	..	..
					Murrah	67	51	22	95

livestock farms in India during 1937-38—contd.

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	..	..	..	..	33 bulls	12,628	20,887
..	..	..	..	..	4 bulls	1,559	11,601
..	..	..	..	322	447 birds and 590 eggs	4,072	4,461
..	..	..	..	448	165 birds and 435 eggs.	2,693	8,319
..	..	..	..	76	46 birds and 6 eggs		
..	..	..	..	218	128 birds and 1,352 eggs.		
52	..	..	..	..	....	60	17,006
16							
..	..	..	..	546	150 cockerels and 30 hens. 167 eggs for hatching.	6,567	2,02,890
..	..	..	..	..	172	13,903	48,537
..	..	..	..	..	328	3,395	70,532

Activities of cattle and other

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	TOTAL NUMBER OF LIVESTOCK				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
United Provinces .	Manjhra* . .	551	Mr. Raghubir Singh.	Deputy Director of Agriculture, Incharge, Cattle Breeding Operations, United Provinces, Jhansi.	Hissar	23	..	..	..
					Sahiwal	34	67	35	96
					Ken Katha.	21	..	..	..
					Ponwar	16	..	..	..
					Murrah	1	..	..	..
	Hempur . .	7,348	Mr. Padam Singh.	Do.	Kherigarh	38	240	54	224
					Ponwar	51	430	47	497
Punjab. . .	Poultry Farm, Gurdaspur.	5	Poultry Expert.	Deputy Director of Agriculture, Gurdaspur.	..	..	..	..	..
	Agricultural College, Lyallpur Dairy Farm.	36	Farm Manager.	Prof. of Agriculture, Lyallpur	Sahiwal	2	25	10	13
					Nili Buffaloes.	1	10	..	10
					Hissar bullocks.	6	..	..	..
	Poultry Farm, Lyallpur.	..	Do.	Do.	.	..	..	..	..
	Dairy Farm, Rawalpindi.	..	Do.	Deputy Director of Agriculture, Rawalpindi.	Dhanni breed.	1	8	1	12
	Poultry Farm, Rawalpindi.	..	Do.	Do	..	..	..	..	..
	Poultry Farm, Montgomery.	..	Do.	Do Montgomery.	..	..	..	..	..
	Poultry Farm, Jullundur.	..	Do.	Do Jullundur.	..	..	..	..	..
	Agricultural Farm, Jullundur.	..	Do.	Do.	..	..	..	..	..
	Government Cattle Farm, Hissar.	38,829	Superintendent.	Director, Veterinary Ser, Punjab.	Hissar breeds.	1,563	3,170	1,127	1,233
	Jahangirabad Cattle Farm.	4,189	Deputy Superintendent, Civil Veterinary Department, Montgomery.	Ditto	Montgomery breeds.	689	687	128	89

* The farm has been closed
† Bulls fit for issue are mostly

livestock farms in India during 1937-38—contd.

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	..	..	..	..	114	6,477	27,856
..	..	..	..	..	25†	323	7,544
..	..	..	..	729	Eggs . . 754 Stock . . 149	734	10,740
..	..	..	..	..	....	14,262	12,793
..	..	..	..	219	Eggs . . 2,443 Birds . . 44	841	907
.	..	..	..	..	....	953	950
..	..	..	..	212	Eggs . . 1,510 Birds . . 4	670	1,840
..	..	..	..	95	Eggs . . 174	..	..
..	..	..	..	75	Eggs . . 561 Fowls . . 17	179	530
46 sheep and 3 rams.	..	..	..	..	....	95	201
2 Merino, 1,101 Hissar, 840 Bikaneri, 233 Lohi and 306 goats.	131	5 stallions, 25 mares and 1 mule.	10	..	Bulls . . 775 Donkey stallion 18 Arab stallion . 3 Rams . . 179 Bucks . . 52	3,16,971	3,11,541
..	..	..	..	..	Bulls . . 67	..	..

from September 1939.
transferred to Manjhra Farm for issue.

Activities of cattle and other

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	Total number of livestock				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
Punjab. . .	Allahadad Cattle Farm.	4,056	Deputy Superintendent, Civil Veterinary Department, Montgomery.	Director, Veterinary Ser., Punjab.	Montgomery breeds.	63	556	89	67
	Montgomery Dairy Farm.	485	Do.	Do.	Do.	9	196	35	2
					Ravi and Nili breed.	4	64	15	..
	Bahadur Nagar Buffalo Farm.	3,049	Do.	Do.	Nili breed.	13	431	52	27
	Qaderabad Cattle Farm.	1,011	Do.	Do.	Hissar breed.	92	273	32	30
	Shergarh Grantee Farms.	5,462	Do.	Do.	Montgomery breed.	7	776	141	137
Bihar . . .	Government Cattle Farm, Patna.	650	Manager	Principal, Bihar Veterinary College.	Tharparkar.	44	144	116	163
					Cross breed	12	30	2	31
	Sepaya . . .	379	Assistant Director of Agriculture.	Deputy Director of Agriculture, Tirhut Range.	Buffaloes	38	32	42	12
	Pusa . . .	641	Do. Pusa.	Do.	..	26	33	25	30
	Kanke . . .	370	Farm Manager, Kanke.	Do. Chota Nagpur.	Sahiwal	27	51	23	37
					Tharparkar.	18	38	18	30
	Patna . . .	194	Farm Manager, Patna.	Do. Patna Range.	Cross breed Hansi Hissar.	1 1	3 ..	.. ..	2 ..
					Tharparkar.	..	2	1	2
					Cross type	..	..	1	..
	Gaya . . .	60	Overseer	Do.	Shahabad	..	..	..	1
					..	..	..	..	..
Central Provinces and Berar.	Telenkhary Cattle Breeding Farm.	1,300	Farm Superintendent.	Extra Assistant Director, In-charge, Animal Husbandry Section, Central Provinces.	Sahiwal	8	36	26	48
					Murrah buffalo.	3	24	12	28

livestock farms in India during 1937-38—contd.

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	..	..	..	..	Bulls . . 20	..	..
..	..	..	..	..	Bulls . . 71	..	..
..	..	..	..	..	Bulls . . 27	..	..
..	..	.	..	..	....	..	..
..	..	1 Horse	..	..	Bulls . . 15	62,163	87,509
..	..	..	..	..	Bull . . 1	20,336	24,331
..	..	..	..	..	. ..	19,294	42,717
..	..	..	..	254	Fertile eggs . 275 Cockrels . 91 Hens . . 88 Pullets . . 36 Chickens 44	33,067	36,693
..	..	..	..	239	....	5,441	21,000
53 (sheep)	..	..	..	..	....	1,506	4,838
..	..	1	..	353	Stud bull . 1 Poultry . . 83 Eggs . . 779	18,004	25,263

Activities of cattle and other

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	Total number of livestock				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
Central Provinces and Berar.	Bod Cattle Breeding Farm.	2,024	Farm Superintendent.	Extra Assistant Director, In charge, Animal Husbandary Section, Central Provinces	Mixed breed.	41	114	75	112
	Garhi Cattle Breeding Farm.	1,617	Do.	Do.	Gaolao cow breed.	34	102	50	120
	Pakara Cattle Breeding Farm.	2,014	Do.	Do.	Murrah buffalo.	9	6	2	16
					Malvi cross.	20	54	48	47
Assam . .	Upper Shillong .	522	Farm Manager.	Deputy Director of Agriculture, Livestock, Assam, Shillong.	Fresian	1	..	..	..
					Cross breed.	4	32	8	24
	Khanapara . .	208	Do.	Do.	Sindhi	12	14	10	12
					Sindhi × Assamese grade.	44	22	28	23
	Sylhet Cattle Breeding Farm.	228	Do.	Do.	Do.	6	12	7	5
					Local	1	10	2	9
					Sindhi and Local grades.	..	12	18	11
	Jorhat Farm . .	..	Do.	Do.	Jorhat Grey.	24	21	12	24
North-West Frontier Province.	Tarnab Farm . .	200	Manager	Agricultural Officer.	..	3	..	..	..
	Naurang Serai Farm	100	Do.	Extra Assistant Director of Agriture, Southern Circle.	..	..	..	..	..
	Haripur Farm .	12	Agricultural Assistant.	Do. Northern Circle.	..	..	..	..	..
	Noel Bagh D. I. Khan	12	Do.	Do. Southern Circle.	..	..	..	..	..
Hyderabad-Deccan	Poultry Farm, Himayatsagar.	..	Fieldman	Deputy Director of Agriculture, West Telingana Division.	..	..	..	..	..

livestock farms in India during 1937-38—contd.

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	..	1	..	..	....	1,297	12,563
..	..	1	..	..	Cow bull . 13 Buffalo bull . 1	4,072	7,040
..	..	1	..	..	Cow bulls . 22	2,903	9,041
..	..	2	..	..			
73 Bikaneri	..	1 stallion, 13 mares and others.	..	13 Black Minorca, 64 White Leghorn, 81 R. I R 15 Khasi Campbel ducks.	150 birds, 7,539 eggs	25,979	34,133
4 Jamnapari 8 Jamnapari × Local.	..	..	..	44 White Leghorn, 20 ducks.	17 bulls .	5,089	15,571
..	..	..	..	39 Ducks	275 eggs . .	7,729	12,944
..	..	..	..				
..	..	..	..				
					Issue of bulls was stopped due to segregation.	1,311	5,177
2 Stud goats 6 stud rams 59 ewes 12 young rams	..	..	..	..	947 country hen eggs, 186 duck eggs, 39 birds, 12 adult rams.		
2 Stud goat	..	..	..	18	27 birds, 1,190 eggs.	81,722	2,18,056
..	..	..	..	..	....		
..	..	..	..	162	23 birds, 678 eggs	..	

Activities of cattle and other

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	TOTAL NUMBER OF LIVESTOCK				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
Hyderabad-Deccan	Poultry Farm, Parbhani.	..	Farm Superintendent.	Deputy Director of Agriculture, Godavari Division.	..	..	..	..	..
	Poultry Farm Rural Development Centre, Patancheru.	..	Superintendent.	Director of Agriculture, Hyderabad.	..	..	..	..	..
	Cattle Breeding Farm, Hangoli.	..	..	..	..	17	59	26	79
	Government Cattle Breeding Farm and Dairy, Himayatsagar.	464	Superintendent.	Director, Veterinary Department.	Krishna Valley.	3	58	66	78
					Malvi	2	48	57	48
					Murrah buffalo.	1	6	10	6
Mysore . .	Cattle Breeding Station, Ajjampur.	5,936	Manager	Livestock Expert in Mysore, Bangalore.	Amrit Mahal breed	78	431	96	271
					Hallikar breed.	1	..	..	..
	Hebbal Dairy Sheep and Poultry Farms.	3	Veterinary Inspector.	Do.	Do.	1	20	12	6
					Amrit Mahal Buffalo.	5	..	..	7
	Yellachihalli Sheep and Poultry Farm.	429	Agricultural Inspector.	Do.	..	..	..	..	1
	Ajjampur Sheep and Poultry Farm.	..	Veterinary Inspector.	Do.	..	..	..	..	..
	Nagenahally Poultry Farm.	..	Agricultural Inspector.	Do.	..	..	..	..	..
Baroda . .	Dairy Farm, Makarpura.	32	Dairy Superintendent.	Deputy Director of Veterinary and Animal Husbandary Ser.	..	1	21	5	38
					Buffalo	2	38	6	42
Cochin . .	Government Central Farm.	400	Manager	Director of Agriculture.	Ongole	7	10	8	14
					Cochin	1	..	1	..
					Sindhi	3	8	10	13
					Buffaloes	2	4	2	6
					Palachi	..	4	3	5
					Ongole	..	..	..	1
					Sindhi	..	..	..	1

livestock farms in India during 1937-38—contd.

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	..	..	..	32	17 birds, 138 eggs	..	..
..	..	..	..	245	12 birds, 2,350 eggs	..	..
50	..	..	..	..	4 rams, 4 bulls	..	..
..	..	..	..	..	6 bulls	6,446	73,083
..	..	..	..	..			
..	..	..	..	..			
..	..	..	..	..	76 bulls	30,519	28,512
65	..	..	..	426	7 sheep, 823 poultry, 3,070 eggs.	4,100	7,705
173	..	..	..	22	60 sheep	1,810	2,684
346	..	..	..	54	5 sheep, 7 poultry, 812 eggs.	946	2,713
..	..	..	..	161	37 poultry, 976 eggs	276	238
10	..	..	..	R.S.R. 87 Austolorps 93 Country 13	Kankrej bulls . 5 Hens . . 9 Pullets . . 24 Cocks . . 32	10,171	35,862
..	..	..	..	..	6 bulls	5,130	6,213

Activities of cattle and other

Province or state	Name of farm	Area in acres	Officer in immediate charge	Supervising officer	Total number of livestock				
					Name of breed	Cattle including buffaloes			
						Bulls	Cows	Heifers	Calves
1	2	3	4	5	6	7	8	9	10
Jammu and Kashmir.	The Central Government Poultry Farm.	9	Poultry Assistant.	Senior Entomological Assistant.	Dhanni Sindhi	30	..	..	..
	Government Sheep Breeding and Research Farm.	18,621	Officer in charge of the Farm.	A Board consisting of (1) Chief Conservator of Forests. (2) Director of Industries and Commerce Department. (3) Superintendent, Veterinary Department.	..	..	..	..	..

livestock farms in India during 1937-38—concld.

ON THE FARM ON 30 JUNE 1938					Issue of bulls, stallions, bucks, rams, etc., for stud purposes and number of eggs for poultry improvement during 1937-38	Receipt for 1937-38	Expenditure for 1937-38
Sheep and goats	Donkeys	Horses and mules	Camels	Poultry			
11	12	13	14	15	16	17	18
						Rs.	Rs.
..	3	7 stallions	..	*White Leghorn.* Cocks . 11 Hens . 14 Chicks . 116 *Rhode.* Cocks . 9 Hens . 12 Chicks . 97 *Bapington.* Cocks . 3 Hens . 16 Chicks . 17 Lotab . 1 Capons . 2 *Loc. Favourettes.* Cock . 1 Hen . 1 Chicks . 21 *Titri (Local).* Cock . 1 Hens . 4 Country hens 22	61 birds issued on swai system, 112 birds sold for breeding purposes, 777 eggs sold for hatching purposes.	328	600 (excluding the pay of the staff).
Sheep. Newzeal and Merinos 15 Austr a l i a n Corriedales. 3 *Local Stock.* Kel . 301 Bakarwal . 125 Gurey . 128 Goats. Bital . 1 Bakarwal 3	..	..	..	..	The Farm was started in October 1937, so no rams could be distributed.	No Farm wool has been sold yet.	23,496 for constructions, purchase of stock and salaries of the establishment.

APPENDIX XVI (A)

List of Research Schemes of the Imperial Council of Agricultural Research completed up to 31st March 1938

1. *General Agricultural Schemes*

1. Grant to Dr K. C. Mehta for—
   (*a*) Investigation of rusts of wheat and barley.
   (*b*) Investigation into the physiologic forms of wheat rusts.
   (c) Giving some relief from a part of his duties at the College.
2. Appointment of Hemp Marketing Officer.
3. Investigation into the vitamin contents of mangoes.
4. Professor Parija's scheme of water-hyacinth.
5. Dr A. N. Puri's scheme of standardization of physico-chemical single value measurements most suitable for Indian soils.
6. Dr Bhatnagar's schemes on (*a*) effects of ions on plant growth and (*b*) physico-chemical properties and fertility of soil.
7. Professor Dastur's scheme of rice physiology.
8. Dr. Chaudhri's scheme for investigations on the wither tip of citrus trees.
9. Grants to provinces for collecting data on manurial experiments conducted in the past.
10. Exhibits for World's Grain Exhibition and Conference.
11. Distribution of sodium fluo-silicate.
12. Experimental consignment of mangoes to the Empire Marketing Board.
13. Cost of exhibits in connection with commercial samples room of the High Commissioner's Office.
14. Grant to Burma Shell Oil Storage and Distributing Co., Bombay, for tractor operating costings.
15. Enquiry into supply of coconut products in India.
16. Award of a prize for a bone-crusher worked by (*a*) animal power and (*b*) mechanical power.
17. Training of an officer in the gas storage of fruits and vegetables.
18. Survey of various fruit growing tracts in Baluchistan to determine the distribution and status as pest of the Codling Moth and *Spilonata Ocellana*.
19. Professor Seth's scheme for investigating an electric method of hygrometry.
20. Financial assistance to the Oil Technological Section of the Harcourt Butler Technological Institute, Cawnpore.
21. Enquiry into production of cloves in India.

2. *Sugar Schemes*

1. Deputation of a Chemist to Bhopal to test Khan Bahadur Hadi's process of manufacturing sugar by open pan method.
2. Hadi's commercial test at Bilari under L. Har Sahai Gupta.
3. Bengal scheme for sugarcane crushing and *gur* boiling.
4. Deputation of Sugar Technologist to Europe and America.
5-7. Lump sum grants to the United Provinces, Bihar and Orissa and the Punjab Governments in designing a satisfactory small power sugarcane crushing mill.
8. Grant to the Sugar Section of the Harcourt Butler Technological Institute, Cawnpore.
9. Investigation into the production of *khandsari* sugar in the United Provinces.
10. Bihar *khandsari* scheme.
11-14. Sugar Technologist—
   (*a*) Main Office.
   (*b*) Sugar Cable Service.
   (c) Construction and testing of improved juice-boiling *bel*.
   (*d*) Indian Sugar Trade Information Service.
15. Grant to Sugar Demonstration Section of the United Provinces Industrial and Agricultural Exhibition.
16. Deputation of Mr. P. V. Isaac to America, Porto Rico, etc., in connection with research on insect pests of sugarcane and representation at the fourth Imperial Entomological Conference.
17. Sugarcane beetle scheme, Burma.

3. *Animal Husbandry Schemes*

1. Testing of Drug Plasmoquine.
2. Appointment of a Statistician for the compilation of certain statistics relating to feeding scales, etc., in Military Dairies.
3. Investigation of the measures of control in existence for the prevention of adulteration of milk and other dairy products.
4. Training of Mr. H. C. Varma in the preparation of skimmed milk and dried milk powder.
5. Punjab apiculture scheme regarding the training of an Agricultural Assistant in apiculture abroad.
6. All-India legislation for the control of animal diseases.
7. Investigation into most suitable methods of combating different types of parasitic infection in ruminants in the field.
8. Investigation regarding vaccination of cattle against rinderpest in the Central Provinces.
9. Village enquiry regarding cattle and the production and consumption of milk.

APPENDIX XVI (B)

List of Research Schemes of the Imperial Council of Agricultural Research in operation on the 31st March 1938

1. *General Agricultural Schemes*

1. Grant to the Government of the Punjab for locust control measures.
2. Special staff for research work with headquarters at Karachi.
3. Central Locust Bureau.
4. Botanical Sub-Station at Pusa.
5. Grant to the Agra College, Agra, for the investigation of rusts of wheat and barley.
6. Agricultural Meteorology, Poona.
7. Appointment of a Physical Assistant to the Staff of the Agricultural Chemist, Bengal.
8. Coordinated schemes of rice research—
   (*a*) Central Provinces.
   (*b*) Bihar.
   (*c*) Assam.
   (*d*) Bengal.
   (*e*) United Provinces.
   (*f*) Orissa.
9. Research work on potatoes in Madras.
10. Chemistry of malting *cholam*, Madras.
11. Malting and brewing tests of improved barleys—
   (*a*) United Provinces.
   (*b*) Punjab.
   (*c*) Bihar.
12. San Jose Scale survey in the Punjab to prevent the pest spreading to other parts of the Punjab, the United Provinces and the North-West Frontier Province.
13. Research in systematic cultivation of medicinal plants and study of food poisons, by Col. Chopra.
14. Statistical Section.
15. Bombay cold storage of fruit scheme.
16. Dry farming research schemes—
   (*a*) Bombay, Deccan.
   (*b*) Ceded Districts of Madras.
   (*c*) South East Punjab.
   (*d*) Hyderabad-Deccan.
17. His Exalted Highness the Nizam's Government scheme for the improvement of the castor crop in India.
18. Grant to the Imperial Agricultural Research Institute for potato breeding research in Northern India.
19. Provincial schemes of fruit research—
   (*a*) Madras.
   (*b*) Bengal.
   (*c*) United Provinces.
   (*d*) Punjab—Fruits and vegetable preservation.
   (*e*) Bihar.
   (*f*) Central Provinces.
   (*g*) Punjab—Citrus and grape vines.
20. Research on the *Gangai* pest of rice in the Central Provinces.
21. Bengal flax fibre scheme.
22. Tobacco cooperative flue curing experiments in provinces and states.
23. Tobacco research, Guntur Sub-station.
24. Oilseed research schemes—
   (*a*) Linseed—Central Provinces.
   (*b*) Linseed—Bengal.
   (*c*) Rape and mustard—Punjab.
   (*d*) Groundnuts—Madras.

25. Travancore scheme of research on the diseases of the cocoanut palm in South India.
26. Fruit Canning and Preserving Laboratory, Quetta.
27. Sunn-hemp schemes—
    (*a*) Madras.
    (*b*) Central Provinces.
    (*c*) Bihar.
    (*d*) Bombay.
28. Investigation of Indian fish poisons and other forest products for their insecticidal properties in Mysore.
29. United Provinces scheme for the supply of decorticated cotton seed cake for propaganda.
30. Wheat Milling and Baking Laboratory at Lyallpur.
31. Cinchona Enquiry.
32. Wheat Breeding Sub-station, Simla.
33. Dacca University scheme of agricultural research (lateritic soils and nutrition of the rice plant).
34. Prof. Mukherjee's scheme of research into the properties of colloid soil constituents.
35. Prof. Mahalanobis' scheme of investigation on experimental errors in field trials.
36. Investigation on the organic constituents of Indian soils by Prof. J. C. Ghosh, Dacca.
37. Investigation for preparation of cheap synthetic manure from town refuse and waste materials by the Indian Institute of Science, Bangalore.
38. Extension of work 'on quality' in crops by the Institute of Science, Bangalore.
39. Research on nitrogen loss in soils and nitrogen fixation in soils by Prof. N. R. Dhar.
40. Research work on plant physiology by Dr. Boshi Sen.
41. Research in agricultural economics at the Gokhale Institute of Politics and Economics.
42. Benares University scheme of research on the physiology of cane and wheat.

2. *Sugar Schemes*

1. Grant to Shahjahanpur Research Station for examination and study of sugarcane seedlings.
2. Bombay-Deccan sugarcane research scheme.
3. Scheme for the establishment of a Sugarcane Research Station in Bihar and for the appointment of a Sugarcane Specialist.
4. Scheme for the establishment of a Sub-station of the Coimbatore Imperial Sugarcane Station at Karnal.
5. Scheme for research on diseases of sugarcane at the I. A. R. I., New Delhi.
6. Sugarcane Seedling Testing Station, Dacca.
7. Grant to the Mysore Durbar for breeding of thick canes.
8. Research on the genetics of sugarcane at the Imperial Cane Breeding Station, Coimbatore.
9. Research on sugarcane in the Madras Presidency.
10. Establishment of a Sugarcane Research Station in the Punjab.
11. Investigation into various problems of sugar industry in the United Provinces.
12. Establishment of a Research and Testing Station for the indigenous system of *gur* and sugar manufacture by the Director, Imperial Institute of Sugar Technology.
13. Extension of sugarcane work at the Jorhat Experimental Station, Assam.
14. Bureau of Sugar Standards.
15. Economic enquiry into the cost of production of crops in the principal sugarcane and cotton tracts in India.
16. Research on insect pests of sugarcane.
17. Research on morphology and anatomy of sugarcane-sorghum hybrids and of the Indian sugarcane.
18. Research on the chemistry of sugarcane.
19. Investigation of suitable types of canes for Gujrat.
20. Utilization of bagasse for paper and board industry.
21. Sugarcane research in Hyderabad.
22. Scheme regarding manufacture of cattle feed from molasses.
23. Sugar marketing survey.
24. Research on the insect pests of sugarcane in the U. P.

3. *Animal Husbandry Schemes*

1. Dr. Slater's scheme of goat breeding in the United Provinces.
2. Appointment of Physiological Chemist to study animal nutrition problems at Dacca.
3. Appointment of Veterinary Investigation Officers in :—
   - (*a*) Hyderabad-Deccan.
   - (*b*) Bombay.
   - (*c*) Bengal.
   - (*d*) Punjab.
   - (*e*) Bihar.
   - (*f*) Central Provinces.
   - (*g*) Madras.
   - (*h*) United Provinces.
   - (*i*) Assam.
   - (*j*) North-West Frontier Province.
   - (*k*) Sind and Ajmer.
4. All-India Animal Husbandry Bureau.
5. Research on the composition of milk at the Allahabad Agricultural Institute.
6. Investigation of Johne's disease among cattle in Mysore.
7. Extension of work on animal nutrition in the Madras Presidency.
8. Research on warble flies.
9. Grant to the Government of the Punjab for investigation of indigenous sheep breeding.
10. Feeding of cattle on departmental farms, United Provinces.
11. Grant to the Government of Bombay for a scheme of research in poultry husbandry to be conducted in the Bombay Presidency.
12. Bihar scheme for the analysis of food-stuffs for cattle.
13. Bengal fresh water fishes scheme.
14. Improvement of poultry for table purposes, Punjab.
15. Bombay sheep breeding scheme.
16. Enquiry into the helminthiasis of cattle, sheep and goats in the United Provinces.
17. Establishment of pedigree herd books.
18. Appointment of a systematic protozoologist, Imperial Veterinary Research Institute.
19. Revised scheme for carrying on research work in the Anand Creamery in the manufacture of products and by-products of milk.

APPENDIX XVII

List of Agricultural and Animal Husbandry Publications in India published during 1937-38

Title	Author	Where published
GENERAL AGRICULTURE		
Agriculture and Livestock in India, Vol. VII, parts 5 and 6 and Vol. VIII, parts 1 to 4. Annual subscription Rs. 6 or 9*s*. 9*d*. (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or livestock in India or the Tropics).	Issued under the authority of the Imperial Council of Agricultural Research.	Manager of Publications, Civil Lines, Delhi.
The Madras Agricultural Journal. Monthly. Annual subscription Rs. 4.	M. U. Vellodi (Editor). Published by the M. A. S. Union, Agricultural Research Institute, Coimbatore.	The Secretary, M. A. S. Union, Agricultural College, Lawley Road, P. O.
The Journal of the Trichinopoly District Agricultural Association. (English and Tamil) Quarterly. Annual subscription Re. 1-8-0 for non-members, free for members.	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post.	The Secretary, The Trichinopoly District Agricultural Association, Teppakulam Post.
The Journal of the Mysore Agricultural and Experimental Union (English). Quarterly. Price As. 13 or 1*s*. 3*d*. per copy.	Dr. V. K. Badami (Ch. Editor).	The Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore.
Mysore Vyavasaya Shodhaka Sanghada Patrike. Monthly. Price As. 4 per copy.	N. Venkatasubbaya (Ch. Editor).	Ditto.
The Poona Agricultural College Magazine. Quarterly. Annual subscription Rs. 2-8-0.	V. G. Deshpande and S. M. Rao (Editors).	The Editor, *Poona Agricultural College Magazine*, Poona.
Shetki Shetkari (Marathi). Monthly. Annual subscription Re. 1-3-0.	Vasudev Ganesh Pande .	The Editor, *Shetki Shetkari*, Agricultural College, Poona.
The Planters' Journal and Agriculturist. Fortnightly. Annual subscription Rs. 10 or 16*s*.	Theo H. Thorne (Editor)	The Manager, *The Planters Journal and Agriculturist*, 13, Ezra Mansions, Calcutta.
Bulletin of the Indian Central Jute Committee. Monthly. Free.	Issued under the authority of the Indian Central Jute Committee.	Secretary, Indian Central Jute Committee, 1, Council House Street, Calcutta.
Krishi-sampad (Bengali). Monthly. Annual subscription Rs. 3.	N. K. Ghosh (Editor) .	The Manager, Krishi-sampad Office, Dacca.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
The Mufidul Mazarin (Urdu). Annual subscription Re. 1 for subscribers in the United Provinces and Re. 1-8-0 for subscribers outside the province.	C. C. Sanyal (Editor), Government Agricultural Journals.	Office of Editor, Government Agricultural Journals, Sikandarbagh, Lucknow.
The Kisan Upkarak (Hindi). Annual subscription Re. 1 for subscribers in the United Provinces and Re. 1-8-0 for subscribers outside the province.	Ditto .	Ditto.
The Allahabad Farmer. Bi-monthly. Annual subscription in India Rs. 2.	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad.	The Allahabad Agricultural Institute, United Provinces (American Presbyterian Mission), Allahabad.
Seasonal Notes. Price As. 4 per copy.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
The Nagpur Agricultural College Magazine. Quarterly. Annual subscription Rs. 3.	Published by P. D. Nair, Agricultural College, Nagpur.	The Editor, *The Nagpur Agricultural College Magazine*, College of Agriculture, Nagpur.
Kisan (Hindi) Quarterly. Annual subscription Rs. 2, As. 8 per copy.	Issued by the Agricultural Association, Bihar and Orissa.	B. N. Sircar, Senior Marketing Officer and Editor, *Kisan*, Patna.
The Planters Gazette and Annual. Annual subscription—inland Rs. 6, foreign 15*s*.	David Hye Arakie (Editor and Publisher).	Published at 109, Park Street, Calcutta.
Jute Journal. Annual subscription—inland Rs. 10, foreign £1.	Ditto .	Ditto.
Agriculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10-0 or 7*s*. 9*d*.	Issued under the authority of the Imperial Council of Agricultural Research.	Manager of Publications, Civil Lines, Delhi.
Report of the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India. Price Rs. 1-14-0 or 3*s*. 3*d*.	Sir John Russell, D.Sc., F.R.S.	Ditto.
Report on the Cold Storage and Transport of Perishable Produce in Delhi. Price As. 12 or 1*s*. 3*d*.	Agricultural Marketing Adviser to the Government of India.	Ditto.
Report on an Enquiry into the Cultivation of Cloves in India. Miscellaneous Bulletin No. 20 of the Imperial Council of Agricultural Research. Price Rs. 2-4-0 or 3*s*. 9*d*.	A. K. Yegna Narayana Aiyer.	Ditto.
Abridged Editions of the Report on the Marketing of Wheat in India (English, Hindi and Urdu). Price As. 8 each.	Issued by the Agricultural Marketing Adviser to the Government of India, Delhi.	Ditto.
Annual Report of the Agricultural Marketing Adviser and summarized Reports of Senior Marketing Officers in Provinces and certain States for the year ending 31st December 1937. Price As. 6.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Report on the Marketing of Linseed in India. Price Re. 1-4-0.	Issued by the Agricultural Marketing Adviser to the Government of India, Delhi.	Manager of Publications, Civil Lines, Delhi.
Agricultural Research and the Indian Farmer. Unpriced publication.	Issued by the Imperial Agricultural Research Institute, New Delhi.	Director, Imperial Agricultural Reserach Institute, New Delhi.
Summary Proceedings of the 34th Meeting of the Indian Central Cotton Committee. Price Re. 1.	Issued by the Publicity Officer Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
Annual Report of the Indian Central Cotton Committee, Bombay, for the year ending 31st August 1937. Price Rs. 2-0-0.	Issued by the Indian Central Cotton Committee, Bombay.	Ditto.
A Guide to Indian Cottons (Marathi, Gujerati and Kanarese). Price As. 6 each.	Ditto .	Ditto.
Summary Proceedings of the 35th Meeting of the Indian Central Cotton Committee, Bombay. Price Re. 1.	Ditto .	Ditto.
Garrowhill Cotton and the Central Provinces Cotton Control Act Prohibiting its Cultivation. (English, Hindi and Marathi) *Gratis.*	Issued by the Publicity Officer, Indian Central Cotton Committee, Bombay.	Indian Central Cotton Committee, Bombay.
First Annual Report of the Indian Central Jute Committe for the period from 1st December 1936 to 31st March 1938. Free.	Issued by the Indian Central Jute Committee, Calcutta.	Secretary, Indian Central Jute Committtee, 1, Council House Street, Calcutta.
Cholam Malt (English, Tamil and Telugu) (Reprint). Leaflet No. 4 of the Department of Agriculture, Madras.	M. Suryanarayana . .	Government Press, Madras.
Care and Management of Cattlemanure in South India (English, Telugu, Tamil, Kanarese and Malayalam) (Reprint). Leaflet No. 24 of the Department of Agriculture, Madras.	V. Muthuswamy Ayyar .	Ditto.
The Earth Scoop (Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 78 of the Department of Agriculture, Madras.	N. G. Charley . .	Ditto.
Improved Turmeric Polisher (Tamil, Telugu, Kanarese and Malayalam). Leaflet No. 80 of the Department of Agriculture, Madras.	Ditto .	Ditto.
Manufacture of Active Carbon from Paddy Husk (English, Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 81 of the Department of Agriculture, Madras.	P. V. Ramiah . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Evils of Damping Groundnut (English, Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 83 of the Department of Agriculture, Madras.	J. S. Patel . . .	Government Press, Madras.
Note on Nilgiri Agriculture (Kanarese). Pamphlet No. 10 of the Department of Agriculture, Madras.	D. G. Munro . .	Ditto.
A. H. 25 improved Groundnut (English). Pamphlet No. 12 of the Department of Agriculture, Madras.	J. S. Patel . . .	Ditto.
Plough Early (English) (Reprinted). Broad Hint No. 3 of the Department of Agriculture, Madras.	Rao Bahadur D. Ananda Rao.	Ditto.
Plough Efficiently (English) (Reprinted). Broad Hint No. 4 of the Department of Agriculture, Madras.	Ditto .	Ditto.
Sow Good Seed (English) (Reprinted). Broad Hint No. 5 of the Department of Agriculture, Madras.	G. R. Hilson . . .	Ditto.
Improved Circular Mhote Water lift for Bullock Power. Leaflet No. 86 of the Department of Agriculture, Madras. Free.	N. G. Charley . .	Ditto.
On Coconut Cultivation (Telugu). Pamphlet No. 8 of the Department of Agriculture, Madras. Free.	J. S. Patel . . .	Ditto.
Note on Nilgiri Agriculture (Kanarese). Pamphlet No. 10 of the Department of Agriculture, Madras. Free.	D. G. Munro . . .	Ditto.
On Improved Groundnut (Tamil, Telugu, Malayalam and Kanarese). Pamphlet No. 12 of the Department of Agriculture, Madras. Free.	J. S. Patel . . .	Ditto.
Feed Your Bullock (Telugu and Malayalam) (Reprinted). Broad Hint No. 1 of the Department of Agriculture, Madras. Free.	G. R. Hilson . . .	Ditto.
Plough Early (Telugu) (Reprinted). Broad Hint No. 3 of the Department of Agriculture, Madras. Free.	Rao Bahadur D. Ananda Rao.	Ditto.
Plough Efficiently (Telugu and Malayalam) (Reprinted). Broad Hint No. 4 of the Department of Agriculture, Madras. Free.	Ditto . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Sow Good Seed (Telugu and Malayalam) (Reprinted). Broad Hint No. 5 of the Department of Agriculture, Madras. Free.	G. R. Hilson . . .	Government Press, Madras.
Beware of Weeds (English, Tamil, Telugu and Malayalam) (Reprinted). Broad Hint No. 6 of the Department of Agriculture, Madras, Free.	Ditto . .	Ditto.
Monograph on Coconut (English). Price Rs. 3-12-0.	J. S. Patel . . .	Ditto.
Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1936-37. Price As. 12.	Issued by the Department of Agriculture, Bombay Presidency.	Government Central press, Bombay.
Annual Report of the Department of Agriculture, Bengal, for 1936-37. Part I, price As. 8; Part II price Re. 1-4-0.	Issued by the Department of Agriculture, Bengal.	Government Printing, Bengal, Calcutta.
A Short Survey of the Work, Achievements and Needs of the Bengal Agricultural Department for the period 1906-1936. Free (For official use only).	Ditto .	Office of the Director of Agriculture, Bengal, Dacca.
Mustard. Leaflet No. 4 of the Department of Agriculture, Bengal. Free.	Ditto .	Government Printing, Bengal, Calcutta.
Instructions for Sowing Improved Varieties of Rice Seed (Reprinted). Leaflet No. 36 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Rai Bahadur R. L. Sethi	1. Deputy Director of Agriculture, Sarda Circle, Lucknow. 2. Deputy Director of Agriculture, Eastern Circle, Partabgarh. 3. Deputy Director of Agriculture, Western Circle, Aligarh. 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur. 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi. 6. Deputy Director of Agriculture, Rohilkhand and Kumaon Circle, Bareilly.
The Utilisation of Molasses as a Manure (Urdu and Hindi). Leaflet No. 41 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Department of Agriculture, United Provinces.	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Lawn Making (Urdu). Leaflet No. 48 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Department of Agriculture, United Provinces.	Ditto.
Seed Sowing (Urdu). Leaflet No. 49 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Hedges (Urdu). Leaflet No. 50 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Rose Cultivatiion (Urdu). Leaflet No. 51 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Other Important Matters about Seeds (Urdu). Leaflet No. 52 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Paddy Cultivation in Canal Tracts (English). Leaflet No. 66 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
The Cultivation of *Ajwain* (English). Leaflet No. 67 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Improved Mustard Strains and their Importance in the Cultivation and Industries of the United Provinces. Leaflet No. 58 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Improved Groundnut Strains and their Importance in the Cultivation and Industries of United Provinces. Leaflet No. 59 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
A Note on Improved Tobacco (Virginian Tobacco). Free.	H. D. Singh Gupta .	Deputy Director of Agriculture, Sarda Circle, Lucknow.
Cultivation of Some Important Drugs in the Punjab. Price As. 10	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
L. S. S., A New Cotton of Hirsutum Type. Leaflet No. 139 of the Department of Agriculture, Punjab. Free.	Issued by the Department of Agriculture, Punjab.	Government Printing, Puajab, Lahore.
Soyabean Cultivation in the Punjab. Leaflet No. 146 of the Department of Agriculture, Punjab. Free.	Ditto .	Ditto.
Annual Report of the Department of Agriculture, Punjab, for the year ending 30th June 1937. Price As. 8.	Ditto .	Ditto.
Annual Report of the Department of Agriculture, Bihar, for the year 1936-37.	Issued by the Department of Agriculture, Bihar.	Government Printing, Bihar, Gulzarbagh.
Annual Report of Tirhut Range. Bulletin No. 3 of 1937 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Annual Report of Patna Range. Bulletin No. 4 of 1937 of the Department of Agriculture, Bihar.	Ditto	Ditto.
Annual Report of Bhagalpur Range. Bulletin No. 5 of 1937 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Annual Report of Chota Nagpur Range. Bulletin No. 6 of 1937 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Annual Report of the Engineering Sections. Bulletin No. 9 of 1937 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Soyabean—— Its Cultivation and Use. Leaflet No. 5 of 1937 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Reports on Demonstration Work carried out in Northern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the years, ending the 31st March 1936 and 1937 Price Re. 1-8-0 each.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing Central Provinces and Berar, Nagpur.
Reports on Demonstration Work carried out in the Eastern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the years ending the 31st March 1936 and 1937. Price Re. 1-8-0 each.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
	GENERAL AGRICULTURE—*contd.*	
Reports on Demonstration Work carried out in the Western Circle together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the years ending the 31st March 1936 and 1937. Price Re. 1-8-0 each.	Issued by the Department of Agriculture, Central Provinces and Berar.	Goverment Printing Central Provinces and Berar, Nagpur.
Reports on Demonstration Work carried out in the Southern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the years ending the 31st March 1936 and 1937. Price Re. 1-8-0 each.	Ditto .	Ditto.
Demonstration Plot, Kham (English, Hindi and Marathi). Leaflet No. 15 of 1937 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Ditto.
Eradication of *Kans* by Cultivated Fallow System (English, Hindi and Marathi). Leaflet No. 16 of 1937 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Ditto.
Eradication of *Kans, Kunda, Dub* and *Nagarmotha* (English). Leaflet No. 17 of 1937 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Ditto.
Report on the working of the Department of Agriculture, Central Provinces and Berar, for the year ending 31st March 1937. Price Re. 1-8-0.	Ditto .	Ditto.
Annual Report on Experimental Farms, Nagpur, Akola, Adhartal, Chhindwara, Powarkhera, Raipur and Tharsa for the year ending the 31st March 1937. Price Re. 1-8-0.	Ditto .	Ditto.
Why we should grow Castor ? Leaflet No. 18 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Ditto.
The Cultivation of Groundnut (Marathi). Leaflet No. 19 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Ditto.
Cultivation of Potato. Leaflet No. 20 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
A Simple Method of Extracting Fibres from Linseed Stalk. Leaflet No. 21 of the Department of Agriculture, Central Provinces and Berar. Free.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing Central Provinces and Berar, Nagpur.
The Potato in Assam. Bulletin No. 2 of the Department of Agriculture, Assam. Free.	R. C. Woodford . .	Director of Agriculture, Assam, Shillong.
Soyabean. Leaflet No. 1 of 1938 of the Department of Agriculture, Assam. Free.	Issued by the Department of Agriculture, Assam, Shillong.	Ditto.
Cultivation of Groundnut. Leaflet No. 11 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
Eupatorium. A Noxious Weed in Assam. Leaflet No. 12 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
The *Arhar* (Pigeon Pea—*Cajanus indicus*). Leaflet No. 13 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
The Spanish Chestnut. Leaflet No. 14 of the Department of Agriculture, Assam (Revised Bulletin No. 3 of 1904). Free.	Ditto .	Ditto.
Catch Crop for Orissa (Oriya). Bulletin No. 8 of 1937 of the Department of Agriculture, Orissa.	Issued by the Director of Development, Orissa.	Orissa Government Press, Cuttack.
Annual Experimental and Research Report of Hyderabad-Deccan for 1344 Fasli.	Issued by the Director of Agriculture, Hyderabad-Deccan.	Government Central Press, Hyderabad-Deccan.
Annual Administration Report of the Department of Agriculture, Mysore, for 1935-36. Price Re. 1-8-0.	Issued under the authority of the Department of Agriculture, Mysore.	Director of Agriculture, Mysore, Bangalore.
Annual Report of the Department of Agriculture, Mysore, for 1936-37. Price Re. 1-8-0.	Ditto .	Ditto.
Mysore Agricultural Calendar for 1938. Price As. 2.	Ditto .	Ditto.
Bone Meal (Malayalam). Free . .	Issued by the Department of Agriculture, Cochin, Trichur.	Director of Agriculture, Cochin, Trichur.
Solanum melongena (Malayalam). Free.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
GENERAL AGRICULTURE—*concld.*		
Soil Erosion	R. Madhavan Pillai .	Government Press, Travancore.
Nutmeg Cultivation (Malayalam). Free.	M. K. Narayana Pillai .	Director of Agriculture and Fisheries, Travancore, Trivandrum.
Fifty Years onwards. The Development of Agriculture and of the Department of Agriculture in Baroda, 1888 to 1938. Price As. 10.	R. G. Allan . . .	Commissioner of Agriculture, Baroda State, Baroda.
Castor Cultivation—*Kasti-Arandi*. Price one anna.	Dr. J. K. Dubey . .	Government Press, Bhopal.
The Elimination of Foreign Matter in Tea.	C. J. Harrison . .	Assistant Secretary, Indian Tea Association, Royal Exchange Buildings, Calcutta.
The Application of Science to Modern Tea Culture.	P. H. Carpenter . .	Ditto.
Proceedings of the Second Annual Conference, held at Tocklai, 1938.	Issued by the Indian Tea Association, Cinnamara P. O.	Ditto.
AGRICULTURAL STATISTICS		
Supply and Distribution of Various Types of Indian Cotton during the Season of 1935-36. Statistical Bulletin No. 6, 1935-36. Price As. 8.	Issued by the Secretary, Indian Central Cotton Committee.	Indian Central Cotton Committee, Bombay.
Stocks of Indian Cotton held in India by the Mills and the Trade on 31st August 1937. Statistical Leaflet No. 2 (Fourth issue 1936-37). Price one anna.	Ditto .	Ditto.
Receipts at Mills in India of Raw Cotton classified by Varieties 1936-37 Season. Statistical Leaflet No. 3 (Fourth issue 1936-37). Price one anna.	Ditto .	Ditto.
Exports by sea of Indian Raw Cotton classified by Varieties 1936-37 Season. Statistical Leaflet No. 4 (Fourth issue, 1936-37). Price one anna.	Ditto .	Ditto.
Report on the Staple Length of Indian Cotton Crops of 1937-38 Season. Statistical Leaflet No. 1 of the Indian Central Cotton Committee. Fifth Issue (1937-38). Price Anna 1.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
AGRICULTURAL STATISTICS—*contd.*		
Report on the Accuracy of the All-India Cotton Forecasts of 1936-37 Season. Statistical Leaflet No. 5 of the Indian Central Cotton Committee. Seasonal Issue (1936-37). Price As. 2.	Issued by the Secretary, Indian Central Cotton Committee.	Indian Central Cotton Committee, Bombay.
Monthly Bulletins (Nos. 1-4) for the Months of April to July 1938 containing information and statistics relating to Jute. Free.	Issued by the Indian Central Jute Committee, Calcutta.	Secretary, Indian Central Jute Committee, 1 Council House Street, Calcutta.
The Delimitation of Areas for Strains of Agricultural Crops with Special Reference to Cotton. Indian Central Cotton Committee Proceedings of the First Conference of Scientific Research Workers on Cotton in India. Cotton Statistical paper No. 1.	V. G. Panse . . .	Director, Institute of Plant Industry and Agricultural Adviser to States in Central India and Rajputana, Indore.
Season and Crop Report of the Bombay Presidency for the year 1936-37. Price As. 4.	Issued by the Department of Agriculture, Bombay Presidency, Poona.	Government Central Press, Bombay.
Season and Crop Report of Bengal for 1937-38. Price As. 4.	Issued by the Department of Agriculture, Bengal.	Government Printing, Bengal, Calcutta.
Season and Crop Report of the Punjab for the year 1936-37.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
Agricultural Statistics, Bihar. 1936-37	Issued by the Department of Agriculture, Bihar.	Government Printing, Bihar, Gulzarbagh.
Season and Crop Report, Sind, for 1936-37.	Issued by the Department of Agriculture, Sind.	The Daily Gazette Press, Ltd., Karachi.
SUGAR RESEARCH		
First and Second Memoranda on the Production of Sugar direct from Cane during the Season 1937-38. Supplied free to sugar factories.	Issued by the Director, Imperial Institute of Sugar Technology, Cawnpore.	Director, Imperial Institute of Sugar Technology, Cawnpore.
Note on the Production of Sugar refined from *Gur* during the year 1937. Supplied free to sugar factories.	Ditto .	Ditto.
Review of the Sugar Industry of India for the crop-year 1936-37. Supplied free to sugar factories.	Ditto .	Ditto.
Note on the Results of the Experiments on the Utilization of Molasses as a Road-making Material. Supplied free to sugar factories.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
SUGAR RESEARCH—*contd.*		
Sugar Production Rules 1935 (Revised Edition). Supplied free to sugar factories.	Issued by the Director, Imperial Institute of Sugar Technology, Cawnpore.	Director, Imperial Institute of Sugar Technology, Cawnpore.
Cultivation of Sugarcane in Tanjore Delta. Leaflet No. 82 of the Department of Agriculture, Madras.	M. Anandan . . .	Government Press, Madras.
The Open Pan System of White Sugar Manufacture in Factories Completely Installed with Machinery Designed by the Bengal Department of Agriculture. Bulletin No. 1 of 1937 of the Department of Agriculture, Bengal. Gratis.	Issued by the Department of Agriculture, Bengal.	Director of Agriculture, Bengal, Dacca.
Improved Methods of Cane Cultivation in the United Provinces. Bulletin No. 72 of the Department of Agriculture, United Provinces. Price Re. 1-8-0.	Rai Bahadur R. L. Sethi, and others.	Printing and Stationery, United Provinces, Allahabad.
General Information about the Sugarcane Crop in the United Provinces (Urdu and Hindi). Leaflet No. 37 of the Department of Agriculture, United Provinces. (Free in the United Provinces, only.)	Issued by the Department of Agriculture, United Provinces.	1. Deputy Director of Agriculture, Sarda Circle, Lucknow. 2. Deputy Director of Agriculture, Western Circle, Aligarh. 3. Deputy Director of Agriculture, Eastern Circle, Partabgarh. 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur. 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi. 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.
Improved Methods of Cultivation and other Important Cultural Operations of Sugarcane (Urdu). Leaflet No. 38 of the Department of Agriculture, United Provinces. (Free in the United Provinces, only.)	Ditto	Ditto.
Irrigation of Sugarcane Crop (Hindi and Urdu). Leaflet No. 39 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
SUGAR RESEARCH—*concld.*		
Manuring of Sugarcane Crop in the United Provinces (Hindi and Urdu). Leaflet No. 40 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Issued by the Department of Agriculture, United Provinces.	Ditto.
Ratooning of Sugarcane (Urdu). Leaflet No. 42 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Open Pan Boiling for *gur* and Sugar Manufacture (Urdu). Leaflet No. 43 of the Department of Agriculture, United Provinces. (Free in the United Provinces only.)	Ditto .	Ditto.
Manufacture of *Khandsari* Sugar as a Cottage Industry in Bihar. Bulletin No. 2 of 1937 of the Department of Agriculture, Bihar.	Issued by the Department of Agriculture, Bihar.	Government Printing, Bihar, Gulzarbagh.
Work Done on Sugarcane in Orissa (English). Bulletin No. 11 of 1937 of the Department of Agriculture, Orissa.	Issued by the Director of Development, Orissa.	Orissa Government Press, Cuttack.
Sugarcane —— Its Cultivation and Manuring. Bulletin No. 1 of 1938 of the Department of Agriculture, Assam. Free.	N. Ghose . .	Director of Agriculture, Assam, Shillong.
Sugarcane Cultivation and Sugar Industry.	V. Narayanan Nair .	Government Press, Travancore.
COTTON TECHNOLOGY		
Technological Reports on Trade Varieties of Indian Cottons, 1937. (Technological Bulletin Series A.) Price Re. 1-8-0.	Dr. Nazir Ahmad . .	Indian Central Cotton Committee, Bombay.
Technological Reports on Standard Indian Cottons, 1937. (Technological Bulletin Series A.) Price Re. 1-8-0.	Ditto .	Ditto.
The Effect of Different Degrees of Compression on the Fibre Properties and Spinning Quality of Indian Cottons. (Technological Bulletin Series A.) Price As. 8.	Ditto .	Ditto.
Spinning Tests on Punjab-American 4F Cotton with Different Schemes of Drafts in the Speed Frames. (Technological Bulletin Series A.) Price As. 8.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
COTTON TECHNOLOGY—*contd.*		
A Device for Determining the Proportion of Fibres of Different Lengths in Samples of Cotton. (Technological Bulletin Series B.) Price As. 8.	Dr. Nazir Ahmed . .	Indian Central Cotton Cammittee, Bombay.
Studies in the Variation of Strength and Weight per inch with Group Length of Cotton Fibres. (Technological Bulletin Series B.) Price As. 8.	Ditto .	Ditto.
Spinning Test Report on Samples of Latur Cotton, 1936-37. (Technological Circular No. 882.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report on Samples of Bengal Cotton, 1937-38. (Technologocal Circular No. 912.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report on Samples of Moglai Cotton, 1937-38 (Technological Circular No. 913.) Price As. 4.	Ditto .	Ditto.
Technological Report on Verum (Nagpur), 1937-38. (Technological Circular.) Price As. 4.	Ditto .	Ditto.
Annual Report of the Director, Technological Laboratory, Matunga, for the year ending 31st May 1938. Price As. 6.	Issued by the Secretary, Indian Central Cotton Committee, Bombay.	Ditto.
Empirical Relationships between Count, Lea Strength and Staple Length of Indian Cottons. (Technological Bulletin Series A, No. 42.) Price As. 8.	V. Venkataraman and Dr Nazir Ahmad.	Ditto.
Suitability of two Cottons for Purposes of Mill Mixings in Relation to their Fibre Characters. (Technological Bulletin Series A, No. 43.) Price Re. 1.	Dr. Nazir Ahmad and K. R. Sen.	Ditto.
A Device for determining the Proportion by Weight of Fibres of Different Lengths in a Sample of Cotton. (Technological Bulletin Series B, No. 23.) Price As. 8.	Dr. Nazir Ahmad and C. Nanjundayya.	Ditto.
Studies in the Variation of Strength and Weight per Inch with Group Length of Cotton Fibres. (Technological Bulletin Series B, No. 24.) Price Re. 1.	C. Nanjundayya and Dr Nazir Ahmad.	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
COTTON TECHNOLOGY—*contd.*		
The Clinging Power of Single Cotton Fibre in relation to its Physical Properties. (Technological Bulletin Series B, No. 25.) Price As. 8.	K. R. Sen and Dr. Nazir Ahmad.	Indian Central Cotton Committee, Bombay.
Spinning Test Report (No. 918) on Samples of Khandesh Cotton, 1937-38. (Technological Circular No. 326.) Price As. 4.	Dr. Nazir Ahmad . .	Ditto.
Technological Report on Late Verum (Nagpur), 1937-38. (Technological Circular No. 327.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 919) on Samples of Berar Cotton, 1937-38. (Technological Circular No. 328.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 921) on Samples of Punjab-American Cotton, 1937-38. (Technological Circular No. 329.) Price As. 4.	Ditto. .	Ditto.
Spinning Test Report (No. 922) on Samples of Central Provinces No. 1 Cotton, 1937-38. (Technological Circular No. 330.) Price As. 4.	Ditto .	Ditto.
Technological Report on Umri Bani, 1937-38. (Technological Circular No. 331.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 925) on Samples of Ujjain Cotton, 1937-38. (Technological Circular No. 332.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 926) on Samples of Khandesh Cotton, 1937-38. (Technological Circular No. 333.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 927) on Samples of Ujjain Cotton, 1937-38. (Technological Circular No. 324.) Price As 4.	Ditto .	Ditto.
Spinning Test Report (No. 931) on Samples of Farm Westerns Cotton, 1937-38. (Technological Circular No. 335.) Price As. 4.	Ditto .	Ditto.
Technological Report on Verum 434 (Akola), 1937-38. (Technological Circular No. 336.) Price As. 4.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38.

Title	Author	Where published
COTTON TECHNOLOGY—*contd.*		
Spinning Test Report No. 934 on Samples of Broach Cotton, 1937-38. (Technological Circular No. 337.) Price As. 4.	Dr. Nazir Ahmad . .	Indian Central Cotton Committee, Bombay.
Technological Report on Verum 262 (Akola), 1937-38. (Technological Circular No. 338.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 939) on Samples of Bailhongal Cotton, 1937-38. (Technological Circular No. 339.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 940) on Samples of Miraj Cotton, 1937-38. (Technological Circular No. 340.) Price As. 4.	Ditto .	Ditto.
Technological Report on Punjab-American 289-F., 1937-38. (Technological Circular No. 341.) Price As. 4.	Ditto .	Ditto.
Technological Report on Punjab-American 4-F., 1937-38. (Technological Circular No. 342) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 942) on Samples of Westerns Cotton 1937-38. (Technological Circular No. 343.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 943) on Samples of Hubli Kumpta Cotton 1937-38. (Technological Circular No. 344.) Price As. 4.	Ditto .	Ditto.
Technological Report on Sind-Sudhar (289-F-1), 1937-38. (Technological Circular No. 345.) Price As. 4.	D. L. Sen . . .	Ditto.
Spinning Test Report (No. 945) on Samples of Tiruppur Cambodia Cotton, 1937-38. (Technological Circular No. 346.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 946), on Samples of Karunganni Cotton, 1937-38. (Technological Circular No. 347.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 947 on Samples of Surat Cotton, 1937-38. (Technological Circular No. 348.) Price As. 4.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
COTTON TECHNOLOGY—*contd.*		
Spinning Test Report (No. 948) on Samples of Kampala Cotton, 1937-38. (Technological Circular No. 349.) Price As. 4.	D. L. Sen. . . .	Indian Central Cotton Committee, Bombay.
Spinning Test Report (No. 950) on Samples of Tiruppur Cambodia Cotton, 1937-38. (Technological Circular No. 350.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 952) on Samples of Jinja Cotton, 1937-38. (Technological Circular No. 351.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 953) on Samples of African Busoga Cotton, 1937-38. (Technological Circular No. 352.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 954) on Samples of Latur Cotton, 1937-38. (Technological Circular No. 353.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 956) on Samples of Broach Cotton, 1937-38. (Technological Circular No. 354.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 957) on Samples of Surat Cotton, 1937-38. (Technological Circular No. 355.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 958) on Samples of Muttia Cotton, 1937-38. (Technological Circular No. 356.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 960) on Samples of Navsari Cotton, 1937-38. (Tech..ological Circular No. 357.) Price As. 4.	Dr. Nazir Ahmad . .	Ditto.
Technological Report on Surat 1027 ALF Cotton, 1937-38. (Technological Circular No. 358.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 964) on Samples of AR Busoga Cotton, 1937-38. (Technological Circular No. 360.) Price As. 4.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
COTTON TECHNOLOGY—*concld.*		
Spinning Test Report (No. 965) on Samples of AR Kampala Cotton, 1937-38. (Technological Circular No. 361.) Price As. 4.	Dr. Nazir Ahmad . .	Indian Central Cotton Committee, Bombay.
Spinning Test Report (No. 966) on Samples of AR Jinja Cotton, 1937-38. (Technological Circular No. 362.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 968) on Samples of Dholleras Cotton, 1937-38. (Technological Circular No. 363.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 969) on Samples of Kadi-Viramgam Cotton, 1937-38. (Technological Circular No. 364.) Price As. 4.	Ditto .	Ditto.
Spinning Test Report (No. 971) on Samples of Kalagin Cotton, 1937-38. (Technological Circular No. 365.) Price As. 4.	Ditto .	Ditto.
FRUITS		
Bulletin of the United Provinces Fruit Development Board (Marketing Series). Fortnightly. Annual Subscription Rs. 2-8-0. Price single copy As. 2.	Issued by the Provincial Marketing Officer, United Provinces, Lucknow.	Secretary, United Provinces Fruit Development Board, Lucknow.
The Punjab Fruit Journal (English and Urdu). Quarterly. Annual subscription Rs. 2 inland and 4*s.* for foreign countries.	Issued by the Punjab Provincial Cooperative Fruit Development Board, Lyallpur.	Honorary Secretary, Punjab Provincial Cooperative Fruit Development Board, Lyallpur.
Investigations on the Cold Storage of Mangoes. Miscellaneous Bulletin No. 21 of the Imperial Council of Agricultural Research.	G. S. Cheema ; D. V. Karmarkar and B. M. Joshi.	Manager of Publications, Civil Lines, Delhi.
Safe-guarding Fruit Trees from Heat, Cold and Wind (Hindi and Urdu). Bulletin No. 16 F. S. of the Department of Agriculture, United Provinces. Price As. 1-6.	Issued by the Department of Agriculture, United Provinces.	Printing and Stationery, United Provinces, Allahabad.
Pruning of Deciduous Fruit Trees (Hindi and Urdu). Bulletin No. 18 F. S. of the Department of Agriculture, United Provinces. Price As. 2.	R. S. Singh . . .	Ditto.
'The *Loquats*'. Bulletin No. 19 F. S. of the Department of Agriculture, United Provinces. Price As. 3.	Pratap Singh . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
	FRUITS—*contd.*	
Planting of Orchards (Urdu). Leaflet No. 68 of the Department of Agriculture, United Provinces. Free in U. P. only.	Issued by the Department of Agriculture, United Provinces.	1. Dy. Director of Agriculture, Sarda Circle, Lucknow. 2. Dy. Director of Agriculture, Western Circle, Aligarh. 3. Dy. Director of Agriculture, Bundelkhand Circle, Jhansi. 4. Dy. Director of Agriculture, Eastern Circle, Partabgarh. 5. Dy. Director of Agriculture, North-Eastern Circle, Gorakhpur. 6. Dy. Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.
Phalon ka bagh lugana (Urdu). Leaflet No. 68 of the Department of Agriculture, United Provinces. Free in U. P. only.	Ditto .	Ditto.
A Note on Peach Cultivation in Chota Nagpur. Leaflet No. 4 of 1937 of the Department of Agriculture, Bihar.	Issued by the Department of Agriculture, Bihar.	Government Printing, Bihar, Gulzarbagh.
For the Attention of Banana Cultivators.	V. Narayanan Nair .	Government Press, Travancore.
	LAC	
A Technical Process for Washing and Refining Stick Lac. Bulletin No. 27. Price As. 3.	A. K. Thakur . .	Director, Indian Lac Research Institute, Namkum, Ranchi, Bihar.
Preparation of Bleached (White) Lac. Technical Note No. 3. Price one anna.	Issued by the Director, Indian Lac Research Institute, Namkum.	Ditto.
Lac Cultivation in India. Being a second and revised edition of 'A Practical Manual of Lac Cultivation', by P. M. Glover. Price Rs. 2.	Ditto. .	Ditto.
The Shellac Industry (Urdu) . .	Ditto . .	Ditto.
Conservation of the *Baisakhi Ber* (*Zizi-phus Jujuba*). Brood of the Lac Insect and Possibilities of effecting Better Returns from Lac Cultivation on *Ber*. Price As. 4.	P. S. Negi . . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
LAC—*contd.*		
Eupelmus tachardiæ How. and the Lac Insect.	P. S. Negi and S. N. Gupta	Director, Indian Lac Research Institute, Namkum, Ranchi, Bihar.
A Few Hints on the Cultivation of Lac (Bengalee).	Faizuddin Bhunya .	Ditto.
AGRICULTURAL SCIENCE		
GENERAL		
The Indian Journal of Agricultural Science, Vol. VII, parts 4-6 and Vol. VIII, parts 1-3. Annual subscription Rs. 15 or 24*s*. (Original scientific work in the various branches of science applied to agriculture, formerly published in the *Memoirs of the Imperial Department of Agriculture in India* is now published in the *Indian Journal of Agricultural Science*).	Issued under the authority of the Imperial Council of Agricultural Research.	Manager of Publications, Civil Lines, Delhi.
Scientific Reports of the Imperial Agricultural Research Institute, New Delhi (for the year ending 30th June 1937). Price Rs. 3.	Issued by the Director, Imperial Agricultural Research Institute, New Delhi.	Ditto.
Report on the (1) Agricultural College, Nagpur, (2) Chemical, Botanical, Mycological Research, (3) Agricultural Engineering Section, (4) Maharajbagh Menagerie together with the external work of the Veterinary Inspection attached to the Agricultural College, Nagpur for 1936-37. Price Re. 1-8.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing, C. P. and Berar, Nagpur.
Annual Report of the Coffee Scientific Officer, 1937-38. Bulletin No. 17 of the Mysore Coffee Experiment Station. Price As. 4.	W. Wilson Mayne . .	Department of Agriculture, Mysore, Bangalore.
BOTANY.		
The Genetics of Gossypium and its Application to Cotton Breeding.	J. B. Hutchinson, P. D. Gadkari and M. A. A. Ansari.	Director, Institute of Plant Industry, Indore.
The Genetics of Lintlessness in Asiatic Cotton.	J. B. Hutchinson and P. D. Gadkari.	Ditto.
Annual Report of Botanical Section, Bihar Bulletin No. 8 of 1937 of the Department of Agriculture, Bihar.	Issued by the Department of Agriculture, Bihar.	Government Printing, Bihar, Gulzarbagh.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
AGRICULTURAL SCIENCE—*contd.*		
CHEMISTRY AND PHYSICAL CHEMISTRY		
On the Reclamation of Alkaline Soils (English). Leaflet No. 84 of the Department of Agriculture, Madras. Free.	P. V. Ramiah . .	Government Press, Madras.
Preparation of a Cheap Manure from Farm Waste. Bulletin No. 1 of 1938 of the Department of Agriculture, Bihar.	Issued by the Department of Agriculture, Bihar.	Government Press, Gulzarbagh, Bihar.
Annual Report of Chemical Section, Bihar. Bulletin No. 7 of 1937 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Manuring of the Rice Crop. Leaflet No. 1 of 1938 of the Department of Agriculture, Bihar.	Ditto .	Ditto.
Lime for Assam Soils. Leaflet No. 3 of 1938 of the Department of Agriculture, Assam. Free.	Issued by the Department of Agriculture, Assam.	Director of Agriculture, Assam, Shillong.
Preservation of Cow-dung Manure (Oriya). Bulletin No. 7 of 1937 of the Department of Agriculture, Orissa.	Issued by the Director of Development, Orissa.	Orissa Government Press, Cuttack.
Compost (English). Bulletin No. 9 of 1937 of the Department of Agriculture, Orissa.	Ditto .	Ditto.
Khad (Manure). (Urdu and Hindi). Price one anna.	Dr J. K. Dubey . .	Government Press, Bhopal.
Night Soil (Malayalam). (Leaflet.) Free.	Issued by the Department of Agriculture, Cochin.	Director of Agriculture, Cochin, Trichur.
Compost (Malayalam). (Leaflet.) Free.	Ditto .	Ditto.
ENTOMOLOGY		
A Preliminary Annotated List of the Fruit Pests of the North-West Frontier Province. Miscellaneous Bulletin No. 19 of the Imperial Council of Agricultural Research. Price Re. 1 or 1*s.* 9*d.*	Hem Singh Pruthi and H. N. Batra. -	Manager of Publications, Civil Lines, Delhi.
The Spotted Boll-worm Pest of Cotton and how to Control it. (English and Urdu). *Gratis.*	Issued by the Publicity Officer, Indian Central Cotton Committee. -	Indian Central Cotton Committee, Bombay.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
AGRICULTURAL SCIENCE—*contd.*		
ENTOMOLOGY—*contd.*		
The Mango-hopper (Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 77 of the Department of Agriculture, Madras.	M. C. Cherian . .	Government Press, Madras.
Red Hairy Caterpillar Pest (Tamil and Kanarese). (Reprinted.) Leaflet No. 23 of the Department of Agriculture, Madras. Free.	Y. Ramachandra Rao .	Director of Agriculture, Madras.
Sugarcane Pests in the United Provinces. Bulletin No. 73 of the Department of Agriculture, United Provinces.	B. D. Gupta . . .	Printing and Stationery, United Provinces, Allahabad.
Insect Diseases and their Remedies (Urdu). Leaflet No. 53 of the Department of Agriculture, United Provinces. Free in U. P. only.	Issued by the Department of Agriculture, United Provinces.	1. Deputy Director of Agriculture, Sarda Circle, Lucknow. 2. Deputy Ditector of Agriculture, Western Circle, Aligarh. 3. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi. 4. Deputy Director of Agriculture, Eastern Circle, Partabgarh. 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur. 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.
A Method of reducing Borer Attack on Sugarcane. Leaflet No. 69 of the Department of Agriculture, United Provinces. Free in U. P. only.	Ditto .	Ditto.
Sugarcane Pests in the United Provinces (English). Bulletin No. 73 of the Department of Agriculture, United Provinces. Price As. 2.	B. D. Gupta . . .	Printing and Stationery, United Provinces, Allahabad.
The White Fly of Cotton. Leaflet No. 141 of the Department of Agriculture, Punjab. Free.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
Surface Grass-hoppers 'Toka'. Leaflet No. 142 of the Department of Agriculture, Punjab. Free.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
AGRICULTURAL SCIENCE—*contd.*		
ENTOMOLOGY—*concld.*		
An Easy Method of Destroying Cactus with Cochineal Insects (Marathi). Leaflet No. 14 of the Department of Agriculture, Central Provinces and Berar. Free.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing, Central Provinces and Berar, Nagpur.
Rice Caterpillar (Hindi). Leaflet No. 23 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Director of Agriculture, Central Provinces and Berar, Nagpur.
Sugarcane Borers and How to Control Them. Leaflet No. 6 of 1938 of the Department of Agriculture, Assam. Free.	Issued by the Department of Agriculture, Assam.	Director of Agriculture, Assam, Shillong.
Rice Case Worm (*Nymphylo dopunctalis*). Leaflet No. 7 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
Swarming Caterpillars in Paddy. Leaflet No. 8 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
Citrus Trunk Borer (*Mohohammus versteegi*). Leaflet No. 9 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
Rhinoceros Beetle Pest (*Oryctes rhinoceros*). Leaflet No. 10 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.
How to Control 'Tid' (Urdu). Leaflet No. 2 of the Department of Agriculture, Baluchistan. Free.	Issued by the Department of Agriculture, Baluchistan.	Agricultural Officer, Baluchistan, Quetta.
Codling Moth and its Control in Baluchistan (Urdu). Leaflet No. 3 of the Department of Agriculture, Baluchistan. Free.	Ditto .	Ditto.
Bee-keeping for Beginners. (Entomological Series Bulletin No. 10.) (Revised.) Price As. 10.	T. V. Subramaniam .	Director of Agriculture, Mysore, Bangalore.
The Occurrence and Treatment of Bark-Eating Caterpillars and Borers.	E. A. H. Roberts and M. Singha.	Assistant Secretary, Indian Tea Association, Royal Exchange Buildings, Calcutta.
The Occurrence and Treatment of Red Spider in Tea in North East India.	C. J. Harrison . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
AGRICULTURAL SCIENCE—*contd.*		
PLANT DISEASES		
The Fungi of India. Supplement I. Scientific Monograph No. 12 of the Imperial Council of Agricultural Research. Price Re. 1-6 or 2*s.* 3*d.*	B. B. Mundkur . .	Manager of Publications, Civil Lines, Delhi.
Sendomans Citre Disease of the Citrus (Urdu). Leaflet No. 63 of the Department of Agriculture, United Provinces. Free in U. P. only.	Issued by the Department of Agriculture, United Provinces.	1. Deputy Director of Agriculture, Sarda Circle, Lucknow. 2. Deputy Director of Agriculture, Western Circle, Aligarh. 3. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi. 4. Deputy Director of Agriculture, Eastern Circle, Partabgarh. 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur. 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.
Wither Tip and Die Back Disease of the Citrus (Urdu). Leaflet No. 64 of the Department of Agriculture, United Provinces. Free in U. P. only.	Ditto .	Ditto.
Leaf Minor Disease of the Citrus (Urdu). Leaflet No. 65 of the Department of Agriculture, United Provinces. Free in U. P. only.	Ditto .	Ditto.
Handbook of Plant Diseases of Economic Importance in the Central Provinces. Bulletin No. 28 of the Department of Agriculture, Central Provinces and Berar. Price As. 8.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing, Central Provinces and Berar, Nagpur.
Moorda or Churda Disease of Chillie Plants, Its Causes and Control. Leaflet No. 22 of the Department of Agriculture, Central Provinces and Berar. Free.	Ditto .	Director of Agriculture, Central Provinces and Berar, Nagpur.
Collar Rot in Sugarcane. Leaflet No. 4 of 1938 of the Department of Agriculture, Assam. Free.	Issued by the Department of Agriculture, Assam.	Director of Agriculture, Assam. Shillong.
Red Rot of Sugarcane. Leaflet No. 5 of 1938 of the Department of Agriculture, Assam. Free.	Ditto .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
AGRICULTURAL SCIENCE—*contd.*		
PLANT DISEASES—*contd.*		
How to Control Bunt of Wheat (Urdu). Circular No. 1 of the Department of Agriculture, Baluchistan. Free.	Issued by the Department of Agriculture, Baluchistan.	Agricultural Officer in Baluchistan, Quetta.
VETERINARY SCIENCE AND ANIMAL HUSBANDRY.		
Agriculture and Livestock in India Vol. VII, parts 5 and 6 and Vol. VIII, parts 1 to 4. Annual subscription Rs. 6 or 9*s.* 9*d.* (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or livestock in India or the Tropics.)	Issued under the authority of the Imperial Council of Agricultural Research.	Manager of Publications, Civil Lines, Delhi.
The Indian Journal of Veterinary Science and Animal Husbandry, Vol. VII, parts 3 and 4, Vol. VIII, parts 1 and 2. Annual subscription Rs. 6 or 9*s.* 9*d.* (A quarterly journal for the publication of scientific matter relating to health, nutrition and breeding of livestock.)	Ditto	Ditto.
Agriculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10 or 7*s.* 9*d.*	Ditto	Ditto.
The Indian Veterinary Journal. (The Journal of the All-India Veterinary Association.) Quarterly. Annual subscription Rs. 4 or 6*s.* 6*d.* for members and Rs. 8 or 10*s.* for others.	P. Srinivasa Rao (Editor)	The Editor, *The Indian Veterinary Journal*, 26 Wallajah Road, Madras.
The United Provinces Veterinary Magazine (English and Urdu). Monthly. Issued free to members of the United Provinces Veterinary Association.	Issued by the United Provinces Veterinary Association.	Editor, *The United Provinces Veterinary Magazine*, Moradabad.
The Punjab Veterinary Journal	Issued by the Punjab Veterinary Association.	The Editor, *The Punjab Veterinary Journal*, Lahore.
The Central Provinces Veterinary Journal. Quarterly.	Issued by the Central Provinces Veterinary Association.	The Honorary Secretary, Central Provinces Veterinary Association, Nagpur.
Investigations on the Course and distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and Formation of the Phrenic Nerve in the Ox with Observations on certain Anatomical Deviations. Scientific Monograph No. 11 of the Imperial Council of Agricultural Research, 1937. Price Rs. 4-10 or 7*s.* 9*d.*	H. N. Chelva Ayyangar	Manager of Publications, Civil Lines, Delhi.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*		
Selected Clinical Articles, Part II. Miscellaneous Bulletin No. 15 of the Imperial Council of Agricultural Research. Price Re. 1-4 or 2*s*.	G. K. Sharma, R. L. Kaura, S. Ganapathy Iyer, G. S. Khan and M. Y. Mangrulkar.	Manager of Publications, Civil Lines, Delhi.
Indian Grazing Conditions and the Mineral Contents of Some Indian Fodders. Miscellaneous Bulletin No. 16 of the Imperial Council of Agricultural Research. Price Rs. 3-14 or 6*s*. 9*d*.	P. E. Lander . .	Ditto.
A Brief Survey of some of the Important Breeds of Cattle in India. Miscellaneous Bulletin No. 17 of the Imperial Council of Agricultural Research. Price Rs. 2 or 3*s*. 6*d*.	Col. Sir Arthur Olver .	Ditto.
Report on the Development of Cattle and Dairy Industries of India. Price Re. 1-8-0 or 2*s*. 6*d*.	Dr. Norman C. Wright .	Ditto.
Milk Records of Cattle in Approved Dairy Farms in India. Miscellaneous Bulletin No. 18 of the Imperial Council of Agricultural Research.	K. P. R. Kartha . .	Ditto.
Proceedings of the Second Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry held at Madras from the 14th to the 16th December 1936. Price Rs. 3-10-0 or 6*s*. 3*d*.	Issued under the authority of the Imperial Council of Agricultural Research.	Ditto.
Annual Report of the Imperial Veterinary Research Institute, Mukteswar, for the year ending 31st March 1937. Price Re. 1-2-0 or 2*s*.	Issued by the Director, Imperial Veterinary Research Institute, Mukteswar.	Ditto.
Feed your Bullock (English) (Reprinted). Broad Hint No. 1 of the Department of Agriculture, Madras.	G. R. Hilson . . .	Government Press, Madras.
Dedication of Breeding Bulls of Ongole Breed (English) (Reprinted). Broad Hint No. 8 of the Department of Agriculture, Madras.	R. W. Littlewood . .	Ditto.
Bullock Harness—An Improved Method of Yoking. Leaflet No. 85 of the Department of Agriculture, Madras. Free.	N. G. Charley . .	Ditto.
Practical Hints on Bee-keeping (Tamil). Pamphlet No. 11 of the Department of Agriculture, Madras. Free.	S. Ramachandran . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*		
Feed and Work your Cow (Tamil) (Reprinted). Broad Hint No. 7 of the Department of Agriculture, Madras. Free.	R. W. Littlewood . .	Government Press, Madras.
Dedication of Breeding Bulls of Ongole Breed (Tamil and Malayalam) (Reprinted). Broad Hint No. 8 of the Department of Agriculture, Madras. Free.	Ditto .	Ditto.
Bee-keeping (Tamil.) Bulletin No. 37 of the Department of Agriculture, Madras. Price Re. 1.	S. Ramachandran . .	Ditto.
Diseases Affecting Poultry in the Bombay Presidency. Bulletin of the Veterinary Department, Bombay. Price one anna.	R. N. Naik . . .	Government Central Press, Bombay.
Feeding of Stock. Leaflet No. 1 of 1938 of the Department of Agriculture, Bengal. Free.	Issued by the Department of Agriculture, Bengal.	Director of Agriculture, Bengal, Dacca.
Incubation for Poultry. Leaflet No. 2 of 1938 of the Department of Agriculture, Bengal. Free.	Ditto .	Ditto.
Feeding of Poultry. Leaflet No. 3 of 1938 of the Department of Agriculture, Bengal. Free.	Ditto .	Ditto.
First Aid to Livestock (Hindi and Urdu). Leaflet No. 47 of the Department of Agriculture, United Provinces. Free in U. P. only.	Khan Bahadur S. Bashir-ud-Din Ahmad.	1. Deputy Director of Agriculture, Sarda Circle, Lucknow. 2. Deputy Director of Agriculture, Western Circle, Aligarh. 3. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi. 4. Deputy Director of Agriculture, Eastern Circle, Partabgarh. 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur. 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*		
Improved Fodder *Jowars*. Leaflet No. 140 of the Department of Agriculture, Punjab. Free.	Issued by the Department of Agriculture, Punjab.	Government Printing, Punjab, Lahore.
Punjab Dairying (Urdu) (Revised Edition). Price As. 13.	Ditto .	Ditto.
Principles of Utility Poultry Breeding (Urdu). Price As. 2.	Ditto .	Ditto.
Fodder Crops of the Punjab. Price As. 8.	H. R. Saini . . .	Ditto.
List of Horse and Cattle Fairs and Shows in the Punjab and the Punjab States for the year *Fasli* 1937-38. Gratis.	Issued by the Director of Veterinary Services, Punjab.	Office of the Director, Veterinary Services, Punjab, Lahore.
A Cheap Blow-Fly Trap (Urdu, Hindi and Gurmukhi). Leaflet No. 6 of 1937 of Veterinary Department, Punjab. Gratis.	L. W. Smith and Sh. Mumtaz Husain.	Ditto.
A Note on Cattle Breeding (Reprinted). Gratis.	T. F. Quirke . . .	Ditto.
Milk in Relation to Public Health (Reprinted from the Journal of the Red Cross Society, India, Vol. VI, No. 4, October 1932). Leaflet of Veterinary Department, Punjab. Gratis.	A. C. Aggarwala . .	Ditto.
The Value of Milk as an Article of Diet (Reprinted from the Report on the Milk supply of Lahore, 1930). Gratis.	Ditto .	Ditto.
Hay-Box Method of Heating Milk for Indigenous Ghee-Making (Reprinted). Bulletin No. 8 of 1936 of Veterinary Department, Punjab. Gratis.	W. S. Read . . .	Ditto.
Some Important Diseases of Sheep in the Low Land, Inundated and Waterlogged Areas of the Punjab with Particular reference to the Control Measures at the Government Cattle Farm, Hissar (Reprinted). Bulletin No. 3 of 1935 of Veterinary Department, Punjab. Gratis.	Issued by the Director of Veterinary Services, Punjab.	Ditto.
Sheep Breeding at the Government Cattle Farm, Hissar (Reprinted). Bulletin No. 4 of 1935 of Veterinary Department, Punjab. Gratis.	L. W. Smith and Sh. Mumtaz Husain.	Ditto.
Goat Breeding (Jamna Pari) at the Government Cattle Farm, Hissar (Reprinted). Bulletin No. 6 of 1935 of Veterinary Department, Punjab. Gratis.	B. N. Handa and D. L. Datta.	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—contd.

Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*		
Livestock at the Government Cattle Farm, Hissar (Reprinted). Bulletin No. 7 of 1936 of Veterinary Department, Punjab. Gratis.	B. N. Handa . .	Office of the Director, Veterinary Services, Punjab, Lahore.
The Art of Milking (Reprinted). Bulletin No. 20 of Veterinary Department, Punjab. Gratis.	A. C. Aggarwala . .	Ditto.
Hints on the Management of Sheep in the Punjab (Urdu) (Reprinted). Leaflet of Veterinary Department, Punjab. Gratis.	Issued by the Director of Veterinary Services, Punjab.	Ditto.
A Lecture on Cattle Breeding (Urdu) (Reprinted). Leaflet of Veterinary Department, Punjab. Gratis.	Ditto .	Ditto.
Rinderpest (Urdu) (Reprinted). Leaflet of Veterinary Department, Punjab. Gratis.	Ditto .	Ditto.
Mange in Sheep (Urdu) (Reprinted). Leaflet of Veterinary Department, Punjab. Gratis.	Ditto .	Ditto.
Haemorrhagic Septicaemia (Urdu) (Reprinted). Leaflet of Veterinary Department, Punjab. Gratis.	Ditto .	Ditto.
Foot and Mouth Disease (Urdu) (Reprinted). Leaflet of Veterinary Department, Punjab. Gratis.	Ditto. .	Ditto.
Annual Report of the Civil Veterinary Department, Punjab, for the year 1936-37. Price As. 4.	Ditto .	Ditto.
Larvicidal Fish in Malarial Control. Leaflet No. 143 of the Department of Agriculture, Punjab. Free.	Issued by the Department of Agriculture, Punjab.	Director of Agriculture, Punjab, Lahore.
Fish Farming in the Punjab. Leaflet No. 144 of the Department of Agriculture, Punjab. Free.	Ditto .	Ditto.
Supply of Green Fodder throughout the year. Leaflet No. 145 of the Department of Agriculture, Punjab. Free.	Ditto .	Ditto.
Stud Bull. Veterinary Leaflet No. 7 of 1938 of Veterinary Department, Punjab. Free.	Issued by the Department of Veterinary Services, Punjab.	Director of Veterinary Services, Punjab, Lahore.
Some Notes on Practical Silage Making. Veterinary Bulletin No. 11 of 1938 of the Veterinary Department, Punjab. Free.	W. S. Read . . .	Ditto.

List of Agricultural and Animal Husbandry Publications in India published during 1937-38—concld.

Title	Author	Where published
	VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*	
The Feeding of Minerals to Livestock. Bulletin No. 2 of 1938 of the Department of Agriculture, Bihar.	Issued by the Department of Agriculture, Bihar.	Government Press, Gulzarbagh, Bihar.
Hints on Poultry Farming. Bulletin No. 29 of the Department of Agriculture, Central Provinces and Berar. Price As. 8.	Issued by the Department of Agriculture, Central Provinces and Berar.	Government Printing, C.P. and Berar, Nagpur.
Paspalum dilatatum—a Promising Fodder Grass for Assam. Leaflet No. 2 of the Department of Agriculture, Assam, 1938. Free.	Issued by the Department of Agriculture, Assam.	Director of Agriculture, Assam, Shillong.
Annual Report of the Civil Veterinary Department, Assam, for the year 1936-37. Price As. 10.	Issued by the Supdt., Civil Veterinary Department, Assam.	Officer in charge, Assam Secretariat Book Depôt, Shillong.
Silage (English). Bulletin No. 10 of 1937 of the Department of Agriculture, Orissa.	Issued by the Director of Developement, Orissa.	Orissa Government Press, Cuttack.
Annual Administration Reports of the Civil Veterinary Department, Sind and Ajmer-Merwara, for 1936-37.	Issued by the Director of Veterinary Services, Sind.	The Daily Gazette Press, Ltd., Karachi.
Fowl Cholera (Malayalam) (Leaflet). Free.	Issued by the Department of Agriculture, Cochin.	Director of Agriculture, Cochin, Trichur.
Nasal Granuloma (Malayalam) (Leaflet). Free.	Ditto .	Ditto.
Rabies (Malayalam) (Leaflet). Free .	Ditto .	Ditto.
Anthrax (Malayalam). Leaflet of the Department of Agriculture, Cochin. Free.	Ditto .	Ditto.

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