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ECONOMIC GEOGRAPHY

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By
RONALD HOPE
O.B.E., M.A., D.PHIL.

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IN MEMORY OF

LEONARD BERTRAM CUNDALL

WITHOUT WHOSE INSPIRATION AND EXAMPLE

THIS BOOK WOULD NEVER HAVE BEEN WRITTEN

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PREFACE

The population of the world is increasing by more than 20 million a year, and by the year A.D. 1980 it is thought that it will have increased from its present 2,700 million to 3,250 million. To feed such a population adequately the amount of food grown would have to be increased by about two-thirds, since existing food supplies are far too small to maintain good health; and some authorities, fearing that such an increase is out of the question, anticipate world famine. Fertile land, they point out, is limited in area, and much of the fertile land which exists is being ruined by erosion of the soil. Other authorities, equally distinguished, are less pessimistic. Agricultural machinery, artificial fertilizers, irrigation and other applications of technological discovery will do much, they believe, to increase output per acre. By using better strains of seed farmers can also increase crop yields, and, with the help of scientists, they may do much yet to reduce the very considerable waste through pests and disease.

Both sets of experts would probably agree that in recent years the rich countries have been getting richer, and that the gap between rich and poor has widened. In part, this is because rich countries can live on less than what they produce and thus devote part of their resources to capital development. This enables them to build factories, machines, dams and power plants which help them to produce more in the next year and in the year after that. Poor countries are too poor to do this as rapidly. It would be a help if the rich countries lent resources to the poor countries provided there were no difficulties over repayment, but there are such difficulties and again experts are not agreed upon their resolution. Some believe matters would be eased if barriers to trade were abolished; others believe that barriers to trade – erected against particular countries or areas – can contribute to a solution.

All these problems – problems which affect the daily lives of every one of us – have their nexus in economic geography. This book does not solve them, but it attempts to provide the background information

with which they may be fruitfully discussed. Part I is concerned with the principles, the geographic and economic factors, which are basic to the whole field of study. Part II gives the facts about the amount of food grown; and Part III the facts about the production of raw materials. In Part IV the work is rounded off with chapters on manufactures, transport and trade which bring the reader back to the difficulties at the core of the subject.

Since the whole book has been written some ten years after the termination of the Second World War, it should not be clouded by pre-war conceptions and, although 1938 has often been used as a reference point, the statistics are as up-to-date as sources will allow. That no date has been assigned to many of these statistics is deliberate, for with some commodities, where the trend of production is clear, it is the latest date which is significant, while with others, where crops fluctuate considerably from year to year, a figure typical of the post-war years is much more appropriate. There are, of course, other difficulties. The various official publications are not always agreed, and some statistics – especially those for the U.S.S.R., China and Eastern Europe – are hard to come by or even non-existent.

As this book goes to press it is reported that world agricultural production, excluding the Communist block of countries, was more than 25 per cent greater in 1954 than it was in 1946–47. At the end of the war world agricultural production was down 5 per cent and world population up 10 per cent on pre-war levels, with a consequent *per capita* fall in production of about 15 per cent. By 1954 this lag had been overtaken and some countries even began to be troubled by surplus stocks of wheat, sugar, cotton and other farm products. Leaving out the Communist countries, for which figures are incomplete, the world is now producing about 20 per cent more rice, milk and cotton than before the war, about 30 per cent more wheat, fats and meat, 50 per cent more fruit and sugar, and 80 per cent more rubber, not counting synthetic rubber. Fisheries output is up by 20 per cent, and the production of roundwood has increased by about 15 per cent (the greatest increases taking place in the U.S.S.R.), the production of timber for industrial purposes having increased by more than one-third while the use of wood for fuel has declined. In the same period (1938–54), world industrial production has doubled. Despite this greater abundance, however, in many far eastern and in some South American countries the consumption of food per person remains below the very inadequate pre-war level.

The student who wishes to keep even more up to date may do so by consulting one or other of the following sources for the latest statistics: the *Statistical Yearbook*, which although incomplete is nevertheless the most comprehensive source of information between two covers, the

Monthly Bulletin of Statistics, which often has valuable special features, the *Yearbook of International Trade Statistics* and *World Facts and Figures*, a useful but incomplete summary brought up to date from time to time, all these being published by the United Nations; the *Yearbook of Forest Products Statistics* and the *Yearbook of Fisheries Statistics*, both published by the Food and Agriculture Organization of the United Nations; the invaluable Commonwealth Economic Committee reports (Commodity Series) on *Fruit*, *Grain Crops*, *Plantation Crops*, *Vegetable Oils and Oilseeds*, *Meat*, *Dairy Produce* and *Industrial Fibres* published by Her Majesty's Stationery Office; the *Statistical Yearbook of the World Power Conference*, and the *Statistical Summary of the Mineral Industry*, the latter also published by Her Majesty's Stationery Office. My own debt to these sources is immense even though they have, at times, set me problems of their own.

The production of such a book as this takes a long time, and thoughts about it go back to 1939. In a sense it is a successor to Professor E. G. R. Taylor's *Commercial Geography*, a text-book of many years standing, and in the planning of it Professor Taylor's advice was sought. To her and to others who have helped in its production my grateful thanks are due. To my wife I owe special thanks for the tedious and exacting labour of compiling the index, but, of course, without her sympathetic understanding, the whole work would never have seen the light of day.

R. H.

18th August 1956

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ECONOMIC GEOGRAPHY

PART ONE – PRINCIPLES

Chapter 1
Economic Geography

Economics is the science of wealth. Geography is the science of the earth. Economic geography, a hybrid science, is therefore the systematic study of wealth which has its origin in the earth, such wealth being found not only in the earth's crust or core, but in its oceans and seas, and in its gaseous envelope, the atmosphere.

This definition of economic geography can, perhaps, be enlarged upon. Economics is concerned with the production, exchange, distribution and consumption of goods and services. Since men cannot have everything they want, the economist emphasizes that they *choose*. A little more of something – food, shelter, clothing, or whatever it may be – can be had only for the sacrifice of a little of something else. It is true that the production of all things may increase as new technological discoveries are made and new methods replace old ones, but the element of choice remains and mankind is never likely to be in the position where all men have a superfluity of all things. Resources are always scarce.

The geographer, too, is aware that resources are scarce – and capable of destruction. The world is not a rich place; indeed, with its present population, scarcely even a place of potential plenty. But it has an income – the commodities of all kinds which are produced by work – an income which is distributed in a particular way between the peoples of the world, and an income which may change. This world income, and its expenditure or distribution, is the special province of the economic geographer.

On what does this world income depend? To the geographer it is immediately apparent that it depends, in part, upon the natural resources of the earth, upon the qualities and properties of the soil, mineral deposits, the configuration of the land surfaces of the globe, the climate. In other words, it depends, in part, upon the physical environment in which men live. Since men themselves can, to some extent, influence their environment by their social (or anti-social) activities, these factors,

too, will be prominently in the mind of the geographer. These specifically geographic factors form the subject-matter of Chapter 2. They cannot be described as exclusively physical any more than they can be described as wholly material since men have intelligence, a limited intelligence, and use that intelligence to make what seems to them, at the time, the most appropriate use of their environment. It is the environment, the physical resources, as used by men, which the geographer has uppermost in mind when he thinks of the world's wealth.

The economist's approach tends to be from another angle. Quite early on in the development of economic thought, the economist classified those things which seemed to him to contribute to income or production. These were the factors of production. Natural resources were only one of those factors, one which the economist was inclined to take for granted and one which, for convenience' sake, he called 'land'. Land comprised the original gifts of nature; these gifts were, no doubt, indispensable, but equally important, in the economist's view, was labour, that is the activities of men upon the 'land'. Moreover, man – the animal with intelligence – had not been long upon the earth before he began to devise instruments to help him in his work: the lever, the wheel, and, ultimately, the factory and the atomic pile. This was 'capital', another factor of production. Lastly, men specialized in their activities, some became craftsmen, some became labourers and machine-minders, and some became 'organizers'. Surely organization, the skilled use of labour and resources, was a factor of production?

Fashions change and, later on, economists pointed out that 'land' had been worked over for many thousands of years and men, by their labour, had contributed much to its qualities. They had hedged it and drained it and cultivated it until, essentially, did it not seem to be but part of 'capital', something akin to a machine? Similarly, organization was nothing more than a special kind of 'labour'.

In this way the economist came to think of the production of the world's income in terms, primarily, of labour working with capital, and in terms of the choices which men made, the ways in which they actually utilized the natural resources of the earth. In Chapter 3, emphasis is placed upon these specifically economic factors: the world's population and its distribution, the extent to which men's work and the organization of that work can contribute to material welfare, and the extent to which that work can be aided by capital equipment, tools, machinery and transport facilities.

Obviously, there is no clear-cut division between the geographic and economic factors. Both are closely interrelated, and mixed up with them are what might be called the 'human' factors. Man does not live by bread alone. His religious and his ethical beliefs may be influenced by his environment – it may be no coincidence that many of the world's

religions have had their birth in a desert – and climate may have some effect upon the development of mental ability. But religious and ethical beliefs, and mental ability, whatever their origin, have their own effects on the production and enjoyment of wealth. If the Moslem will not touch pork, his standard of living cannot be raised by raising pigs. If Hindus cannot share cooked foods, there are obvious limits to the possibility of communal feeding in India. Indeed, the caste system must inevitably have important economic repercussions in that vast sub-continent. A Hindu of the Brahman caste once told the author that his English host was scornful of his folly in refusing a delicious dish of chicken. In returning this hospitality the Hindu was careful to supply chicken for his guest which, in the event, was refused with equal indignation. The day was a Friday, and the Englishman a strict Catholic. Economic geographers, as well as politicians, will do well to remember the importance of creed.

Part I of this book is largely taken up with the principles of economic geography, and Parts II–IV are concerned with the practice, with the commodities which enter into income, and with their production and exchange. But the standard of living of any person depends not only on the commodities or goods which he can command; it depends also on the services, for the higher the standard of living, the higher the proportion of income spent on personal service of all kinds. The rich man has his mansion and, along with the mansion, he has a posse of personal attendants who cater to his wants. The meanest of us in Western society have our hair cut and use the public library. In the United States, the richest country in the world, the European is surprised by what even a simple haircut may involve. In New York, if he is not extremely wary, it will probably include a shampoo, a friction and a singe, perhaps even a face-massage, a manicure, and a shoe-cleaning. The economist does not ignore the importance of services of this description but they find little place in a concise economic geography. In part, this is because the world, taken as a whole, is poor and first needs come first. The first needs of most men and women are food, clothing, shelter and warmth, and overwhelmingly the greater part of the world's resources of both labour and materials are engaged in satisfying them. In part, however, the reason for this omission lies in the fact that here we are taking a global view, and personal service is largely internal to a particular country. Economic geography is much concerned with those products which enter into international trade and the 'taking in of washing' rarely transcends a national boundary.

None the less, it should not be forgotten how much of the world's work is service. Transport and trade comprise the bringing of commodities to the right places at the right times. Banking and insurance

are services indispensable to production in the modern world. Indeed, production itself is not complete until the product is in the hands of the consumer. The economic geographer, therefore, is not concerned merely with the growing or mining of raw materials and foodstuffs, the origin of power, and the combination of these in manufacturing industry. He is also intimately interested in the organization of commerce and transport, the marketing of the world's goods, and the whole system of exchanges.

Chapter 2
Geographic Factors

FACTORS INFLUENCING THE USE OF LAND

In the beginning, perhaps 2,000 million but probably not more than 4,000 million years ago, there was a ball of whirling gases, a chip off the sun, which cooled into a globe measuring nearly 8,000 miles in diameter and 25,000 miles in circumference. As the crust of this globe hardened perhaps the moon was torn away, leaving a scar which now holds the Pacific Ocean. If this were so, the birth of the moon may have helped shape the other regions of the earth, the thin granite envelope cracking and the masses of granite drifting apart, helped by the earth's rotation, to form the backbone of the continents. Then, as the ball grew cooler still, the rains came. The rains formed the sedimentary rocks (sandstone, clay, shale and limestone) from the igneous rocks (the granite and basalt) which formed the first hard crust. Probably before the sun shone through the rain-clouds, the first life floated in the oceans, but the shaping of the continents still went on. As the earth cooled and shrank, the crust fell into folds and wrinkles, and such shrinking happened more than once. Rain, frost, snow, ice and wind all contributed – as they contribute still – to the weathering and sculpturing of the mountain ranges and the great plains. Even to-day, rivers and glaciers carry 6,000 million tons of sediment to the seas each year.

As economic geographers, the early history of the earth concerns us only in so far as we are the legatees of what happened then. We live in a world the superficial area of which is estimated at some 200,000,000 square miles, but of this only 56,000,000 square miles – little more than one-quarter – is land. This land area is divided into six continents: Asia, with 16⅔ million square miles, Africa with 11⅔ million square miles, North America and Mexico with 8½ million square miles, South America a little smaller still (7 million square miles), Europe, including European Russia, nearly half as small again (4 million square miles), and Oceania (of which Australia takes up nearly 3 million square miles)

with $3\frac{1}{8}$ million square miles. To these we can add the vast area of Antarctica ($4\frac{3}{8}$ million square miles), somewhat larger than Europe, not yet of any great economic importance but harbouring, perhaps, minerals which will one day be used. More than half of this antarctic land mass belongs to Australia.

As great in significance as its division into continents is the division of the world into political units. Of these the British Commonwealth extends over 14 million square miles, and is followed by the U.S.S.R. with nearly $8\frac{3}{4}$ million square miles. After these giants come the French Empire with $4\frac{1}{3}$ million square miles in 1939, China with 4 million square miles, the United States and its insular jurisdiction with $3\frac{3}{4}$ million square miles, and Brazil with $3\frac{1}{4}$ million square miles. Six political units with nearly two-thirds of the world's land between them.

But the mere mensuration of square miles is not enough, for land is not all of equal worth. Antarctica is covered with ice and snow and so, too, are Greenland's icy mountains and all but the coastal fringes of that vast island. In northern Norway, American tourists take trips to see the midnight sun, but there is not much other activity of economic importance. If we add together Antarctica and most of Greenland, and those parts of Alaska, Canada and the U.S.S.R. where the heat of summer does no more than thaw the surface at most, if we add together all those areas where the soil or subsoil is permanently frozen and little or nothing grows, we find that, for these reasons alone, one-fifth of the world's land surface is not suitable for human habitation.

Then there are the dry and arid zones, the world's deserts. These, too, form perhaps one-fifth of the land area.

Thirdly, there are the highlands, those areas found in almost every country which are too rugged or too lofty for cultivation. Here the population can be no more than sparse, and yet these areas, like the others, form perhaps one-fifth of the world's land.

Two-fifths, at most, of the land area of the world permits the growth of crops. One geographer puts it at less than one-third, a mere 16 million square miles or 10,000 million acres, with an area as large again which is productive if not cultivable – forest and poor grazing land, scrub and bush, and mountain pasture. And yet men do not use all of this. Land which is actually cultivated to-day amounts to no more than 4,000 million acres – which is perhaps just as well when one considers the rate at which the world's population is growing. A recent survey* of the use made of the world's lands yielded the following figures: arable or cropped 3,006 million acres, meadow and permanent pasture, 5,269 million acres, forest and woodland, 8,702 million acres, unused but potentially productive, 936 million acres, and built over,

* *Year-book of Food and Agricultural Statistics* (F.A.O.), 1949.

wasteland, etc., 15,200 million acres; a grand total of 33,113 million acres.

What are the physical factors which influence the use to which this land is put? Climate, soil and topography all play their part.

Men will not live where the climate is hostile – where food or raw materials cannot be grown, or animals reared or trapped, or fish or whales caught – unless minerals take them there, as is mainly the case in Spitsbergen or Klondike, or unless the topography offers features essential to the establishment of a port, as is the case with Murmansk or Churchill.

If the climate is not inhospitable, men will settle most readily where the soil is good and where the topography or local physical features offer such things as a steady water-supply and good means of communication, but climate, since it determines much else, is so important among the geographic factors that it must be dealt with at some length.

CLIMATE

The earth moves round the sun in a year. Because the axis about which the earth itself rotates is not perpendicular to its orbit round the sun, the sun appears higher in the heavens in summer than it does in winter. At the vernal equinox, about 20 March, the sun appears directly overhead at noon on the equator and, in the northern hemisphere, the spring is conventionally supposed to have begun. At the summer solstice, about 21 June, the sun appears directly overhead at noon on the Tropic of Cancer, and people in England enjoy their longest day. At the autumn equinox, about 20 September, the sun is once more directly overhead at noon on the equator. At the winter solstice, about 21 December, it is directly overhead at noon on the Tropic of Capricorn, and the Australians spend their Christmas bathing in the sea.

The inclination of the earth's axis is thus responsible for the seasons, and for those who live away from the tropics there will be considerable variations in temperature between summer and winter and considerable variation in the length of the day. At the poles the longest day will be six months long, but as far north as Iceland the sun will dip below the horizon for at least a few minutes even at midsummer. The length of the day may be important, for the lack of warmth in the sun's rays may be compensated for by the number of hours on which it shines, and in this way is the spring wheat germinated in Canada and the U.S.S.R.

But of greater significance than the length of the day in the determination of the surface temperature is the angle at which the sun's rays strike the earth's surface. Away from the tropics the sun's energy has to pass through a thicker layer of air, since it is striking obliquely, and – more important – it has to warm a greater area of the earth. We may

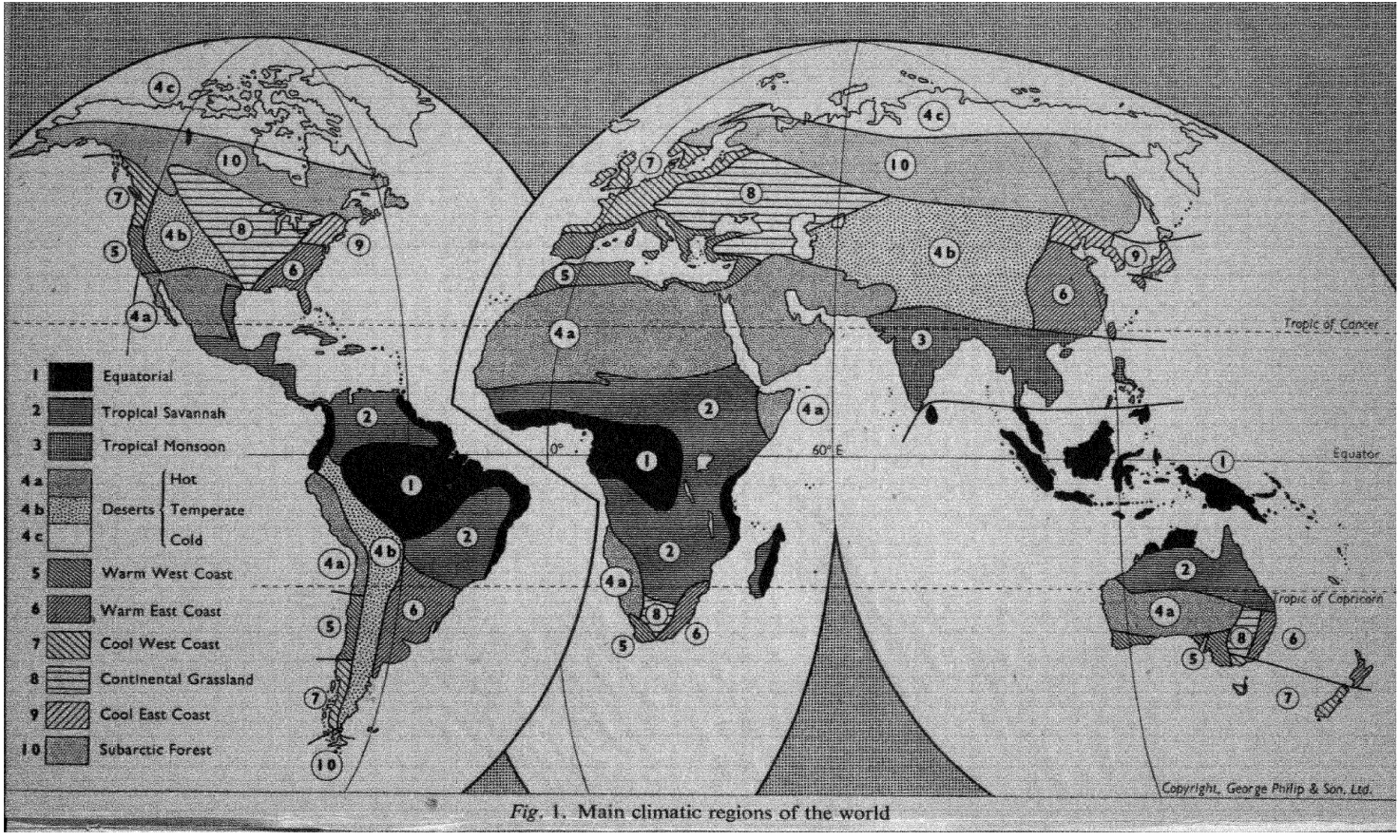

Fig. 1. Main climatic regions of the world

expect therefore that the climate will become cooler as we travel towards the poles.

The seas are slower to warm up than the land and slower to cool down, and so they will have a moderating effect upon the temperatures experienced in lands adjacent to them. The great extremes of temperature will be in the interiors of the great land masses. Furthermore, the winds and the moon disturb the seas, setting them in motion, and the spinning earth deflects the course of the currents thus produced to create the great clockwise movement in the northern oceans and the less apparent, because more confused, anti-clockwise movement in the southern seas. Thus warm water is brought by the Gulf Stream to warm north-west Europe and, to fill the gap, cold water flows down the east coast of the United States. In the southern hemisphere a cool current flows up the coast of Chile and Peru (the same one which, after it has turned westward at the equator, bore the Kon-Tiki raft to Raroia) and another up the west coast of South Africa, while Japan, like England, benefits from a movement of warm water. The ocean currents, too, have their effect upon climate.

The direct influence of the sun's rays, their indirect influence upon the seas, and the wind: these are the main factors determining climate.

The source of the winds lies in the high-pressure regions, from which they move to the low-pressure areas, being deflected *en route* – like the ocean currents – by the spinning of the earth from west to east. The regions of low pressure themselves result from the heat of the sun's rays and the fact that the land warms up more quickly than the sea. Thus we find regions of high pressure over the northern continental land masses – America and Russia – in January, and regions of low pressure in these same areas in the northern summer. In January, regions of low pressure are found over the land masses of the southern hemisphere South America, South and Central Africa, and North Australia – but the corresponding areas of high pressure remain centred over the seas in the southern winter because of the relatively smaller area of land.

The trade winds originate in the high-pressure regions of the two hemispheres – the so-called 'horse latitudes' – and converge upon the equatorial belt of low pressure, low because of the intense heat, and die away in the doldrums. In the Atlantic and Pacific north of the equator there are the north-east trade winds; south of the equator there are the south-east trade winds; and, in both cases, the easterly slant results from the earth's rotation.

In higher latitudes there are the westerly winds, flowing from the subtropical areas of high pressure to the subarctic lows, but they are not nearly so regular as the trade winds, though their force is often greater. In the southern hemisphere, where there are fewer complicating land masses, they are to be found in the 'roaring forties'.

In higher latitudes still are the cold polar winds travelling outwards from the poles.

In these days of air travel it is as well to remember that all these are surface winds, and above them there may be found winds travelling in different directions. The different winds at different heights are used regularly by aircraft on the North Atlantic route and, above the south-east trade over Queensland, Australia, there is a north-west return current which an aircraft can use on the eastward run.

Air movements are responsible for rain and cloud. In the low-pressure region of the doldrums, the rising air brings thunderstorms. The trade winds bring rain to the eastern margins of continents and islands. The horse latitudes are dry and in them are the world's great deserts. The westerlies bring rain to the western land margins and, in winter, to the continental interiors as well. The polar winds bring snow. As the sun migrates from tropic to tropic so the belts of pressure, winds and rain move, and there are drier and wetter seasons. Thus in summer the belt of drought associated with the horse latitudes moves to the Mediterranean climates, and in winter towards the tropics. The great land mass of Asia, with its low-pressure area in summer, creates conditions of its own, bringing the summer monsoon, which is faintly resembled by conditions in other regions of the earth.

All these factors – of which the most important are temperature and rainfall – determine the type of natural vegetation and hence govern the agricultural activities of mankind. The different combinations of these factors acting on an almost infinite variety of topography (for the influence on climate of the great mountain ranges, particularly those running down the western flank of the American continent, must not be forgotten) produce a bewildering number of climates. Fortunately, however, any over-elaborate classification would defeat its object by drawing hard and fast lines which do not in fact exist. The broad climatic regions described below correspond with the major regions of natural vegetation and, with slight variations, are accepted by most geographers. Whatever lines are drawn on the map, it must be remembered that each region changes gradually to the next.

CLIMATIC REGIONS

1 – *Equatorial*

In the equatorial belt which stretches some five to ten degrees on either side of the equator temperature is monotonously high, about 80°F., rarely dropping below 70°F., and rarely rising above 90°F., though a fall in temperature from, say, 85°F. in the daytime to 70° F. at night may seem much to those who live there, for they become sensitive to small changes.

Rainfall is heavy, about 80 inches a year compared with some 25 inches in Britain, and there is no dry season, though it may be somewhat wetter than usual a month or two after the sun is overhead. The rain is also regular: an early morning mist, a clear morning, a cloudy mid-day, and violent rain- and even thunder-storms in the afternoon is the common pattern, with perhaps rain at night in coastal areas. One day is much like another and there is no seasonal rhythm.

Here is a description of one such area, the Malayan jungle:

> 'The moment we entered the forest the sun was blotted out by the thick carpet of foliage which spread across the tops of the gigantic trees; yet we could still feel the heat from it, not the same burning heat that we knew on the outside, but stifling humid warmth which sapped every ounce of our energy. The hanging vines, the tall lush undergrowth, the great thickets of bamboo and atap closed in on us, shutting us off from the world we knew as completely as prison walls. Everywhere insects were crawling: small white ants, great red ants, little black soldier ants, centipedes, scorpions, beetles of every size and shape. There was a constant movement and yet no one moving thing made the slightest sound. It was this eerie silence which told on the men most. . . . All their movements were silent too; their rubber-soled jungle boots made no noise on the damp leaf-mould which covered the soil'.*

But at night the jungle comes alive.

> 'Millions of insects combined to make a strident, toneless chorus of discordant noise. Above it we could hear the other animals as they prowled round the camp in search of food and water; a panther coughed as it devoured its evening meal; a great seladang crashed through a bamboo thicket on its way to a water point; the smaller jungle animals barked at each other as they darted nervously to and fro. We were all amazed at the volume of noise, . . .'†

Much of the equatorial belt, particularly along the Amazon and Congo river systems, is undeveloped and largely uninhabited, and it is likely to remain so. In their natural state, the forests yield hardwoods of commercial value but, although their use is extending, they still supply less than four per cent of the world's commercial timber because felling and transporting those trees which are in demand is expensive, and the timber is difficult to work. In Malaya, where one-sixth of the jungle has been cleared, and elsewhere, the rubber tree has been introduced and supplies a raw material of great importance, but it is dangerous to clear the hillsides because of soil erosion, and, in the

*Arthur Campbell, *Jungle Green* (Allen & Unwin) p. 16.
† *Ibid.*, p. 18.

rubber plantations, a 'cover' crop is grown or each tree is rimmed round to conserve the soil. It is a mistake to suppose that, because the jungle is so luxuriant, the soil is rich for, when the jungle is cleared, the heavy rainfall will wash the goodness rapidly away.

In Java and other parts of the East Indies, and in parts of Malaya, rice can be grown, but rice cultivation requires a clay soil and flat land, or land susceptible to terracing. Java has the advantage of volcanic soils and this whole East Indian region differs from other equatorial areas in that the monsoons make the climate slightly more favourable for agriculture.

Where the equatorial belt merges into the savannah region in West Africa, cocoa and the oil palm are cash crops, and sago and tapioca are other products which come upon the world markets. Here, too, yams, bananas, and some other vegetables and fruits can be grown. But if farming becomes large-scale the danger of erosion is present, while pests and diseases, like the swollen-shoot disease which attacks cocoa, may limit specialization in particular crops.

Life in this climate is not easy for men. Diseases like dysentery, typhus, yellow fever, malaria and dengue are prevalent and, as in all hot climates, man's resistance to disease is lower, so that, although perhaps as much as two million square miles of these regions might be described as undeveloped, development will be slow.

2 – *Tropical Savannah*

Savannah means parkland, or grassland with scattered trees; not the grassland and trees of England, but tufty grasses as high as a man, with acacias, baobabs, shrub eucalypts and saltbush. It is typical of the region which lies between the equatorial belt and the great deserts, a region which has summer rain – as the doldrums move with the sun and bring equatorial precipitation – and winter drought. From the 'cool', dry season (the monthly mean temperature will probably still be above 70 °F.), which is from October to January north of the equator, the climate passes gradually into the 'hot', dry season when monthly mean temperatures of 90°F. are not unusual and daily maxima often exceed 110 °F., and everything becomes parched and dry. Then, in May or June in the north, the rains come suddenly as violent thunderstorms and from 20 to 40 inches of rain may fall in four or five months. Unfortunately for purposes of agriculture the amount of rain which falls in the wet season is unreliable and may be half or double the average from one year to the next.

During the rainy season, which brings a slight fall in temperature (though it is harder to bear because of the humidity), everything grows rapidly – the trees and shrubs even burst into flower in anticipation of the rain - the dust turns to mud and dry river-courses turn to torrents.

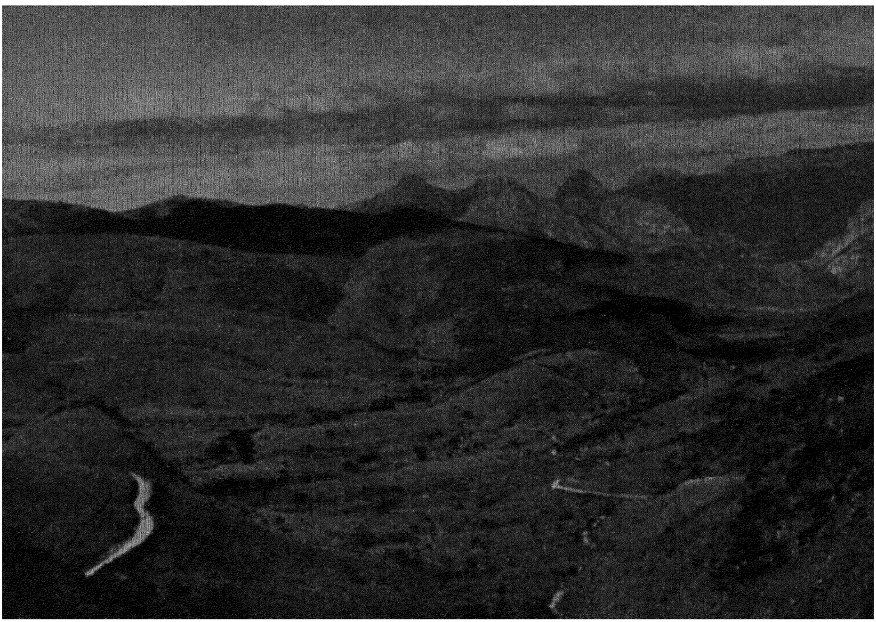

Fig. 2. Tropical savannah in Southern Rhodesia

Ernestine Hill describes a cattle-drive in this kind of country in North Australia:

> 'First mobs leave the north at the end of the wet. Strong green feed and stinging flies, thunder and lightning, floods, have made them restless and unruly. The rivers are still "running bankers" . . .
>
> 'It is the law that through all the pastoral holdings they travel at ten miles a day, lest they eat the station-owner out of house and home, and drink his waters dry . . .
>
> 'A running river of red and white, the mob goes drifting down, through the pindan, light scrub in red sand, "Bay o' Biscay" country, raggedy gullies and hills like tumbled waves in a big sea, "drummy" country, a crust over limestone where their own hoofs with a sound of drums terrify the cattle, and black-soil "debil-debil" of hard-baked holes hidden in long yellow grass, over the sandhills into "mickery", soak country'.*

This is the long trek from the savannah into the desert. It well suggests the difficulty of rearing cattle in these lands where the favourable season may be no more than a quarter of the year.

The failure of the groundnuts scheme in East Africa from 1947 to 1951 – where the British government hoped to produce vegetable oil on a large scale in the savannah regions – also points to the difficulties of

*Ernestine Hill, *The Territory* (Angus & Robertson) pp. 293–4.

crop production. Tropical soils need careful management and a hazardous water-supply must be carefully conserved.

In the tropical savannahs the native economy is pastoral and, owing to the unreliability of the rains which may fall below the requisite 40 inches for two or three years running, partly nomadic. In Australia there is an organized cattle industry, and cattle-ranching is practised on the Brazilian campos and the Venezuelan llanos. In Africa such native agriculture as there is is largely confined to the small-scale cultivation of maize, millet and sorghum, though rice may be grown in favoured places and groundnuts, tobacco and cotton may serve as cash crops. In general, however, it is a hand-to-mouth existence. Health and stamina, though better than in the equatorial forests, are low, and the Gambia experiments of the late 1940's, in which the British government tried to introduce new methods of agriculture into part of the African savannahs, showed the difficulties in the way of any rapid rise in the standard of living.

Where temperature is mitigated by altitude, as it is on the East and South African plateaus and in Mexico and Peru, Europeans can live fairly satisfactorily and coffee, cotton and tobacco are among the crops they have introduced with success. Coffee is, of course, also grown in Brazil; and round Rio de Janeiro and in the West Indies – where the climate is wetter – the sugar-cane is an important article of commerce.

3 – *Tropical Monsoon*

Because of the excessive heating of the great central land mass of Asia in summer, and its excessive cooling during the winter months, an exaggerated type of savannah climate is produced in India, Burma, Indo China and southern China, which has resulted in some geographers separating this region out as a distinct climatic zone, usually called 'tropical monsoon'. It has the same general climatic pattern as the savannah regions north of the equator – in India a 'cold' season from mid-December to the end of February (with a mean day temperature of 80°F. in Ceylon and 50°F. in the Punjab), a hot season from March to the end of May, and a wet season from June to mid-December – but the onset of the wet season or summer monsoon is abrupt, the monsoon arriving with dramatic suddenness. In Bombay, for example, five months of drought is followed by 40 to 45 inches of rain in June and July. The total rainfall varies with elevation and distance from the sea, but the peoples of these lands are mainly dependent on agriculture, and rice, oil-seeds, tea and jute are characteristic of the crops produced for marketing.

4 – *Hot, Temperate and Cold Deserts*

Of all the climatic regions, the deserts – hot or cold – are of the least interest to the economic geographer. Deserts, by definition, are dry and

arid regions where the rainfall is generally less than 15 inches a year and often less than 10, so that crops cannot be grown except by irrigation. The hot and temperate deserts lie between the tropical savannahs and the Mediterranean climates, and extend into those parts of Central Asia which lie beyond the reach of the monsoon rains, and into a large area east of the Rockies and Andes mountain chains in America. These deserts in the Old World are inhabited by sturdy, nomadic peoples of great strength of character who despite – or rather because of – their hard lives have had a great influence upon the world's history. It is the deserts which have inspired the great religions of Christianity and Islam, and it is from the deserts that the more favoured lands have been invaded again and again by self-reliant peoples who have brought new vigour to those settled in agriculture. Lawrence of Arabia gives a clue to the impulses directing desert life in this passage from *Seven Pillars of Wisdom*:

> 'The economic life of the desert was based on the supply of camels, which were best bred on the rigorous upland pastures with their strong nutritive thorns. By this industry the Bedouins lived; and it in turn moulded their life, apportioned the tribal areas, and kept the clans revolving through their rota of spring, summer and winter pasturages, as the herds cropped the scanty growths of each in turn. The camel markets in Syria, Mesopotamia, and Egypt determined the population which the deserts could support, and regulated strictly their standard of living. So the desert likewise over-peopled itself upon occasion: and then there were heavings and thrustings of the crowded tribes as they elbowed themselves by natural courses towards the light'.*

He discusses the direction in which they might turn and continues:

> 'The tribes found themselves driven to the very edge of cultivation in Syria or Mesopotamia. Opportunity and their bellies persuaded them of the advantages of possessing goats, and then of possessing sheep; and lastly they began to sow, if only a little barley for their animals. They were now no longer Bedouin, and began to suffer like the villagers from the ravages of the nomads behind. Insensibly, they made common cause with the peasants on the soil, and found that they, too, were peasantry'.†

Settlement in the hot deserts is around oases where water may be tapped by wells, or where water can be brought from rivers, and here the date palm is the characteristic product. In its shade, maize, beans and millet may be grown. Where water is more abundant still, and on

*T. E. Lawrence, *Seven Pillars of Wisdom* (Cape) p. 34.
†*Ibid.*, p. 35.

the desert fringe, cotton and millet may be grown in the tropics, and wheat in the temperate latitudes. The Nile valley is the best known of such irrigated regions, but much is being done to develop the Tigris-Euphrates and Indus river systems and the eastern states of the Soviet Union.

The cold deserts or arctic climates are also inhospitable. Where there is a permanent cover of snow and ice no one can live, but south of these regions there are scantily populated areas with an economy dependent on fishing, trapping, or the herding of reindeer.

The deserts become of importance to the economic geographer, of course, when they are the source of important minerals. In some places the desert soil itself, by the concentration of surface salts through evaporation, yields borax and nitre, as in Chile, or phosphates and salt, and forms the basis of mining enterprises. In the Middle East much of the world's mineral oil is found and takes men to places they would not otherwise inhabit – bringing unexpected wealth to native populations.

5 – *Warm West Coast*

The temperate latitudes are the kindest to man. Very broadly we can describe the regions between latitudes 30° and 45° as warm, and those between 45° and 60° as cool, remembering that as one goes inland from the coasts the climate becomes more extreme with greater differences between winter and summer temperatures. As we have seen, the horse latitudes, between 30° and 40°, are high-pressure belts from which the trade winds blow towards the equator and the westerlies blow towards the poles and, as these belts swing north and south with the sun, so the warm latitudes come under the influence of the westerlies in winter and the trade winds in summer. Because these winds blow in different directions, a different climate is produced on the west coasts of continents from that on the east coasts.

The warm west coasts are often described as 'Mediterranean' because, owing to the Mediterranean Sea, it is in this part of the world that the climate has its greatest extent, becoming gradually more extreme as one moves east until, away from the influence of the winter winds from the west, it changes into desert or continental grassland. In California, Central Chile, Cape Province, and in Western and South Australia, the warm west coast region is narrower in width.

Winter in the Mediterranean regions is mild and rainy, with mean temperatures of 50°F., and most of the rain, which may total from 15 to 35 inches, falling in these six months of the year. Summer is hot and dry – even tropical – with mean temperatures of about 70°F. There is no really cold season.

Conditions such as these produce evergreen woodland, degenerating into scrub in the drier parts, and the olive, the vine and the fig, with

their deep roots to withstand the summer drought, flourish, while beans, cereals and vegetables will grow in the rainy months and ripen in the early summer. Although the citrus fruits – oranges, lemons and limes – and peaches are not native to these climates, requiring in their natural state the summer rain of warm east coasts, they are grown extensively where they can be artificially watered in the dry months.

'This used to be my prayer', wrote the Latin poet Horace, 'a moderate-sized piece of land, with a garden, a spring near the house, and a small wood beside'.* The Mediterranean climate would produce such a scene but, although pigs would feed on the acorns from the wood, it is not the best of climates for the production of meat, butter and milk, and there is a deficiency of these things in Mediterranean lands except where mountains provide summer pasturage above the forest zone. Nevertheless, where the warm west coasts shade into the cool west coasts conditions are as idyllic as they are anywhere. It is just such a region as Rousseau has described:

> 'Between two fairly high hills lies a little valley running north and south, down which a stream trickles over pebbles and under trees. . . . The house was very habitable. In front was a terraced garden; above it a vineyard, below it an orchard, facing it was a little chestnut plantation, close by was a spring, and higher up the mountain were meadows for grazing cattle'.†

6 – *Warm East Coast*

The warm east coasts of continents differ from the west coasts in that the trade winds bring summer rain and thus rain is well distributed throughout the year and amounts to 25 to 50 inches. This is the climate of New South Wales, the Gulf States of North America and much of China. The summer rains may be of the monsoon type and there may be cold winter winds blowing from the continental interiors. This is particularly true in China, though cold snaps are not unknown in winter elsewhere, as the Southerly Burster of New South Wales, the Pampero of Argentina and the Norther of the Gulf States – all local names for cold winter winds – indicate. Such cold spells may damage citrus fruits.

Apart from such spells, winters are mild with mean temperatures of 50°F. Spring, summer and autumn temperatures average from 70° to 85°F., with summer temperatures above 90°F. or even 100°F. almost daily. Since the summers are humid, the summer heat is oppressive.

The absence of a dry season produces, in addition to the evergreens

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†*The Confessions of Jean Jacques Rousseau*, translated by J. M. Cohen (Penguin) p. 214.

of Mediterranean lands, a forest vegetation of bamboos and magnolias, and such cabinet woods as oak, maple, hickory and walnut, as well as the mulberry (the food of the silkworm) and tea. In Argentina, where the forest may have been destroyed or, because of an earlier and drier period in geological history, never grew, the climate produces the pampas or grassland.

These regions, with their long summer and long frost-free period, are typically agricultural and horticultural, growing tobacco, cotton, tea, citrus fruits, corn (maize) in the drier parts, and rice and sugar-cane in the wetter parts. Indeed, it is not unusual for two crops of corn to be harvested.

7 – *Cool West Coast*

Polewards from the warm coasts, and stretching across continents, are the cool regions, which have a cold season in which temperatures fall below 43°F. and thus prevent the growth of plants. 'Cool' is a word which describes average conditions but, in the continental interiors, these climates have a very great range of temperatures, from the hot in summer to the very cold in winter.

Even the west coasts, to which the adjectives cool and temperate are most applicable, experience sudden changes of temperature, sometimes from day to day, changes which are said to be stimulating to those who live in this environment. The unreliability of their weather is a feature of these regions and, as the seasons change imperceptibly one into the other, one day may seem to be in one season and the next in another as the coastal regions come now under tropical influences, now under arctic influences. In the winter of 1947 southern England lay under snow for six weeks on end, yet six years later some of the spring flowers were in bloom at Christmas. Generally speaking, however, there is a small annual range of temperature, the average temperatures of the coldest months being above 32°F., and the average temperatures of the hottest months varying from about 55°F. to 73°F.

The prevailing winds are westerly and rainfall tends to be well distributed throughout the year though there is a tendency to an autumn and winter maximum. In mountainous districts it may be as much as 80 inches and more a year, but is customarily a good deal less. In winter and early spring the continental high pressure systems may influence the climate at times, bringing easterly winds and cold, dry spells with severe frost. To Western Europe and the west coast of North America, warm ocean currents bring an extra mildness, but also damp and cloud.

In Western Europe the natural vegetative cover is deciduous forest of such trees as oak, beech, ash and chestnut, but the forest has long since disappeared over large areas, being replaced by grass and meadow

land which yields excellent fodder, particularly for dairy cattle, or being cleared for the cultivation of such crops as oats, barley and potatoes. In the drier parts the summer sunshine is adequate for ripening good wheat crops, and at no season of the year is farming activity out of the question. In North America the deciduous forest is replaced by the giant Douglas fir and Sitka spruce, forming the basis of a lumber industry in British Columbia, Washington and Oregon.

8 – *Continental Grassland*

Eastwards from the west coasts the rainfall decreases suddenly or gradually, depending on the mountain ranges, and tends to come in summer rather than in winter in the form of thundery showers – the result of low pressure conditions as the continents warm up. Temperatures become more extreme and mean monthly temperatures of minus 15°F. in winter and 80°F. in summer may be found. This continental type of climate with 20 inches of rain a year or less and its long, hard winters favours grassland – the prairie and the steppe – rather than forest, and in the Eurasian land mass changes gradually into temperate desert in the neighbourhood of the Caspian Sea.

Annual prairie fires in late summer have made the soils rich and well suited to cattle-raising. In the better-watered areas cereals can be grown, corn towards the equator and wheat towards the poles, so that the continental type of climate harbours the world's greatest granaries. Here, however, owing to the bitterness of the winters, the wheat is sown in spring instead of in the autumn. The sun is warm enough in summer to ripen the crops, and winter frosts help to break up the soil and keep down the pests.

9 – *Cool East Coast*

On the eastern margins of the continents, winds from the south and east bring rain. The climate of North China, owing to the monsoon influence, is prevailingly continental in type with dry, cold winters, but the south-east monsoon brings summer rain and a hot, humid atmosphere with temperatures exceeding 80°F.

In the eastern United States and maritime provinces of Canada, the continental influences are less obvious and rain may fall at any time. The climate is therefore more like that of the west coasts and produces both deciduous and coniferous forests, the latter in Canada forming the basis of an important timber and wood-pulp industry.

10 – *Subarctic Forest*

Above the cool climate and below the arctic deserts or tundra, the deciduous forest gives way to the hardier conifers which can exist on the 10 to 15 inches of rain a year, most of it falling in summer. In winter the

ground is often covered with snow for three or four months and temperatures may fall below minus 50°F. The weather, however, is generally calm and the dry cold is endurable. The trees cease to grow where the mean temperature falls below 50°F.

These regions serve for hunting and trapping and some lumbering. The timber is poorer than it is in the cool zones but spruce survives and is suitable for wood-pulp.

TOPOGRAPHICAL FEATURES

Perhaps overmuch space has been devoted to the brief description of the main climatic regions given above, but much is implicit in it regarding the other factors affecting the use of land. The topographical features and configuration of the land affect climate as climate affects them. We have already seen that the 'Mediterranean' climate has its greatest extent in the Mediterranean basin itself, because of the existence of that basin. In the same way, the cool west coast climate extends furthest inland in north-west Europe because of the absence of the great mountain chains of the Americas. Topography everywhere influences local climate and, hence, the use made of the land by man. England east of the Pennines is drier than England west of the Pennines and thus, in East Anglia, wheat is grown successfully.

The bottom of a valley experiences a different climate from the top of a hill and some geographers have gone so far as to describe a 'mountain climate' because, whatever the latitude, mountains have certain features in common, at least equatorwards from the arctic deserts. Those Swiss mountains above cloud level enjoy a great deal of sunshine which makes them enjoyable ski-ing grounds, and the sunny slopes are unexpectedly warm. The windward slopes of mountains are wetter than the lee sides, and the lee sides, where air is descending, may experience warm dry winds of which perhaps the best known is the chinook of the Rockies. In the Alps and elsewhere there is summer pasture above the tree-line because a diminishing rainfall turns the forest into grass, and the grass grows as far as a height where the temperature is so low that there is permanent snow.

Mountains and deserts, like the seas, are also cultural and economic barriers which have long affected the development of communities. Switzerland, perhaps, owes its independence to its mountains, Tibet was for long a land of mystery and, even now, there are no roads into Nepal. The rivers, on the other hand, provide easy means of communication and transport and in such otherwise impenetrable areas as the equatorial forest of Brazil still offer the only lines of commerce. Nations have long struggled for easily defended frontiers – a river or a mountain range – and topographical features have played a significant part in the history of war from Alexander the Great's conquest of

Greece from Macedonia (and before) to France's struggle for a frontier on the Rhine.

In any particular climatic zone it is topography and soil which determine actual settlement, or at least it was until men began to 'plan' and sometimes to make fools of themselves in consequence. To topography, too, is owed the power to be derived from running water, an increasingly important source of electricity and a source which, unlike most means of power supply, is virtually inexhaustible. It has already had immense effects upon the economic development of such countries as Canada, Switzerland and Italy, and is likely to prove still more important in the future development of tropical lands, lands deficient in coal and oil supplies.

SOIL

Soil is rock which has been weathered and broken up by wind, water, ice, frost, sun and earth movements. It has been further affected in the course of centuries by plants, animals and, of course, men themselves. There is an infinite degree of local variety, with good and bad soils found close together, as any farmer knows. In the middle ages the two, or three-field system was evolved, we may assume, by painful experiment. In Europe, there was the forest, which had not yet been cleared, which supplied fuel, building materials, and cover for game. There was the meadowland, near a river, which provided fodder for cattle, and the poor grassland of the hill-slopes which nourished sheep. There was the wasteland, often too poor for cultivation, the 'commonland' which has left its legacy in many of the London commons of to-day. And there were the open fields, cultivated in rotation because men knew that, with too much cropping, the soil gets sick and its yield falls.

The sedimentary rocks, formed by the weathering of the igneous rocks, the earth's first crust, are of different types. The sandstones and grits contain little nourishing material, water drains off them quickly and, if they are too coarse, they are hard to plough. The clays are sticky and compact and the weaker plants may be unable to send their roots down into them. The limestones consist mainly of the shells or skeletons of animals and plants and, by themselves, are porous and provide little food. The best soils are a mixture of all three of these, together with humus or decayed organic matter which supplies the life-giving nitrates. Such soils are what gardeners call 'loam', soils which are friable, which are easily broken up by plough or hoe, and which contain all the chemicals necessary for plant life.

Loam-like soils are found on the great alluvial plains to which the constituents have been transported by water and so it is not surprising that dense populations are found in the Yangtse-kiang and Hwang-ho river valleys, in the Indo-Gangetic plain, along the Nile, Rhine and

Mississippi valleys, or in the Netherlands where such soils have been reclaimed from the sea. Java, too, where volcanic rocks quickly weather under equatorial conditions into rich soils, supports a dense population. The residual soils of little fertility are left on the highlands and so the highlands are less prosperous than the valleys.

Type of Soil	*Characteristics of Soil*	*Climate*	*Vegetation*
Tundra	Peat. Subsoil permanently frozen	4(c). Cold Desert	Sphagnum Moor
Podsol	Acid raw humus. Topsoil leached of bases	10. Subarctic Forest	Coniferous Forest or Heathland
Brown Earth	'Mild' humus – some leaching	7. Cool West Coast 9. Cool East Coast	Deciduous Forest
Black Earth	Deep humus in the soil. No leaching	8. Continental Grassland	Perennial Grasses
Chestnut-coloured Soils	Less humus than black earth. Soil slightly alkaline. Some accumulation of salts near the surface	4(b). Temperate Desert	Dry Steppe. Salt Bush
Saline and Alkaline Soils	Strongly alkaline. Low humus content	4(a). Hot Desert	
Tropical Red Earths	Rather acid. Red or reddish-grey. Very little humus	2. Tropical Savannah	Savannah Grassland and Tropical Rain Forest
Laterite Soils	Acid. Brick-red. No humus. Leached of bases and much silica	1. Equatorial 3. Tropical Monsoon	Equatorial Forest

Fig. 3. The relationship between soil, climate and vegetation

Climate plays its part in the determination of the quality of soils, a part no less important than that played by the original rocks. Despite their apparent richness, a richness suggested by their lush vegetable cover, the equatorial soils are of no great fertility because, when they are cleared of forest, the rains wash the plant food downwards, rapidly leaving the surface sterile. Hence the densest populations in equatorial regions are found on the coasts, in recently uplifted valley bottoms – if

they are not waterlogged – and in volcanic regions, where the soils are 'newer' and less leached, or on slopes which are neither so steep that the soil is washed away nor so flat that they cannot be drained. For these reasons the sugar-cane is cultivated near the coasts and Brazilian coffee is grown on laboriously-constructed terraces.

At the other extreme, in cold climates, chemical changes cannot take place readily in frozen soils, and, since plants are scarce, humus is not added. Weathering is slower with low rainfall and little heat, and the soils are thin and poor. As in other respects, the temperate lands are favoured in soil formation, this being best of all in the continental 'grassland' of Saskatchewan through Nebraska to Texas and in the Black Earth region of the U.S.S.R. where the amount of leaching is so slight that the richness of centuries of decaying grasses has remained.

MINERALS

The word mineral is used here to mean materials which are won from the earth's crust and used by man. So far as building materials are concerned, they have much in common with the sedimentary rocks which go to make up the soil and, in one form or another, are as widely distributed, so that the building minerals play a relatively small part in international trade. For work in stone, men look for a medium-grained rock which is suitable for quarrying and not so porous that frost disintegrates it and chemical decay sets in. Bricks are made from clays which do not shrink too much when dried, and the most suitable clays contain soda, lime, and even magnesia, while the presence of iron imparts to the brick a desirable 'warm' red or brown colour. The best cement is two-thirds limestone and one-third clay burned together and ground to a fine powder; when used, it is mixed with sand. The best materials for making roads consist of fine-grained igneous and limestone rocks, but others can be pressed into service if these are not available. Roofing slate is rarer, being a mudstone or shale which has been subjected to such intense lateral pressure that the rock acquires a definite grain and can be split into thin sheets. As with all building materials, slate is costly to transport so that, where it is not found, substitutes are usually used. The best slates in Britain come from the region between Snowdon and the North Wales coast and so, in the south of England, one finds the tile roof replacing the slate roof of the north and midland area.

With minerals other than building materials distribution is much more uneven and some countries are much more fortunate than others, with consequent effects upon the distribution of world power, in the political sense, and upon national ambitions. These minerals play a vital role in international trade and bring wealth to many countries which are otherwise poorly endowed with natural resources. Moreover,

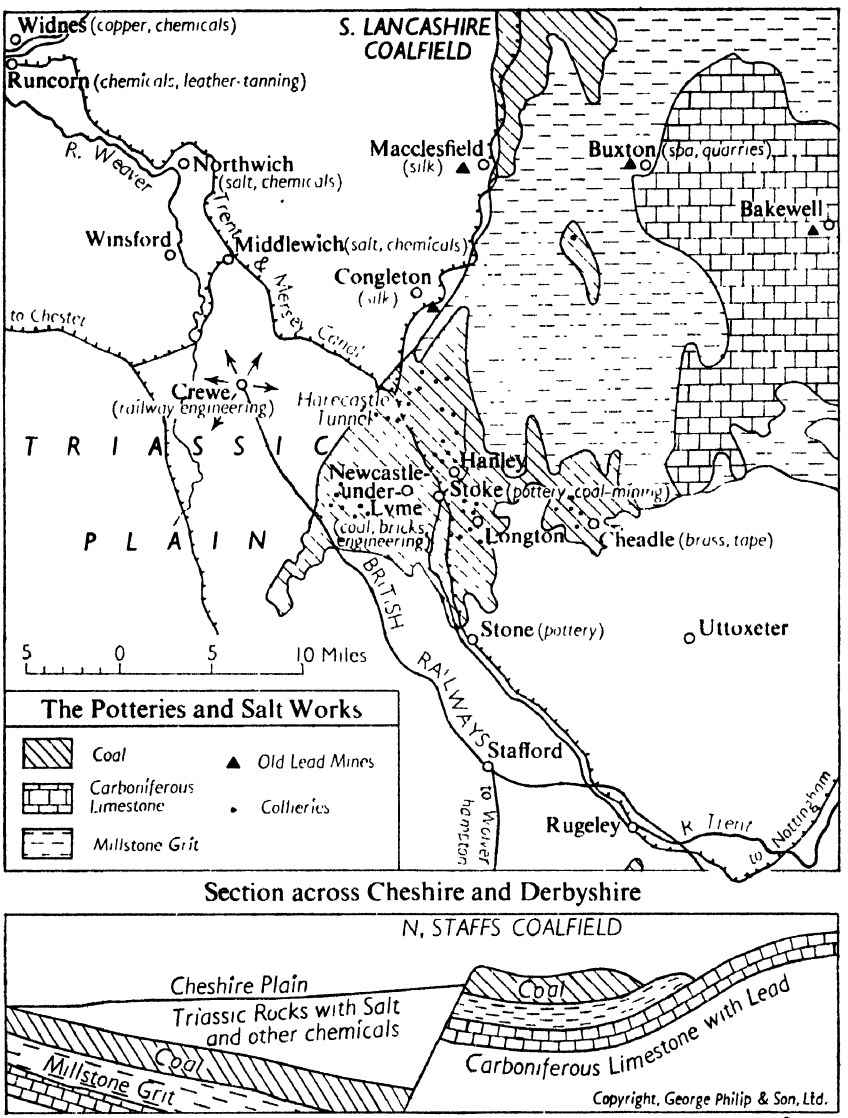

Fig. 4. Profile of rock formation in relation to economic activity

there is an element of luck or chance in the discovery of minerals, and in their changing economic importance, which favours now one community and now another, bringing an element of instability into human settlements devoted to their exploitation. The deserted 'ghost towns' of the Yukon, built in and immediately after the gold-rush of 1898, are now the subject of a tourist industry. The sheikhdoms of the Persian

Gulf have become prosperous since the Second World War through the discovery of oil. In some cases, the initial discovery of mineral deposits – diamonds at Kimberley in 1867 and gold on the Rand, gold in California in 1848, oil in Alberta since 1945 – has led to the development in other ways of hitherto undeveloped countries and the growth of an economy which has elements of stability, even if the minerals which originally took men there become exhausted. Sometimes, as in the case of the coal-mining villages of north-east England, so much of man's work has been devoted to building houses, roads, schools and other services, that, although the coal may be exhausted, complete abandonment of the area is not lightly to be embarked upon. It may be worth while instead to take new industry there. It would be a brave man who would forecast what parts of the world will acquire a new significance in the next fifty years through some new mineral discovery and its exploitation.

Coal, which, after building materials, is the most important mineral, is a sedimentary rock formed by the compression of partially decomposed plant matter, the product of swampy forest growths of a kind no longer found on earth. It is, and for a long time is likely to remain, a major source of power, but its geographical distribution is most uneven. The United States, the U.S.S.R., the United Kingdom and Germany, together produce nearly eighty per cent of the coal mined each year, but the largest reserves are in the first two countries and in China and Canada. Latin America, Asia except for China, India and Turkey, and Africa except for the Union of South Africa and Rhodesia, are all deficient in the mineral upon which the industrialism of the nineteenth century was built.

Oil is found in regions where rocks have suffered little disturbance, because the oil escapes if rocks are much fractured. Other geological conditions are also necessary: the opportunity in times past for the accumulation of finely disseminated organic matter where it was buried by slowly-deposited mud before it had had time to decompose completely; subsequent heat and pressure; the presence of such good 'oil-reservoir' rocks as sandstone and limestone in which the oil remained stored; and a 'cap' rock to seal it in. These conditions existed in California, Mexico and Oklahoma, in Venezuela, Colombia, Ecuador and Peru, in Persia, Iraq, Arabia and its coastal sheikhdoms, in parts of the East Indies and Burma, and in areas adjacent to some of these now under the sea. They did not exist, so far as is known at present, in much of tropical Africa, in Scandinavia, or most of India.

The other minerals of economic importance – apart from deposits of salts in arid climates such as the sodium nitrate beds in Chile – are found mainly in mountainous regions. By nature they are heavy and originally sank into the interior of the earth. Only in the various periods of

mountain-building have these materials, in molten state, been pushed up to harden near the surface and, sometimes, to be exposed by subsequent erosion of the mountain range. Iron ore is a partial exception since it forms 4·6 per cent of the earth's crust and is found in most parts of the world, though not everywhere in exploitable form. Rich ores carry from fifty to sixty per cent of iron, but leaner ores with as little as twenty per cent of iron may be economically important provided they are accessible and in large deposits, while the discovery of new methods of extraction may always change the situation almost overnight. Those places in which civilization first arose – Egypt, Mesopotamia, northern India, eastern China, Greece, and even Italy – are all deficient in iron, and all but China lack coal as well, so that this may well explain their limited industrial progress. The presence of iron, in conjunction first of all with forests and then with coal, gave the United Kingdom, France, Germany and, subsequently, the United States, immense advantages which, to a large extent, North America and North-west Europe still retain.

Aluminium is even more common in the earth's crust than iron, since it is contained in clay, but at present its profitable exploitation requires both cheap power and a special type of clay, bauxite. The bauxite comes largely from Guiana, the United States, Equatorial Africa, Indonesia and Jamaica, but the extraction of aluminium takes place in the mountains of France, Germany, Norway, Switzerland and Italy, and around the Niagara Falls, where there is an abundance of hydro-electric power.

The other minerals of economic importance include copper, tin, tungsten, nickel, manganese, uranium, silver, platinum, chromium, molybdenum, mercury, cobalt, magnesium, sulphur, and the precious stones. Their irregular distribution may be indicated by giving a few sources. Nickel, for example, is found in Canada, the U.S.S.R. and New Caledonia; tin in South-east Asia, Bolivia, the Belgian Congo and Nigeria; copper in the western states of the United States, Chile, Canada, Northern Rhodesia, Belgian Katanga and the U.S.S.R. Their scarcity and chance distribution make them a cause of international friction and international interdependence, for no country has a supply of all the minerals it needs. Even the United States has to import nickel, tin, tungsten and manganese, while Italy's extreme poverty in all metals and fuels has had the most important effect on her position as a world power. At one time it was thought that peace-loving nations might band together and apply 'sanctions' to aggressors by denying them access to important minerals. This might well have been possible in the days of the Abyssinian war, but, perhaps inevitably, the two great world powers – the United States and the U.S.S.R. – are the best endowed by nature with the minerals they need and can 'stock-pile' the few in which

they are deficient to an extent which will meet their requirements for many years.

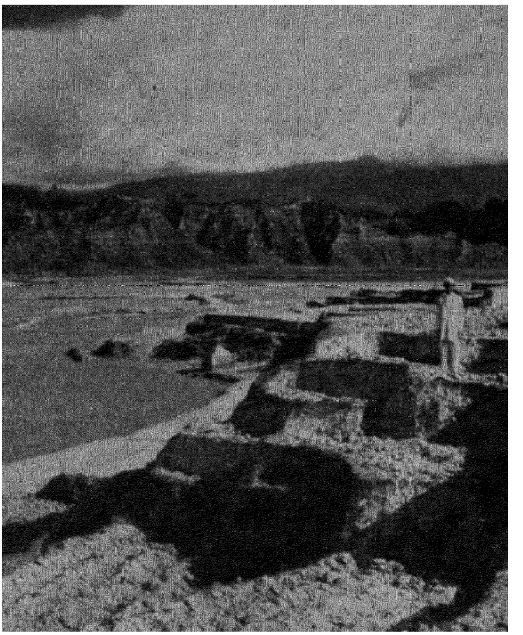

Fig. 5. New terraces and old erosion in Kathmandu, Nepal.

THE SEA

The influence of the sea on climate has already been indicated. But the sea is also important as a source of food and as the cheapest means of transport, while land easily reclaimed from the sea is among the most fertile in the world. These factors influence human settlement along the coasts and, although as yet very little of our food is obtained from the sea (it is calculated that not more than two per cent of our daily energy is derived from fish, though fish is an important source of protein), the sea may become of greater importance in the future if some means can be found both of harnessing its power and harvesting and utilizing other forms of marine life.

THE CONSERVATION OF RESOURCES

A famous economist* has suggested that men have acquired a 'telescopic faculty', an ability to visualize the future and bring it clearly before the mind's eye. It is to be regretted that this telescopic faculty is not greater and, in particular, seldom extends to succeeding generations, where the maxim is too frequently 'après moi le déluge' or 'eat, drink and be merry, for tomorrow we die'.

Nowhere is this more true than in mankind's use of the resources which have been supplied to him by nature. Some of the great fishing grounds are already on their way to exhaustion and international action has become necessary – with what long-term results remains to be seen – to conserve the number of whales. Other animals are already extinct or threatened with extinction. In some cases, the light-hearted – or even the considered – introduction of animals and plants to parts of the world in which they were not formerly found has created serious

*Alfred Marshall. See his *Principles of Economics*, p. 617.

economic problems. The rabbit in Australia, the grey squirrel in England, and the goat on the tiny island of St. Helena are all well-known examples. The delicate balance of nature is easily upset.

Although it is doubtful whether – as some geographers have suggested – the climate of the Mediterranean basin has been affected in historical times by deforestation, the wholesale destruction of forests has caused the erosion of the soil from hill and mountain sides in the Scottish highlands, the hilly areas of the south-eastern United States and the barren hills of North China. Only recently has any process of conservation by re-afforestation been begun and this process is still far from complete. The world's forest areas are still decreasing year by year. Indeed, nowhere has man been more prodigal of natural resources than in his treatment of the soil. It is probable that soil erosion has already marked the end of many ancient civilizations, from those in North China, Persia, Mesopotamia and North Africa in the Old World, to the Mayan culture of the New. Now, soil erosion is the greatest threat to our own civilization, and that threat is the more formidable in these modern times because the world is one world, and improved means of communication spread man's ignorance at terrifying speed.

In a state of nature, plant-roots conserve the soil, the leafy branches of trees protect it, and the chemicals essential to plant life remain where they are. The richness of the soil is even added to by decaying vegetation. In primitive communities, where population is thin upon the land, the soil is usually conserved. In temperate climates there has been a rotation of crops, in the tropics a shifting cultivation by which only a small part of the forest is cleared at a time. Primitive man removes little from the soil which he does not return, and by 'basin' farming in West Africa (where the forest clearing is hoed up into a series of ridges), by building walls in Malta, by cultivating terraces in the Peruvian Andes, by laboriously exchanging soils in China, to give but a few examples, he ensures that nature is not robbed nor his livelihood threatened.

But with large-scale agriculture, in which vast areas are put under the plough and sown with a single cash crop – wheat, tobacco or cotton – year after year, part of the goodness is carried away in the product to be consumed elsewhere and the rest is rapidly carried from the soil itself by wind and rain. This 'robber economy' in the United States alone has led to one hundred million acres being lost to cultivation in a century. Three hundred million acres more have been seriously damaged, and a further eight hundred million acres affected in some measure – altogether more than half the area of the continental United States. In Africa there is the same serious problem.

A little knowledge may be dangerous. Monoculture – the constant cultivation of a single crop on the same piece of ground – brings not

only the exhaustion of the soil but encourages pests which attack that crop, as the allotment-holder who discovers potato eel-worm knows to his cost. Chemists, through the development of new insecticides and germicides, may combat this situation but, in destroying pests, they may also destroy animal and bacterial life of value. Even the control of disease in cattle has proved dangerous in Africa, where the bigger herds have, in some places, overcropped the pasture and thus brought about soil erosion.

Of course, men have not been unsuccessful in their control of soil erosion where measures of conservation have been taken before they were too late. By adopting methods which earlier farmers often practised on a smaller scale by instinct – by strip-cropping, by contouring, by drainage, crop rotation and the reseeding of pastures – they have kept erosion in check. Much too has been learnt about the conservation of fertility. The cultivation of cover crops, the use of the residue of crops as a surface mulch, the use of artificial fertilizers – lime, potash, nitrogenous compounds and phosphates – all these are means of keeping the soil in good heart. Indeed, there is a positive side to the use of sound farming methods and, wisely used, the soil is indefinitely productive. Still more wisely used, its yield can be increased and in the American corn belt, as elsewhere, it is probable that by the proper application of fertilizers output could be doubled. Nevertheless, the problems of soil erosion and soil exhaustion remain among the most serious known to man.

If 'soil-winning' is dangerous and can rob fertile lands of their potential wealth for ever, it is even more obvious that the mining of minerals is a once-for-all process. To give but one illustration, the world is consuming coal at a rate approaching two thousand million tons a year. Even so, it is doubtful whether the dissipation of mineral resources is as fraught with dangers as is the dissipation of soil fertility. New discoveries of mineral deposits and power resources have yet to be made. Technological discovery – the invention of new methods of extraction or refining, for example – enhances the value of old deposits, and already scrap-iron constitutes a high proportion of the iron used in the manufacture of iron and steel. Moreover, different minerals may assume economic importance as time goes on and men have still made little use of the world's water-power reserves, let alone the power which resides in the sun, tides, wind and atomic fission. There are great possibilities, too, in the more efficient utilization of existing power sources, particularly in the utilization of coal which, when burned in the type of steam engine commonly in use in the middle of the twentieth century, produces only some fifteen per cent of its potential energy. In the production of electricity still less of this energy is converted into power, and there are other avoidable losses in carriage and in mining.

It must be remembered, however, that there are costs involved in the conversion to more efficient engines or different sources of power, and the prospective gain must more than cover these costs to make it worth while. Those who talk of nuclear energy and its industrial applications – practicable as these are proving to be – sometimes forget these costs, not the least of them being the protection of workers in atomic plants against radiations. But, whatever the future holds, it is certain that future discovery and new application will change the relative importance of many present sources of both mineral and power supply, even though the world as a whole may not need to fear a famine in either.

THE GEOGRAPHIC FACTORS AND HEALTH

When William Hickey and his friends in eighteenth-century Calcutta felt ill and all the usual physic had failed, the doctors invariably recommended a sea-voyage. Nowadays, Europeans working in tropical climates are given regular periods of leave. Those working in the Persian Gulf take anything up to twenty salt tablets a day to avoid 'sunstroke' since this complaint is no longer thought to result from leaving the head uncovered when out in the sun. (One result of this change of practice is that the famous 'George Robey' at Port Said is now said to have many thousand sun-helmets on his hands which at one time he was able to hire out profitably for the use of their crews to the tanker companies whose ships pass through the canal.)

A connection between climate and health, as between the mineral content of the soil and health, has long been recognized. While this may not much affect the settlement of native populations, it does affect their efficiency and thus their incomes. The intestinal worm and the blood parasite keep the native populations of Indo China, Java and Burma in far greater subjection than any human ruler ever did.

It may be questioned whether the keeping alive of the unfit by modern medical discovery is an act of humanity if these people are kept alive only to starve through a poverty of natural resources, but it is an obvious act of humanity to try to keep those already alive in better health and thus able the better to fend for themselves.

HUMAN SETTLEMENTS

This chapter has ranged widely over the various geographic factors which influence the settlement of man. When men were grouped in largely self-supporting communities these factors were all-important. In the beginning there was man, the hunter, living in caves or at the bottom of dene-holes in temperate climes, in huts of thatch or skins or ice elsewhere, anywhere that offered shelter of a kind, following the game, fishing, seeking out water, and kindling fire from wood. At a

later stage, animals were domesticated and some men learned the arts of agriculture and building from the materials of the soil. The nomad still lived on the great plains, but others began to lead a more settled life. The types of human settlement were as numerous as the geographic factors which determined them. Always there was the need for fresh water, but there were the hill settlements of the shepherds, the valley settlements of the farmers and, ultimately, the miners, and the coastal settlements of the fishermen and the fen-dwellers.

But as men specialized and grew in numbers another set of factors – the economic factors – assumed importance. The geographic factors did not lose their significance. Indeed, the means of communication, still primarily determined by geography, became even more important. Nevertheless, in these more highly organized societies, men themselves became responsible for influences affecting their welfare which were no less important in their way than the influences resulting from physical environment. It is to these other influences that we turn in the next chapter.

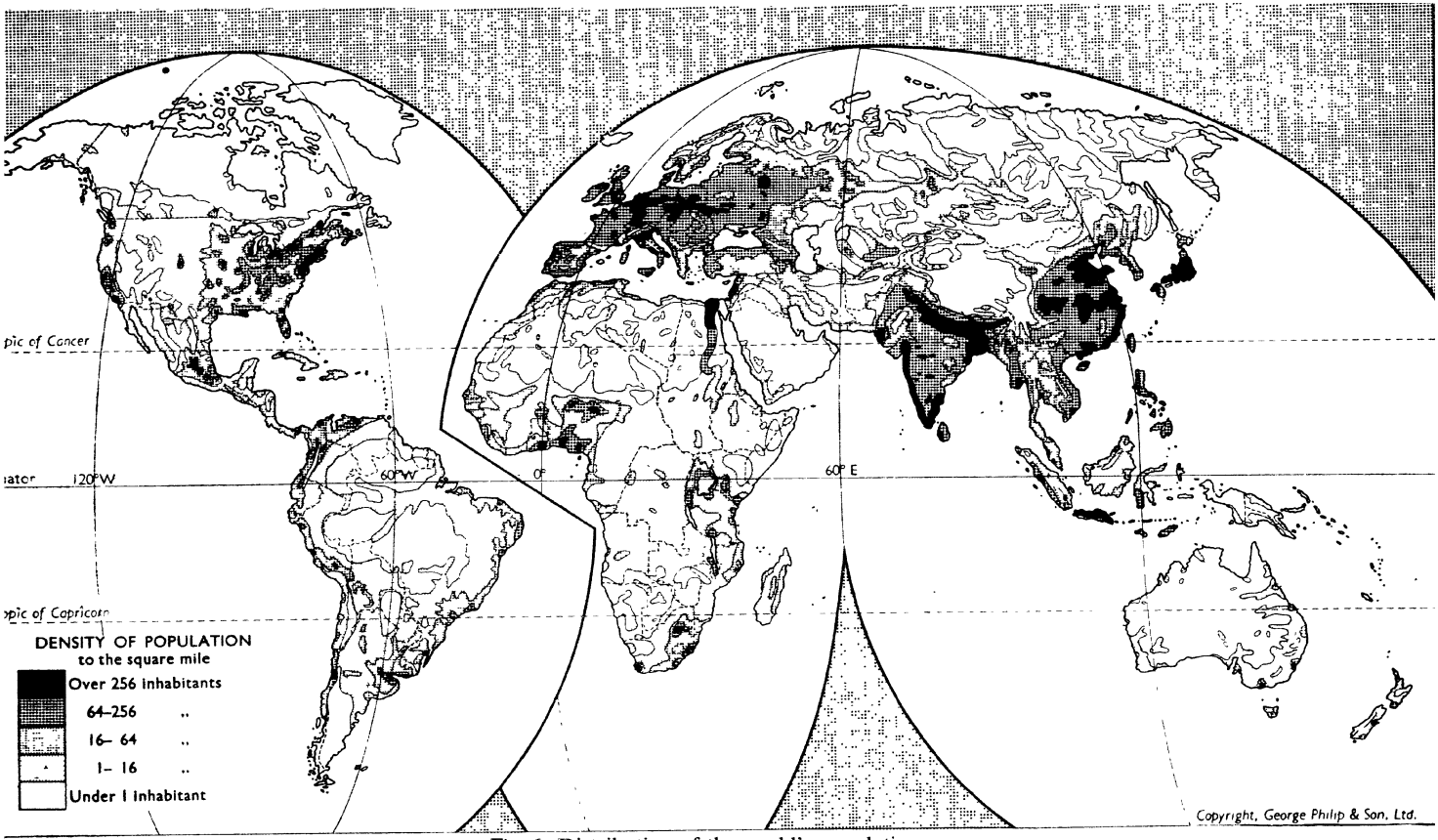

Fig. 6. Distribution of the world's population

Chapter 3

Economic Factors

POPULATION

Whether it be called human or economic, no one will deny that the total number of people living in the world, or in any particular part of it, is a factor which has some influence upon their standard of life. Obviously, there might be too many people on any particular plot of land for that land to yield each of them enough food to maintain him in good health. In Egypt, overcrowding is so extreme that the Egyptian labourer is said to work, on an average, only one day in three: there is insufficient land to keep him any busier. In China, with existing methods of cultivation and standards of health and nutrition, the production of food would probably be as high if one-fifth of the rural population were to disappear overnight. There has never been enough food for the peoples of the world, and it is estimated that three-quarters of the population of Asia live on a diet well below the standard required for good health, and anything between twenty and fifty per cent of the people in the rest of the world are in a similarly unhappy position. At the present time the population of the world is increasing so rapidly that many experts fear that numbers will continue to outstrip food production possibilities.

Less obviously, there might be too few people on any particular plot of land. It is not suggested that, where there are too few, they will starve. But if there were more, they might, by working together and specializing in their various activities, raise their standard of living. Two men on ten acres of land might produce more than twice as much as one man could produce, because one might specialize in cultivation, while the other might specialize in looking after the livestock.

Somewhere between these two extremes there should be an ideal or 'optimum' population, a population, which, given the tools and natural resources it has to work with, would produce the highest possible output of food and other essentials per man or woman employed. Unfortunately, this concept of an ideal population is not of much practical

use because men do not, by any fiat of government, change their numbers overnight and, even if they did, the ideal population depends not only upon the natural qualities of the land but upon the tools and other things men work with, and these latter change from year to year and from generation to generation, as new construction, manufacture and discovery take place. Thus, even though China might at present be described as 'overpopulated', it does not follow that the lands of China would not support 600 million people if the Chinese were given modern technical facilities and the knowledge of using them. The United Kingdom and other West European countries would certainly have been vastly overpopulated had they possessed their present numbers in the seventeenth century.

It is probable that the population of the world as a whole is now about 2,700 million, or more than two-and-a-half times what it is estimated to have been only 150 years ago. Of this immense number more than one-half (55 per cent) lives in Asia, one-quarter in Europe, and one-eighth in the Americas. The population of China alone is now reckoned to be rather more than 600 million. Another 400 million live in the subcontinent of India, half this number in the U.S.S.R., over 160 million in the United States, 65 million in Germany, 54 million in Brazil, 52 million in the United Kingdom, and 43 million in France. The peoples of the world are thus spread most unevenly over its surface, and nearly two-thirds of them are concentrated in the three most populous areas which together constitute no more than one-eighth of the total land area.

These existing populations are not, of course, likely to remain stationary. For the world as a whole the population appears to have grown at a constantly increasing rate, from an estimated 10 million, about 5,000 B.C., to its present figure. Currently, it is believed to be increasing at the rate of 20 to 30 million a year and some forecasts suggest a total of 3,300 million or even 4,000 million well before the end of this millenium. The most rapid increases are to be found in the new lands of the Americas, Africa and Australia, but population is also increasing rapidly in India, China and the U.S.S.R., and will increase more rapidly yet if, as seems probable with the spread of medical knowledge, death rates are reduced in years to come. Only in Western Europe are there signs that the population may actually fall, though even this is not certain. For the next twenty years, at any rate, it seems likely that in the world at large there will be 80,000 more mouths to feed every day than there were the day before.

Changes such as these must inevitably have important political repercussions. In terms of population, Russia, the United States, China, India and Brazil will become more powerful, and Germany, Britain and France less so. In the past century it has been the white races which

have increased most in numbers; the next century may witness a different pattern, and it may be the turn of other races.

But commentators in this field have been concerned most with the prospect of world famine. Food production can be increased, but it may not increase fast enough. If it does not, population will be reduced somehow – by famine and starvation, by war, by pestilence and disease, by such natural disasters as flood and earthquake, or possibly by the limitation of family size. If we consider these factors separately, natural disasters seem unlikely to play a major part in reducing the world's population since men are better able to deal with such events than ever before. Pestilence and disease are likewise fields in which man's knowledge saves lives rather than loses them, though the possibility of widespread epidemics cannot be ruled out of account. War is all too likely and atomic war may well destroy millions of people though, since they would be killed largely in manufacturing centres and the output of agricultural machinery from such centres is one of the means by which men might increase food production, war is unlikely to leave the problem of overpopulation solved, even if it could be commended. Nor is family limitation, either by restraint or by birth-control, likely to contribute much in the near future. It is true that once a certain standard of living has been reached people tend to limit the size of their families, but it would require a very great increase in production (or a startling and improbable redistribution of the world's wealth) before this standard could be reached over the greater part of the earth's surface. We can only hope that this increase in production will take place, and the world's fertility-rate decline, before famine takes its toll.

LIVING STANDARDS

In the middle nineteen-fifties the gross national income of the United Kingdom was estimated to be nearly £17,000 million, or $46,500 million. That was the estimated value of all the goods and services produced or otherwise made available to the nation during the year. It does not mean that the whole of these goods and services were available for ordinary consumption, for this sum covers not only the value of all food, clothing, heating, shelter and services of various kinds (e.g. entertainment, health, and other public services) but also what was 'saved'. That is, it includes what went into the building of new factories and power-stations, and what went to increase the stocks of goods held by manufacturers and distributors, as well as what went to maintain existing factories and buildings in good repair. A further deduction has to be made in these years for that part of profits which was due wholly to a rise in the value of stocks held by businesses, a fortuitous result of rising prices.

In the same period, the annual total of personal incomes in the United Kingdom was estimated to be about £15,700 million, of which some £12,000 million, or about 78 per cent, was paid as wages and salaries,* £1,700 million (11 per cent) was received by farmers, professional people and small traders working on their own account, and about as much again (11 per cent) went in rent, dividends and interest

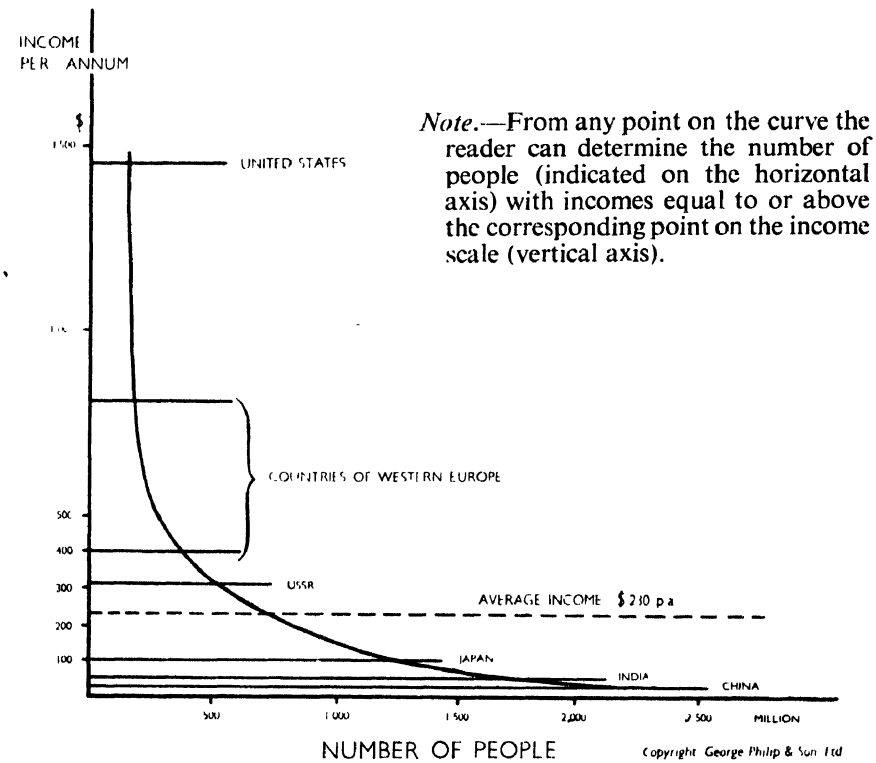

Fig. 7. Graph showing distribution of the world's incomes

received by persons. Had the total been equally divided between the inhabitants of the United Kingdom (if we could assume that with equal division the £15,700 million would remain the same), each man, woman and child would have had about £300 ($860). If, instead, it had been equally divided between the 24 million actually at work, each worker would have had an income of about £650 ($1,840) before taxes were paid or savings were made. If, of course, taxes and savings at current

*Including pay, etc., to the Forces and national insurance benefits.

Fig. 8. Poor Navajo Indians in the Arizona Canyon

levels were deducted, what was left over to spend would have been considerably lower.*

In fact, incomes were not equally distributed. In 1954 it was calculated that only 190 people were left in the United Kingdom with annual incomes exceeding £6,000 after they had paid their taxes, though more may have been spending a sum greater than this by 'living on their capital'. Nearly 835,000, however, had incomes between £1,000 and £6,000 a year after they had paid their taxes. A further 1·3 million (in round figures) had net incomes between £750 and £1,000, nearly 6 million had incomes between £500 and £750, and 18 million incomes between £135 and £500. (It must be remembered that many of those in the last group† would have been contributing their incomes to a family in which there was another wage-earner. It is known that there are some 14 million households or family groups in the United Kingdom.)

*Consumers' expenditure was no more than £12,677 million (£248 per head) in 1955 and of this £2,144 million went in indirect taxes.

†In fact, probably all the 8,700,000 – or half the group – earning less than £250 a year.

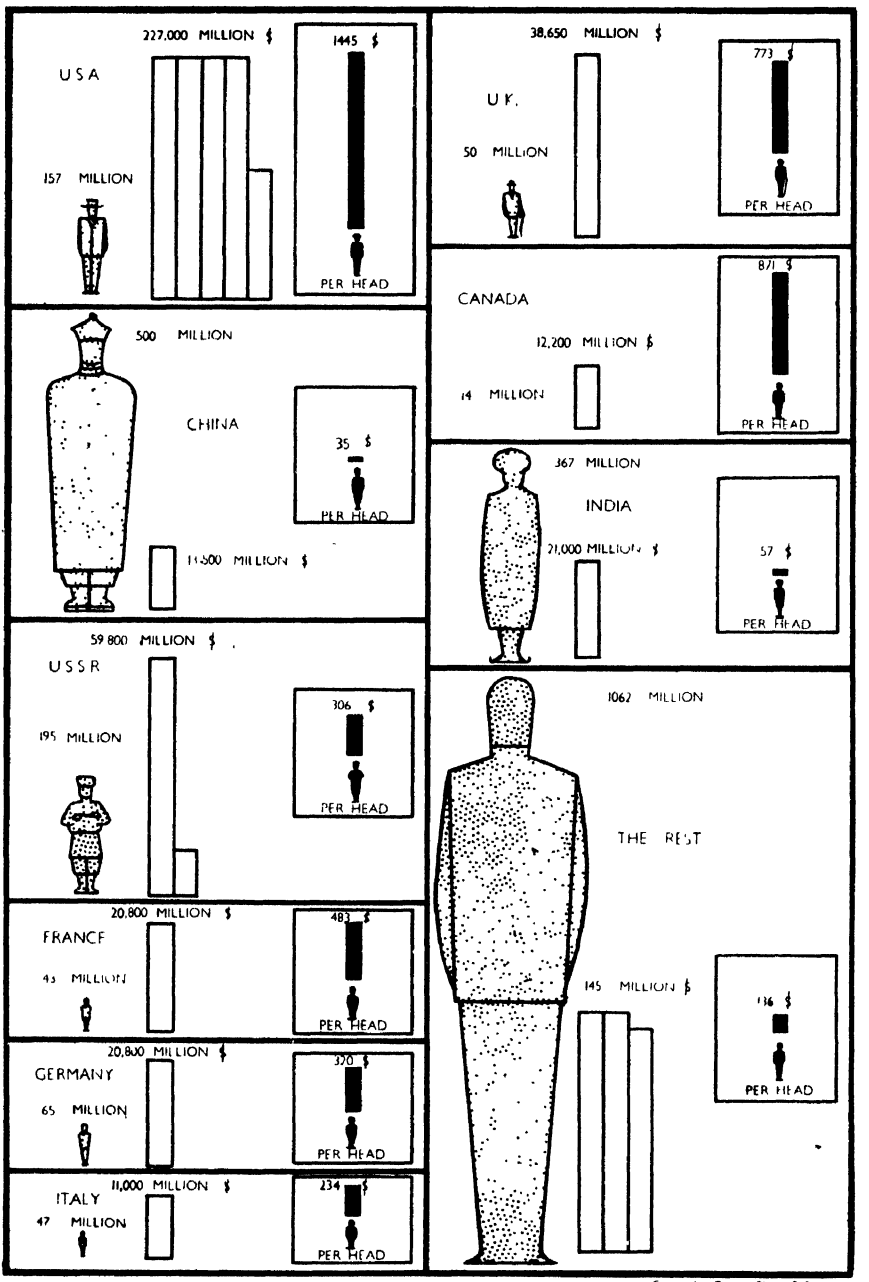

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Fig. 9. Population, national income and average income per head for certain countries

Imperfect as these figures are, they give us some idea of living standards in what remains a 'rich' country. What about the rest of the world?

Unfortunately, no official organization has ever estimated the annual income of the world and it is not perhaps very meaningful to do so. However, if such an estimate were made, it might amount – and this figure must be taken as subject to a considerable margin of error – to as much as £245,000 million, or $680,000 million.* In other words, an average about £90 or $250 a year for every man, woman and child in the world, a figure which is to be compared with the £300 for each of the inhabitants of the United Kingdom, or $1,800 for each of the inhabitants of the United States. Thus the average standard of living in Great Britain might be said to be three times as high, and the average standard of living in the United States over six times as high, as the average standard in the world as a whole.

Nor is this the whole story, for the income of the world, like the income within a country, is very unevenly distributed. The average American standard of living is about twice as high as that in Great Britain, and the British standard of living may be as much as twenty times as high as that in China. The eight richest countries – the United States, Canada, New Zealand, Australia, the United Kingdom, Sweden, the Netherlands and Denmark – enjoy perhaps one-half of the world's wealth with little more than one-tenth of its population, while China and India, with well over one-third of the world's population between them, probably enjoy less than one-twelfth of the world's wealth.

In addition to the eight already mentioned, the 'well-to-do' countries would include Norway, Belgium, Switzerland, Germany and France – the countries of North-western Europe – with average incomes exceeding £260 a year (1956 prices) for those in work, this figure comparing with the £650 given for the United Kingdom above. Below these come the countries of Eastern Europe, including Russia, with average incomes exceeding £160 a year. Below these again are the native peoples of Asia and much of Africa. In China, it is probable that most families live on the equivalent of little more than £1 ($2·80) a week.

All these figures must be hedged about with qualifications and they should not be taken as any more than the roughest guide to living standards in the middle of the twentieth century. That they are not improbable can be illustrated by the fact that an English middle-class family of four, with an income of £1,500 a year, does not normally spend more than about £6 a week on food, and its members could keep alive, though not perhaps in good health, if they spent as little as seventeen shillings a week on food. Indeed, this latter position is that of many

*The figures in the text have been revised to 1954–55. The figures in Figs. 7 and 9 relate to a year or two earlier when world prices were 10–15 per cent lower.

Fig. 10. A room in a fairly modest American home

millions of families on the earth's surface and it is a commonplace among economists that the proportion of income spent on food falls rapidly as income increases.

Welfare, of course, is not wholly a question of a family's command over commodities and services, and these income figures, even where they can be relied upon, tend to exaggerate the differences between nations. The man with a small income in a settled community may well be more content than the relatively 'rich' man in a mining camp or urban centre who has to seek distractions to which a large proportion of his income is devoted. Nevertheless, that the difference between living standards in different parts of the world is immense, and that the majority of those living on the earth do not have a sufficient command of material goods to ensure even reasonable vitality, can be shown in other ways. It has been estimated, for example, that two and a half acres of reasonably productive land is necessary to produce enough food for one person. But the actual cultivated area of the world falls far short of this figure, and, although the cultivated areas can be increased, they might still fall short of this minimum figure in a few decades time with a larger world population to be supported. By another widely accepted calculation, 2,500 calories a day is the amount of energy which the normal person needs to absorb from his food to maintain himself in good health. The world production of cereals, however, yields an average of only some 1,650 calories a day for each man, woman and

child, and, although cereals are supplemented by other foods, the poorer peoples of the earth are mainly dependent upon them. It is probable that more than one-half of the world's inhabitants exist on a diet which is too poor to maintain them in good health. Whatever measure we use, the world is a very poor place.

DETERMINING FACTORS

What are the factors which determine these living standards? The natural riches of the earth – the climate, soil, and mineral wealth – are of obvious importance and have been adequately discussed in Chapter 2. The warm and temperate lands have advantages of climate and soil which make them both more attractive and more productive than the cold and tropical lands, and the northern hemisphere is more favoured with minerals than the southern hemisphere. These influences alone go a long way to explain the advantages enjoyed by North America, North-western Europe, New Zealand, Australia and Argentina.

The density of population – the number of people per acre of land – is another factor of the utmost importance, though it cannot be considered in isolation from the geographic factors. The population densities of Australia, New Zealand, the Americas, the U.S.S.R. and Africa are all well below the average figures for the world as a whole. If these figures are considered together with the geographic factors of soil and climate, we have one clue to the relative prosperity of the United States and the two British Dominions. In Asia, excluding the Russian dominions, the density of population is nearly three times the world average, while in Europe it is nearly five times the world average. Why then is Europe so much more prosperous than Asia? The explanation lies mainly in Europe's favoured geographical position. In particular, it has a lower proportion of mountainous and arid land than Asia where the vast populations of India and China are most heavily concentrated upon the fertile areas. In these areas the density of population is greater than it is in Europe.

How, apart from the destruction, limitation or redistribution of populations, can living standards be raised, or the world output of food and other goods be increased?

It might be thought that one solution could be found in harder work if we refer only to western experience, but it is immediately obvious that the Chinese and Indian peasant toils upon the land, whenever he is able to, far more laboriously than the West European with his forty-five-hour week or the American with his forty-hour week. It is true that in the richest countries more work might produce more goods, but it by no means follows in the poorest countries. It was discovered in nineteenth-century England that a reduction of the long hours of work

in factories did not reduce their output because tired people work less efficiently in all their working hours.

If we examine the key to the riches of the more prosperous lands we find that one of the reasons for their greater prosperity lies in their greater use of *capital.* To take the stock example given in economic textbooks, Robinson Crusoe might lead a very poor life if he caught his fish with his hands, but if, for a time, he lived on a very low diet and used some of his extra leisure in fashioning a net or a spear, he might ultimately be able to catch twice as many fish and live very much better. The net or the spear would be capital. Capital, to the economist, means all those things – tools, machinery, buildings and fertilizers – which men have made themselves to help them in their work. It is no coincidence that the American factory-worker produces twice as much for the same amount of work as his British counterpart and, at the same time, uses to help him probably twice as much 'capital'–in the form of machinery and electric power. It is no coincidence either that, during the Second World War, the output of food from British farms increased very considerably while, at the same time, Britain became the most highly mechanized farming country in the world. Nor is it any coincidence – to give one last example – that investment in German industry doubled between 1948 and 1954, and so did its output.

THE ROLE OF CAPITAL

How then can capital contribute to the raising of the world's living standards? The simple answer is that capital is labour saving. It enables a man to produce more than he could by his own unaided efforts. But a word of caution is necessary in connection with the use of capital in agriculture. In the densely settled parts of China, the use of tractors and imported fertilizers would do little or nothing to increase the amount of food grown on the land, and labour is so abundant that it is not worth while substituting tractors for buffalo if the former cost the farmer anything. The running costs of a tractor alone would probably exceed the costs of the native buffalo teams. In the thinly populated savannah lands, as was pointed out in Chapter 2, the crop-yield may well fail to repay the costs of production where machinery is used, and there is the further danger of soil erosion. Nevertheless, provided that precautions are taken to conserve the fertility of the soil, there are undoubtedly very large areas of the world's surface where agricultural production could be greatly increased by the adoption of capital-using or labour-saving methods. Artificial fertilizers, proper drainage, and irrigation all require capital in the sense in which the word is used by economists. Even in China it has been estimated that only 190 million out of 700 million potentially cultivable acres are used, though it is in the lands of the temperate latitudes – particularly in the more recently

settled lands – in the United States, Canada, the U.S.S.R. and Argentina, that the output of food could be most readily increased.

But food, although essential, is only one factor contributing to the standard of living, a factor of declining relative importance as the standard of living rises. In manufacturing industry there is no doubt about the advantages to be gained from the use of machinery and, what goes with machinery, the increasing specialization of labour. Everyone knows that it is far cheaper, per car produced, to turn out 10,000 vehicles by assembly-line and large-scale methods than it is to produce each of them laboriously by hand in the manner of the early craftsmen. However much one may regret the passing of the hand-sewn shoe or the hand-tailored suit, there is no doubt that more people can be clothed and shod where these commodities are made with the aid of machinery than where they are not. Much can be gained by the industrialization of the poorer countries, by the building of roads, railways, docks, harbours, and sewage systems, by the development of power supplies, by the establishment of textile industries, by the manufacture or importation of mining machinery, tractors and lorries.

If the role which capital can play is admitted, a big problem still remains. Where is the capital to come from? If it took Robinson Crusoe all his time to catch fish to keep himself alive, he would have no time in which to make his spear or net. To produce capital a community must devote time and resources to its production, but if that community is already near starvation it may have no resources to set aside and all its time will be needed to stave off death through hunger. The richest countries are those which are also in the best position to produce capital and thus in the best position to help themselves to become richer. The poorest countries cannot help themselves and are thus in danger of remaining poor for ever.

The world has already witnessed in Japan and the U.S.S.R. the rapid industrialization of two formerly 'backward' countries. The machine age began in Japan in 1867 when an Englishman introduced the use of explosives into a lead mine in Hokkaido. Coal and copper-mining and the development of the cotton industry followed rapidly. Between 1867 and the outbreak of the Second World War the average income per head in Japan probably quadrupled despite a very large growth in population.

In the U.S.S.R. industrialization took place largely after 1917, and the capital was produced almost entirely within the country from its own resources. At the same time methods of agricultural production underwent a revolutionary change. Despite mistakes and setbacks – not forgetting the immense damage done to the Russian economy by the Second World War – production is growing more rapidly in the U.S.S.R. to-day than anywhere else in the world.

Fig. 11. F.A.O. cotton expert in Afghanistan

These two examples are of particular interest because both illustrate the difficulty of generalizing too readily about countries which remain without large-scale industry. Both the U.S.S.R. and Japan are favoured climatically – the former at least in some parts of its vast dominions. Both had undeveloped mineral wealth, and the U.S.S.R. a large area of fruitful soil, as well as the largest forest reserves in the world. These things are not given to nations everywhere. Moreover, Japan received very considerable assistance from foreign capital – Europeans and Americans invested heavily there – while the Russian government was ruthless in its endeavours to make a poor population 'save' and thus provide the resources necessary to finance its industrial programme. At the same time, in the U.S.S.R., millions of people were driven off the land to man the new factories or develop the thinly populated lands of Siberia.

Japan and the U.S.S.R. thus provide us with models of a kind for the development of the other poorer countries of the world, the countries of Eastern Europe, India, China and other Asiatic countries, and the poor lands of Africa and South America. Either the government has to be sufficiently powerful to force through its programme of capital development, perhaps at the expense of present suffering, or help in the way of gifts or loans of capital has to come from outside, from such rich or well-to-do countries as the United States and the United Kingdom.

The past decade has been witness to many different methods of capital development. In China and in the countries of Eastern Europe under Russian influence there have been powerful governments able, in some measure, to impose compulsory saving for capital purposes upon their peoples. From the United States to Western Europe, to Yugoslavia and to parts of Asia have come gifts of capital to permit self-development.* The United Kingdom has made many and varied attempts to help its colonial peoples and, by paying off war debts, to help India and Egypt. The people of Yugoslavia, as well as the people

*The International Bank for Reconstruction and Development has also made loans to Finland, Iceland, Peru, Colombia, and many other countries.

of many European countries, including the United Kingdom, have also been trying to help themselves.

So, too, have India, Pakistan, Ceylon, Malaya and British Borneo through the brave experiment of the Colombo Plan, which envisages a large increase in food and power production, nearly one-half of it to be financed internally, the rest to come from abroad. The Colombo Plan exemplifies what might well be the best solution of the problems of the so-called under-developed countries if political ideologies play no part in world affairs: a combination of self-help through sacrifice, and assistance from those who are better off. For, even if the countries which need capital most are poor, they are not necessarily in the position of the Robinson Crusoe who had to spend all his time catching fish. There may be some margin devoted to ostentatious expenditure which could be devoted to the building of roads and railways; indeed, the resources of most under-developed countries are adequate, if effectively used, to support a substantially higher level of production and income. In the England of the fifteenth and sixteenth centuries, less was consumed than was produced and a great deal of wealth was accumulated, but this wealth did not go to raise the standard of living of the people. Much of it was spent in the construction of ornate and beautiful churches, still to be found throughout the land, of a size out of all proportion to the neighbouring population.

On the other hand, foreign help is not to be despised. Although it raises no problem of repayment if the help received from the richer countries is in the form of gifts, it does not follow that loans from abroad should not be sought out. A loan is always worth while to a business or a country if it is so wisely spent that it produces enough to repay the loan and leave something over as well. Such loans have been an inestimable boon in the development of Argentina, the British Dominions, Germany, Japan, and even in the development of the United States itself.

Unfortunately, in the modern world, the repayment of loans to the world's richest country – the United States – creates problems of its own. A debtor country can only repay its debts by exporting commodities, services or gold to the creditor country, but the United States is so rich that anything sent in repayment other than gold may be an embarrassment, with certain sections of American industry decrying 'unfair' foreign competition. This particular problem is one which is linked closely to the problem of large-scale unemployment and further reference is made to it below.

EDUCATION AND ORGANIZATION

Charles Thayer, in his recollections of diplomatic life in the U.S.S.R.,* tells a story, both touching and amusing, about a new potato planter

*Charles Thayer, *Bears in the Caviar* (Michael Joseph) pp. 132–4.

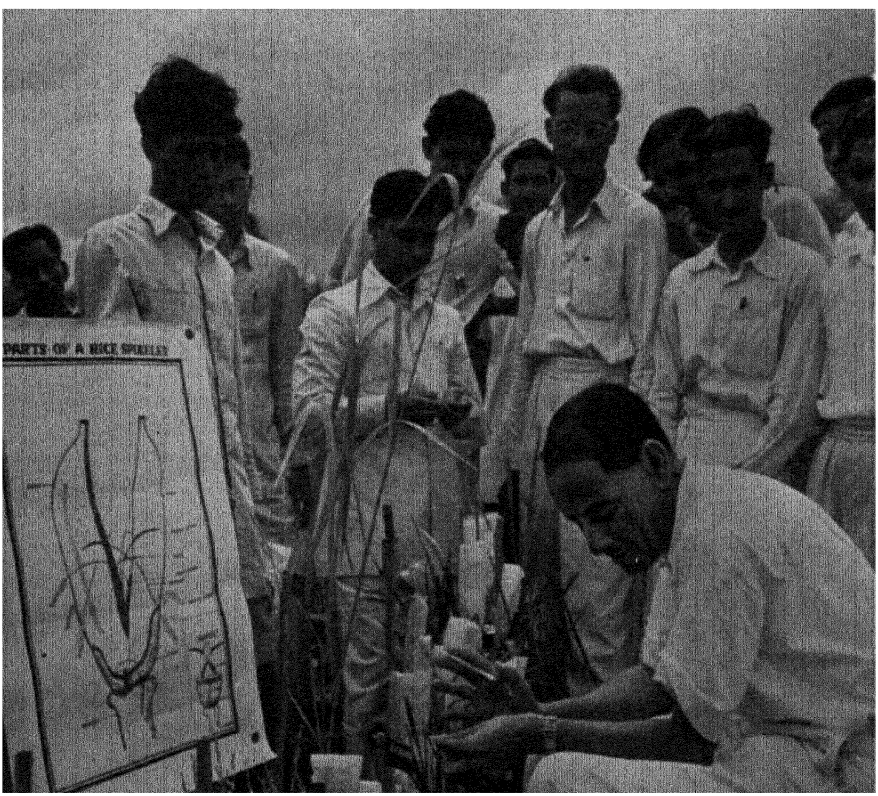
which had been acquired by a collective farm. Half the village had gathered to see it tried out: it was supposed to do the work of six men.

> 'Anna got on the tractor and someone started to crank it up. But for some reason it wouldn't start until a small boy jiggled the carburettor to keep the petrol flowing. Whenever he got tired and stopped jiggling the engine died, so he climbed up under Anna's feet, flattened himself out on the chassis and settled down to become a permanent part of the machinery'.

A number of other accidents happened and eventually a connecting bolt came loose 'so that another young man with a hammer was obliged to trot along beside it hitting the bolt back into place every time it came round'. After that, it was discovered that the potato seedlings were larger than the holes they were supposed to go through so three women armed with broomsticks 'perched themselves on the rear of the planter and by working the broomsticks like pistons managed to get the potatoes moving in the right way'.

Eventually the tractor went off, Anna driving it, the boy jiggling the

Fig. 12. To increase rice yields, an expert instructs Indian students



carburettor, the young man with the hammer trotting beside, and the three old women poking their broomsticks. 'Wonderful', said the president of the farm, without irony. 'And to think it does the work of six!'

No doubt these Russian farm-workers soon had their potato-planter working to perfection, but the story illustrates that capital alone is not sufficient. It requires an educated people to use it and trained organizers or managers who can organize the work done in the most economical or labour-saving manner.

The battle against ignorance is going on all over the world. A famous historian has suggested that without the Education Act of 1870, which introduced compulsory primary education, the United Kingdom could not successfully have played her vital part in the First World War. It is probable that without the secondary education consequent upon the Acts of 1902 and 1918, the even more highly mechanized war of 1939–45 could not have been waged by Britain. But education does not help merely in the winning of wars; it helps fight the battles of peace, among them the battle of raising the standard of living.

It cannot yet be said that that battle has been won. A great number of the people in the world cannot read and write and they are to be found, in the main, in the economically backward countries. Even where the ability to read and write is almost universal, the general standard of education is often miserably low and relatively few people in the United Kingdom can read such a book as this with ease. The development and training of such intelligence as exists in a country – at all levels – is essential, for an intelligent workman knows how best to do his job, why he is doing it, and how his own contribution fits into the whole productive scheme. This is as important in the richest countries in the world as it is in the poorest.

If it is important to educate everyone, it is also important to allow the most intelligent people to develop their abilities to the full. Intelligence and management do not necessarily go together but they should, for it is at the managerial level in industry and agriculture that policy decisions are made, explained and implemented. In the half-dozen years immediately after the Second World War many 'teams' from different British industries visited the United States to study American industry because it was recognized that American productivity per man-year was considerably higher than it was in Britain. The main reasons which they advanced to explain this difference were two: 'First, there is a climate of opinion which regards maximum effort by *every* individual as the primary guarantee not only of material standards but of the way of life of a free society. Second, there is a quality in management inspired by this climate of opinion, and stimulated by the American system of higher education in general and, in particular, by that part of it which

is devoted to administrative studies.... American experience has shown that productivity and education for management are closely related'.*

The production of goods can often be increased very considerably not only by the use of capital which saves labour but by using labour itself more effectively. Economists have always emphasized the importance of the 'division of labour' as a factor contributing to higher living standards. John Ball's epigram – 'When Adam delved and Eve span, who was then the gentleman?' – suggests that the advantages of specialization were recognized early on in the development of human society. More could be produced if Eve became expert in the spinning and Adam in the digging than if both tried to do a bit of each. In modern industrial society the process of specialization has been carried very far but not so far that in some instances it cannot be carried farther. The study of the way in which people work, with a view to cutting out superfluous effort and making the most effective use of different skills, together with the elimination of wastes of time and materials, can produce quite startling increases in output. Reports from the cotton-spinning and doubling sections of the textile industry in the United Kingdom, following upon suggestions made in a productivity-team report, showed a rise in productivity of thirty per cent in the card-room and ring-room of one firm through the use and application of such 'work-study'. By the provision of mechanical aids, by simplifying jobs or methods, and by the standardization of moulding boxes, one iron foundry increased its output per moulder/coremaker by two-thirds.†

Managers, foremen, trade unions and workers can all combine to achieve results of this kind provided that there is the proper use of intelligence in all sections of industry. But such co-operation demands a higher perception of the common good than is customary with the general level of world education. Our immediate interests do not always seem to coincide with the interests of society at large, and one group or section may decide that its own interests are best served by 'organizing scarcity' or by 'going slow' though it is obvious that if all groups or sections follow the same policy the whole society will be the poorer.

WORLD TRADE

When the boy in the junior school barters or exchanges twenty glass marbles for a penknife or two toffees for a Canadian ten cent stamp, both he and his partner in the exchange are well satisfied. Each has gained something he prefers to what he had before. The first boy may have been willing to give twenty-five marbles for the knife. His friend may have been willing to take fifteen. There is room for a certain amount of

**Education for Management* (British Productivity Council) p. 19.

†See Graham Hutton, *We Too Can Prosper* (Allen & Unwin), for other examples.

bargaining, but if the exchange takes place, each of them finds himself in a situation which he likes better.

This is the essence of all trade. The ways in which the different factors of production – natural resources, the labour of men and women, and capital – are combined determine the world's wealth but not necessarily the satisfaction which is derived from it. This is enhanced by exchange.

It is not surprising that people will always want to exchange some part of what they have for things which they do not have and cannot produce. One may expect that some part of the meat of the continental grasslands will always be exchanged – political barriers apart – for the fruits of the warm temperate lands or the forest products of the cold and equatorial zones. In peaceful circumstances there will always be an exchange of products between the different climatic zones, and those people who are not blessed with minerals will obtain them if they can. Tea will not grow in Britain; India is short of iron. Manganese is not found in any quantity in the United States; the Gold Coast is unlikely to develop a large-scale motor-car manufacturing industry. Exchange of this kind adds variety to life and raises the standard of living.

But trade is not confined to goods which cannot possibly be produced in other areas. Australia may import soft-woods which are not grown in that continent at all, but she also imports motor-cars which can be produced there. Why is this? In all probability it is because the Australians can produce some other commodity – say, wool – more cheaply. That is to say, for a given expenditure of effort, capital and resources the Australians can produce an amount of wool which will exchange for more cars than could be produced at home for that same expenditure of effort, capital and resources. Since the factors of production are unequally distributed over the surface of the earth, different districts specialize in the production of particular goods and services.

The factors which influence this 'localization' of industry or production will include the availability of a suitable kind of labour (skilled chemists, for example, are rarer in West Africa than they are in the United Kingdom or the United States), the availability of raw materials and other natural resources, including power, the availability of capital, and, since goods have to be marketed and the cost of transport is an element in total costs, the availability of the 'market' in which the goods are sold. The cotton industry settled in Lancashire because there was local labour which was already skilled in spinning and weaving woollens, because the climate was moist, because water power was readily available, because the raw material was brought to Europe in British ships, and because British inventors were already turning their minds to inventions which would facilitate production. Though increasingly subject to foreign competition, it stays there because a good deal of capital is invested in the area, the population retains its skills, there is a 'know-

how' appertaining to textile production which is the legacy of two hundred years' work in this field, and there is a large home market at hand in the United Kingdom. The iron and steel industries have normally settled down near the coalfields and the aluminium industry near cheap hydro-electric power because it is cheaper to bring the ores to the power than the power to the ores. The motor-car industries are normally sited where many of them can be sold because only then can full advantage be taken of the economies of large-scale production.

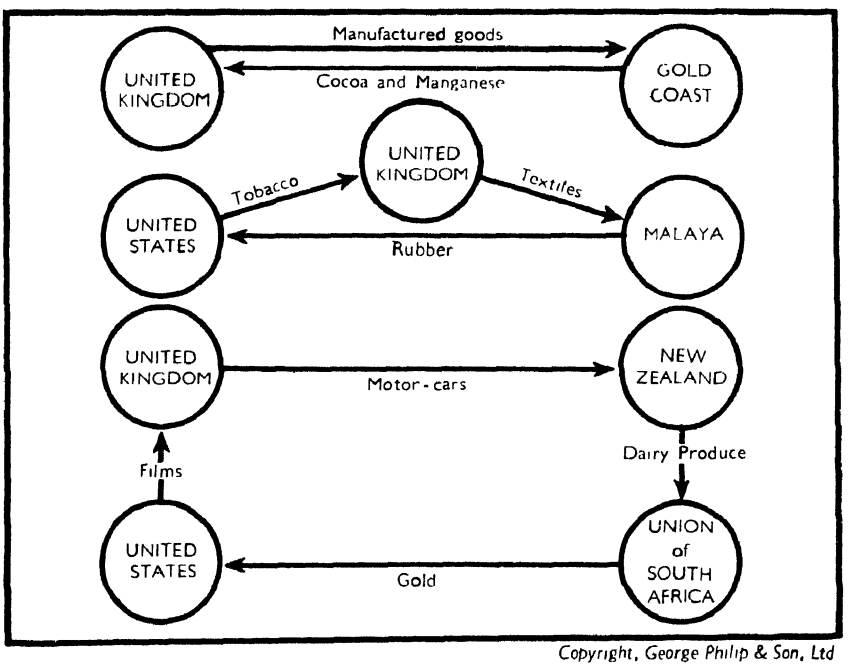


Fig. 13. Some simple trade patterns

In an ideal world all goods would be produced where their costs of production plus the cost of sending them where they were in demand were lowest.

The advantages of the two-way trade between, say, the United States and the Gold Coast in manganese and motor-cars or between Britain and the Gold Coast in textiles and cocoa are too obvious to require elaboration. It will also be apparent that there may be advantages in the three-way or even more complicated patterns of trade illustrated above.

It might be worth while, however, elaborating upon other aspects of what is called 'the theory of comparative costs', particularly where both

countries can produce both of the goods exchanged. For purposes of illustration let us suppose that Australia and Britain can each produce both wool and cars but that in Australia it takes x factors of production (so much labour, so much land, and so on) to produce 100 bales of wool *or* 5 motor-cars, while in Britain x factors produce 20 motor-cars *or* 10 bales of wool. If trade takes place, Australia specializing in wool and Britain in motor-cars, 2x factors in Australia will produce 200 bales of wool and 2x factors in Britain will produce 40 motor-cars, a total of

200 bales of wool + 40 motor-cars,

whereas without trade the total would be

110 bales of wool + 25 motor-cars.

Britain will be willing to exchange up to 20 motor-cars for 10 bales of wool and Australia will be willing to exchange up to 100 bales of wool for 5 motor-cars. Trade is obviously worth while and if, by bargaining, it is settled that 100 bales of wool exchange for 10 motor-cars the final position may be:

Britain: 30 motor-cars + 100 bales of wool.
Australia: 100 bales of wool + 10 motor-cars.

Both are considerably better off.

Trade may still take place if one country, say Britain, can produce both wool and motor-cars more cheaply than Australia but has a comparative advantage in the production of motor-cars. Suppose, for example, that 2x factors in Britain can produce either 40 cars *or* 40 bales of wool *or* 20 cars + 20 bales of wool, and so on, and, in fact, when no trade takes place, produces the latter – 20 cars + 20 bales of wool.

In Australia, on the other hand, 2x factors now produce either 10 cars *or* 30 bales of wool *or* 5 cars + 15 bales of wool, etc., and again the latter is actually produced when there is no trading.

By specializing Australia produces 30 bales of wool and it is still worth while exchanging up to 15 bales of wool for 5 cars, so that, with trade, the final position might be:

Britain: 25 cars + 20 bales of wool.
Australia: 20 bales of wool + 5 cars.

In this case Australia has given up the production of cars but Britain, while specializing in cars, continues to produce some wool since Australia does not supply all her needs.

These latter examples, however, provide less permanent lines of trade if the differences in comparative costs are due to factors subject to change (the skill of labour and the availability of machinery) than if they are due to natural resources which cannot be transformed or transferred easily (such as mineral resources, climate and soil). The pattern of

world trade is changing as industrialization spreads to countries which have not hitherto had large-scale manufacturing industries, and this changing pattern has the most important repercussions on the position of the United Kingdom which is peculiarly dependent on international trade.

The industrial revolution came first to Great Britain and, with it, the population grew enormously. Britain found that it paid to specialize in the production of manufactured goods and exchange them for food. Nowadays she grows perhaps half the food her population consumes. In the meantime the knowledge of machine methods spread abroad and Germany, the United States and Japan became great trade rivals. Britain's coal exports declined as other countries developed their own power resources. Other countries, notably Japan, began to produce cheaper cotton textiles.

This process was speeded up by two world wars, which cut Britain off from world markets for years on end, and by trade barriers – tariffs, subsidies and quota systems – which fostered the growth of industry in other countries. There were sound reasons why some of these trade barriers should be erected, temporarily at least, for behind them some countries could develop large-scale industry quite capable, once it was established, of producing as cheaply as British industry. Other reasons were not so sound and trade barriers once erected tend to persist. Many examples are to be found in the United States, as elsewhere, where industries protected in their 'infancy' are still protected in their 'maturity' though it might well be in the interest of world welfare if they were to compete on equal terms with foreign industries.

There are strong demands, particularly from American economists if not from American businessmen, for the tearing down of these barriers and the freeing of world trade so that the advantages of international specialization can be enjoyed to the full but, at the same time, there are opposing forces which tend to restrict trade. Not the least of these is the need for the greatest possible self-sufficiency in time of war. Another factor, no less potent in the older industrialized countries of Europe, is the fear that whole areas which have specialized in some such basic industry as textiles or shipbuilding will be threatened with a loss of livelihood if open foreign competition is allowed. Thirdly, there is the fear that without 'protection' – or impediments to trade – unemployment may spread more easily from one country to another in times of economic depression.

It is difficult – indeed, impossible in general terms – to decide between these various arguments. In a peaceful world in which no change took place, the arguments for free trade would be unanswerable. In a changing world, however, there may be good reasons for temporary measures of protection though it can be argued that, unless such protection

ultimately results in a genuine lowering of costs or is accompanied by political action, it is doomed to fail in its object. If, for example, the Japanese can turn out textiles equal in quality to those produced in Lancashire but cheaper in cost, in the long run Britain could only keep its foreign, dominion and colonial markets for British textiles by force. It could, of course, keep the home market indefinitely by placing a prohibitive tariff on Japanese goods, but it is open to doubt whether this would be in the real interests of the British people themselves. It would, it is true, keep some people at work in their old occupations in Lancashire – which might be sensible if there were no other work for them to do – but they would be kept at work at the expense of the rest of the community, which would pay more for the clothes it wore. If competition were freely allowed, the British would at least have an opportunity to specialize in something else in which they still had a cost advantage. If there were nothing else in which they could specialize in this way, then the British standard of living would be threatened, protective tariffs or no protective tariffs.

ECONOMIC FLUCTUATIONS

The major reason for the growth of tariff barriers and other obstacles to trade has been the desire to protect home industry or agriculture against foreign competition either when industry was 'young' or whenever there was a depression or recession of trade. If much of the world's protective legislation has been passed in the interests of special groups of farmers or manufacturers whose profits have been at stake, governments have also been concerned with protecting the community at large against the evils of widespread unemployment.

There is little disagreement nowadays with the view that large-scale unemployment is due to a deficiency of 'effective' demand. It is generally agreed that the world is not so rich that it can afford to suffer millions of its inhabitants to be idle and unproductive; there is a need for everything which can be produced. If, therefore, large-scale unemployment develops it can only be because the world's demands for what the unemployed could produce is not made effective by the provision of funds with which that produce could be bought.

True though this may be, it is still not easy to prevent economic fluctuations. Economists have never been able to agree about the 'causes' of the trade cycle – that cycle of boom and slump which seemed to recur at intervals of from eight to eleven years for a period of two or more centuries* – and that is probably because the causes were neither simple nor always identical. Nature herself is capricious in the rewards

*Pharaoh's dream of the seven fat kine and the seven lean kine, and Joseph's interpretation of it (*Genesis*, c. 41), suggests that a natural 'cycle' was not unrecognized in Old Testament times.

which she offers for men's labours. The harvest is sometimes good and sometimes bad, and it would often seem to be in the interests of particular groups of farmers to organize scarcity rather than abundance because the demand for their product is what the economists call 'inelastic'. A small amount of wheat, in relation to the world's demand for it, will always sell for a high price or – what is the same thing – exchange for much of what the farmer needs. But the price which wheat in abundance will command may be low and the farmer's income on a large harvest smaller than his income on a small one, and all this even where men and women are starving for want of bread. In manufacturing industry the problem is even more complex. Not only is there a demand for shoes, which may fluctuate; there is a demand for the machines which make shoes which will fluctuate more. Supposing, for example, that 1,000 machines make one million pairs of shoes each year, and each machine lasts ten years so that 100 new machines are required each year to maintain this output. Then suppose that, for some reason, the demand for shoes increases by as little as ten per cent. To produce 1,100,000 pairs of shoes, the industry will need another 100 machines in the first year: the demand for shoemaking machinery has doubled in twelve months. But next year it is halved again even though the demand for 1,100,000 pairs of shoes continues. Here is the essence of a 'self-generating' cycle which has important repercussions upon employment in the machine-making industry, for at the end of ten years the new machines will be worn out and need replacing again. Such fluctuations in demand do not stop at the industry directly affected, for those who make machines also buy shoes themselves, and bread, and houses, and all kinds of other goods. Fluctuations in the demand for their services influence the demand for other services – the demand for things by which other people get their livelihood.

This is a very simplified example of what may happen in industry. The reasons why it may happen are many. The exploitation of technological discovery – the cathode-ray tube and its use in television, for example – may lead to new demands for a particular product, demands which will not continue at the same level. A war may destroy ships or houses which are rapidly re-built, but houses and ships last for anything over twenty years. Once the ravages of war are made good, the demand will fall, for a time at least, unless there are other ways by which demand is maintained. A change in population will certainly affect demand and population does not necessarily change at a steady rate.

Some degree of economic fluctuation is inevitable in a changing world and, in so far as it is inevitable, it will have effects upon employment and hence upon the standard of living of the world's peoples. In an increasingly industrialized society, in which the specialist in Dundee may well be at the mercy of a strike in India, a crop failure in

the West Indies, a new invention in the United States, or a rumour of war in Europe, such fluctuation will have widespread repercussions, though it must not thereby be supposed that modern man is leading a life riskier than that of the medieval peasant dependent for his livelihood upon the direct bounty of nature. In the modern world all but a very few nations are much influenced by what happens in others. Slump and unemployment can spread with catastrophic swiftness. A depression in the United States, for example, would overnight reduce the demand for Staffordshire pottery, Malayan tin, Australian wool, South African gold, Brazilian coffee, and a whole host of other goods and services which cross international frontiers. The reduction in incomes of those directly affected would also reduce the incomes of those who produced purely for home markets. The garage-hand in Sydney might well find himself out of a job because the housewife in New York decided to make do with cracked china cups.

It follows that it is in the interests of world welfare that the nations of the world should work together to reduce economic fluctuations to a minimum. To guarantee reasonably stable markets to the world's producers of primary products – food and raw materials – is one aim. To maintain policies at home which will ensure a continuously high level of employment is another.

To become less dependent upon world trade or internally more self-sufficient is a third aim, one which commends itself only to those who see little prospect of international collaboration and are therefore prepared to sacrifice the benefits of international specialization for stability even though this means attaining something less than the highest possible standard of living.

EXCHANGE RATES

The degree to which a country can protect itself against economic fluctuations in the world at large naturally depends upon the degree to which it is dependent on world trade. (And, as was indicated in the section on capital, a country which borrows from abroad must repay the loan by trading.)

Robinson Crusoe's standard of living depended only on his natural ability and skill and the natural resources and capital at his command. Any country can become a closed unit – can aim at being self-sufficient – if it is not concerned with the sacrifices which it makes in living standards. All governments, however, will be concerned with living standards because, in the lowest political terms, living standards are intimately connected with power, and all governments are concerned to be powerful.

The ways in which a country may set out to protect itself and its peoples against want are manifold. At the highest, it will co-operate

with others on equal terms, trying to solve problems by intelligence, goodwill and understanding. At the lowest, it will wage war, maintaining its own standards at the expense of those of the weak. Between these two extremes are many policies, partially effective, about the efficacy of which reasonable men may differ. As we have seen, in certain circumstances there may be good reasons for the imposition of tariff barriers. Import duties may provide revenue for the government which is easily collected, and a government may use them to discourage the consumption of certain goods – tobacco and drink may be examples – which it considers harmful or unnecessary. They may enable a country to develop an industry in which costs fall rapidly as the scale of production increases. They may protect agriculture or industry which is vital in time of war and which, for that reason, cannot be allowed to decline. They may exclude goods similar to goods produced at home and thus be intended to maintain home employment.

The last is perhaps the most dubious of the reasons for imposing import duties. In order to sell, a country must buy. The country from which these excluded goods are imported will, in all probability, have to reduce its own imports.

It sometimes happens, however, that a country imports more than it pays for by its exports and consequently becomes indebted to other nations. This is a state of affairs which cannot be allowed to continue indefinitely – assuming that other nations are not prepared to give away their goods free – and remedial steps must be taken. One such step is to reduce the prices of the country's exports so that other countries may be persuaded to buy more from it, though this supposes that other countries will be prepared to buy more at lower prices. This cannot readily be assumed in times of economic depression and so it is impossible to discuss the merits and demerits of the various means of exchange control in general terms. It may be said, however, that a country which continues to import more than it exports for any considerable time will be forced, sooner or later, to make its currency, and therefore its goods, cheaper if it is not to resort to war. The only alternative is more tariff barriers which will reduce the volume of trade.

Towards the end of the Second World War many of the nations of the world agreed in principle upon a method of determining the rates of exchange between currencies which it was thought would best facilitate the expansion and balanced growth of international trade. The members of the 'International Monetary Fund' were to fix the value of their currency in terms of gold and only to change that value thereafter to correct any 'fundamental disequilibrium' in the balance of payments, any change in the value of the currency to be made only after consultations had taken place with the fund. If the proposed new value differed by more than ten per cent from the original value

fixed, the change was to be made only with the fund's agreement. The fund itself was to provide a mechanism by which nations would be made aware of tendencies to disequilibrium so that early consultation among its members would set matters aright. These proposals were an experiment by which it was hoped to secure reasonable stability in exchange rates and at the same time avoid the difficulties which arose in practice when most countries were on the gold standard.

THE TERMS OF TRADE

The terms of trade indicate changes in the rate at which the goods from any country exchange for the goods of other countries. In the nineteen-thirties, the terms of trade moved in favour of the United Kingdom since the world demand for manufactured goods remained high in proportion to the world demand for agricultural products. In consequence Britain obtained more in return for her exports than she did in the late nineteen-twenties. Following upon the devastation produced by war and the growth of the world's population, this position was reversed in the years immediately after 1945. The world's capacity for producing manufactured goods had increased tremendously under the stimulus of war, but food production was not keeping pace with the number of mouths to feed. In these years, the terms of trade moved against the United Kingdom.

Changes in the terms of trade will obviously affect the economic welfare of particular countries, and the terms of trade are another factor which the economist must take into account when considering the relative prosperity of nations.

INTERNATIONAL MIGRATION

In the century which followed the Napoleonic wars, some forty million Europeans emigrated and settled permanently overseas, particularly in the United States, the British Dominions, and the countries of South America. This movement of peoples – the greatest migration in history – certainly benefited the countries to which they went and probably did no harm to the countries of their origin.

Except for those groups of workers in receiving countries who are concerned to keep their own type of labour scarce, a migration of people from over-populated countries to under-populated countries is in the economic interests of everyone, though it may be doubted whether the possibility of such migrations on any large scale will be among the major economic factors affecting welfare in the modern world, at least so far as the crossing of international boundaries is concerned. The difficulties arise, first of all, in defining over- and under-population, and once these have been defined, from such political factors as opposition from powerful sectional interests in the under-populated countries, and

the requirement of large populations in the over-populated countries for the waging of war.

The political difficulties are the greatest to overcome. Whether under-populated or over-populated, the governments of South Africa, Australia, New Zealand, Canada and the United States are not willing to receive peoples of Asian origin. It is unlikely, therefore, that international migration – war apart – will contribute all that it might do to the raising of living standards. Even so, its contribution should not be overlooked. South and Eastern Europe is almost certainly over-populated, and it is possible that parts of Western Europe may be. Latin America and the British Dominions are almost certainly under-populated and the United States probably is too, at least in relation to Western Europe. Between these areas alone, if governments will co-operate (as some of them are doing on a small scale), there are possibilities of an exchange of populations which would prove beneficial to all concerned.

Migration, however, cannot solve the problems raised by the world's increasing population. The reductions of population brought about by emigration are not normally permanent, since the gaps are quickly filled by new expansion.

WASTE

This chapter – long as it has become – would not be complete without some reference to the high proportion of the world's goods which are wasted or lost, mainly through pests and animal and plant diseases. In some degree this section is analogous to that in Chapter 2 which dealt with geographic factors and health. Economic factors – particularly the overcrowding of urban centres – have their effect on health, and geographic factors cannot be dissociated from waste through pests and disease. But large-scale production for a national or world market produces those conditions in which crop diseases can flourish best, and the means of combating them require laboratories, chemical industries and other capital equipment. For the world as a whole it is estimated that the loss of crops resulting from pests and disease, excluding pests like rats and mice, is 'at least equal to the annual loss of all the crops of the United States', while for Britain alone it is 'as if at least thirty-three thousand farms in Britain produced no crop'.* The reduction of such waste, by research and the dissemination of existing knowledge, must come high on the list of problems to be tackled if standards of living are to be raised. In this field the Food and Agriculture Organization of the United Nations is doing valuable work.

Waste of another kind is to be found in the large proportion of their incomes – twelve per cent of the national income is by no means un-

*See George Ordish, *Untaken Harvest* (Constable) p. 151.

common among the larger powers – which nations spend on armaments. Any prospect of peace which enabled these proportions to be reduced would considerably enhance the possibilities of bringing about a steady rise in living standards. The waste and devastation produced by war itself, of course, is even greater. Human suffering and misery cannot be expressed in terms of money but, in the purely financial sense, the Second World War cost Britain alone no less than £27,000 million at the prices then current. It is probable that the whole of the world's income for a year would give some measure of the cost of this war to all nations taken together.

CONCLUSION

We are now in a position to assess the importance of some of the economic and geographic factors which affect the world's wealth – the subject-matter of economic geography. The geographic controls – climate, topography, soil, and the availability of minerals – are basic and, originally, people settled most densely where nature was most lavish with her gifts. If they did not, it was because there were geographic barriers to their migrations.

But the relations between man and nature are never simple; nor are they static. Man can destroy natural resources: he has done so in the past, and he is doing so in the present; and so there are population movements and changes as that destruction, and perhaps new discovery, takes place.

Population movements – movements to the virgin lands of the Americas after the fifteenth century, for example, or movements to the site of the latest mineral discovery – are easy to understand, for men as a whole are always seeking what they hope will prove to be an easier living, and they are held back only by fear of the unknown or, once government is organized, by force.

Population growth or decline, on the other hand, is more mysterious. In the last resort, nature may dictate the upper limit, but that limit is not fixed, since men themselves are not without influence. As they can destroy, so can they build. What is so far unexplained is that, in the process of building, in the process of accumulating capital, their numbers rapidly increase – at least until there is a high degree of general education. Perhaps, since discoveries go hand in hand, and a lowering of the death-rate was just as much a result of the ferment of the eighteenth century as the invention of the steam-engine, it is not so mysterious after all; and when most are educated they realize more clearly where their own self-interest lies and limit births, as the educated have done throughout the ages.

Whatever the facts of the matter, world population is currently increasing at a very rapid rate, and there are fears that the ultimate geo-

graphic controls may apply. But as population increases, so does man's control over nature, even though he may not use it to his benefit. We have discussed the uses to which capital may be put, the difficulties in the way of its formation, and the importance of education and organization. We have indicated the wastes that there may be: war, and the preparation for war; pests and disease; and the dangers of economic fluctuation.

It is often said that this is one world, and with war and economic fluctuation the dictum is now true. No more than one-eighth of the world's goods by value, and far less than one-eighth by volume, cross international frontiers into world trade, and it might seem that fluctuations in such trade should be of relatively small importance when we take into account the whole world's capacity to earn and live. But trade is often a tail which wags the dog, and a diminution in trade, by such 'multiplier' effects as we have tried to indicate above, may well diminish home incomes by much more than the absolute fall in the volume of trade itself.

It is here that the importance of the United States in world economy cannot be overlooked. In terms of world wealth, the United States, with about 40 per cent of the world's income in the hands of a mere 162 million people, is a colossus whose very hiccups can mean storm and earthquake in other regions. Out of a world income of $680,000 million, $80,000 million-worth of goods (some of them counted twice over) may not seem much to enter into international trade. It may seem less still considering that out of this $80,000 million-worth of goods the rest of the world may not pay for one-quarter of the $23,000 million-worth or so which originates in the dollar countries. Yet it is here, in the fluctuations in American demand, in the changing policies of American government, that slump or boom can originate. A drop in American foreign spending, lending or giving of a mere $5,000 million (a tiny fraction of United States income) may be magnified ten-fold in the incomes of other nations, and those other nations are less well able to suffer privations of any kind than are the peoples of North America.

The geographic and economic factors affecting world income are a complex of forces which interact one upon another in a way which defies simple description, but the close connection which exists between them has been touched on by Mr. Mohamad Ali, finance minister of Pakistan, in an address which he gave as chairman of the International Monetary Fund in September, 1953.

At that time, said Mr. Mohamad Ali, partly as a result of aid given by the Americans under the Marshall Programme, Western Europe had recovered substantially from the effects of the Second World War. The same could not be said for the 'under-developed' countries where two-

thirds of the world's population existed on an average annual income of less than 100 dollars (about £35 a year). In 1952–3 the economic condition of many of these countries had deteriorated because of a fall in the world demand for raw materials (in part a result of the progress made at that time with peace-talks in Korea). In consequence there had been a sharp reduction in the export incomes of these countries and the terms of trade had swung against them.

'The questions raised by this situation', Mr. Ali went on, 'call for earnest reflection on the part of all of us. We must give anxious thought to the evolving of practical policies which will enable the weaker countries to acquire economic stability and strength. The stabilization of primary product prices at reasonable levels so as to ensure an adequate return to the producer is of particular importance. . . . By assisting the underdeveloped areas, the advanced countries would be placing their own prosperity on a more lasting basis, for in those areas are great potential markets for the industrial surpluses of Europe and North America, as well as vast reserves of materials. I believe that in developing these great human and natural resources we shall find the key to most of the world's economic difficulties. But it will require a great deal of effort, technical skill and capital'.

The capital, he thought, would have to come from governments as well as from private individuals. 'There is an urgent need in the underdeveloped countries for pressing forward with schemes of basic development, improvements in methods and technique of agriculture and a reasonable degree of industrial production. At the same time the task of social reconstruction must be taken in hand by the extension of popular education and public health measures. Projects of this kind will raise productive efficiency and living standards. The underdeveloped countries must in the main rely on their own efforts, follow sound internal policies and provide as much capital as possible from their own resources. These resources are, however, limited and in some cases the rate of saving and capital formation is not even enough to match the growth of population. If progress is to be as rapid as is desired, external assistance will be necessary and in a far bigger volume than has generally been envisaged so far'.

Most politicians use such question-begging words as 'reasonable', as Mr. Ali did in his reference to primary product prices, and it is no reflection upon him that he should do so in a speech of this kind.

In general, however, whatever its limitations, few informed people would disagree with his analysis of the world economic situation, except perhaps to express the fear that in the under-developed countries population may grow as fast as the supply of goods and services – particularly the supply of food – unless social practices in these countries

change. In the nineteenth century the fast-increasing population of Europe was fed from the undeveloped lands of America. In the twentieth century, it cannot be taken for granted that some such *deus ex machina* will appear even though we may still look to a maturer United States for guidance and help in the world's need.

PART II – FOOD, DRINK AND TOBACCO

Chapter 4
Food: A Summary

Food is the first requirement of human beings, as it is of all life, and a complete list of all the many foods which enter into human diet would fill a book. Nevertheless, the basic foodstuffs are relatively few in number and, for our purposes, can be adequately covered in the six chapters which follow. They fall, nutritionally, into three broad groups – the energy-providers, the protein-providers and the vitamin-providers – though it should not be thought that the boundaries between these groups are at all clearly defined. The energy-providers, for example, include oil-seeds and cereals though these foods are also important sources of what nutrition experts call 'second-class protein'; indeed, for many of those living in the world cereals and oil-seeds are practically the sole source of protein. Milk, meat and allied foods – the protein-providers – are also sources of vitamins which are vital to health, and the third group, fruit and vegetables, is really the source of Vitamin C rather than the source of vitamins in general, though some fruits and vegetables contribute significant quantities of energy as well and are therefore included in group one.

The main energy-providers are cereals, potatoes, sugar, bananas, olives, coconuts, soya beans, groundnuts, sunflower seeds and the products of the oil-palm, and it follows that these foods can, to some extent, be substituted for one another. Wheat, rye, beet sugar, potatoes and sunflower seeds are mainly grown in the cool or temperate regions; wheat and olives are the product of Mediterranean lands; rice, soya beans and groundnuts feed the peoples of the monsoon regions; cane sugar, bananas, coconuts, groundnuts, beans and the millets provide the basic diet in different parts of the tropics.

Wheat is the aristocrat of the cereals and yields the biggest and most valuable crop – about 175 million tons a year. Among the grain crops which are used directly for human food, rice comes next – with an annual production of 95 million tons of milled rice or its equivalent –

and rye third, though little more than 40 million tons of rye is harvested each year and this mainly in Central and Northern Europe. To these we can add rather more than 40 million tons of sugar, two-thirds of it produced from cane and grown within the tropics, 11 million tons or so of oil-seeds measured as 'oil-equivalent' (possibly five times as much by weight in the form of fruit) and used as food, 180 million tons of potatoes, and perhaps 4 million tons or more of bananas. All told – and after every allowance has been made for unreported production – it is unlikely that the world produces more than 85–90 per cent of what would be required of these foods if a minimum standard of health were to be maintained, even assuming that production were evenly distributed, which is far from being the case.

Energy-providers, however, are not enough. The protein-providers are just as essential to health but are in even shorter supply. Meat is mainly the product of the continental and savannah grasslands, though it is also produced on the cool west coasts, particularly in Europe. Milk and cheese are largely produced in the cool regions, and eggs and fish – though found in some quantity throughout the world – are also primarily a product of the temperate zones. The 40 million tons of meat and 30 million tons of fish which enter into human diet each year are probably no more than 70 per cent of what would be required to maintain good health throughout the world, and existing supplies enter little into tropical, monsoon and Mediterranean diets. If milk were to be produced in sufficient quantity, probably four times the existing annual output of 30,000 million gallons or so would be necessary, and egg production – about 7,000 million dozen a year at present – would need to increase five-fold. It is doubtful whether any part of the world outside the United States, Australia, Canada, and New Zealand – unless it be certain favoured areas of Western Europe – has a sufficiency of these foods.

Supplies of fruit are less scarce in relation to needs than those of milk and eggs, and some fruits grow satisfactorily in every climate. The apple and other deciduous fruits of the temperate regions, the orange and other citrus fruits of the Mediterranean regions, and the banana of the tropics are, perhaps, produced in half the quantities required, but of existing supplies there is a big drain away from the poorer to the richer parts of the world.

Only a small proportion of all these foods, particularly of the basic foodstuffs, enters into international trade. If we examine the flow of this trade we find that much of it is from the under-populated temperate lands to the rich and more heavily-populated temperate lands – in other words, from the rich producers of wheat, meat and dairy products to the rich producers of manufactured goods. The rest is mainly a flow from the poor lands of the tropics to the rich countries in the temperate zone again.

Thus fourteen per cent of the world's wheat and three per cent of the other temperate grains enter into world trade and go mainly from the United States, Canada and Australia to the United Kingdom and other countries of Western Europe. Trade in mutton is almost wholly from New Zealand, Australia and Argentina to the United Kingdom; beef from Argentina, Uruguay, Australia and New Zealand to Western Europe (mainly to the United Kingdom); and pork from Denmark to the United Kingdom as bacon and hams and to Western Germany as fresh meat. All told, no more than three per cent of the world's meat crosses national boundaries. Trade in butter and cheese is largely between European countries or a flow from New Zealand and Australia to the United Kingdom. Fish is mainly exported from one group of European countries to another, though this trade brings some much-needed protein to the Mediterranean.

In return the 'Mediterranean' regions, including California and South Africa, supply oranges and a little olive oil to Western Europe, Canada and the United States, while apples are exported from Italy, the Netherlands, Canada, Australia and Argentina, mainly to Western Germany and the United Kingdom.

From the tropics to the temperate zones come large quantities – in most cases a major part of the crop – of sugar, bananas, beverages and vegetable oils. Thus Cuba, Puerto Rica, Hawaii and the Philippines supply sugar to the United States, the United Kingdom, Japan, Germany and Canada; over eighty per cent of the world's coffee flows from Brazil, Colombia and smaller producers, mainly to the United States and, in lesser degree, to France, Italy and Germany; sixty per cent or more of the world's tea is sent from India, Ceylon and other eastern countries to the United Kingdom and, in smaller amounts to the United States, and British Commonwealth countries in the temperate zones; the great bulk of the world's cocoa comes from West Africa to the United States and Western Europe. The United States and Western Europe, too, absorb a large part of the Central and South American banana crop as well as that from other areas. Groundnuts and oil-palm products are chiefly a West African export to Western Europe, though Indonesia and Malaya also provide exports of palm oil. From the Philippine Islands copra goes to the United States, from Indonesia it is sent to the Netherlands, and from Malaya to the United Kingdom and Germany. The only other trade in vegetable oils of any note is a flow of soya bean oil from the United States to Western Europe and Japan and from Manchuria to China and the U.S.S.R., and a flow of sunflower seed oil from Argentina to the United Kingdom.

Trade in tobacco is very much an export from sub-tropical United States to Western Europe, though currency difficulties between these regions since the war have caused the European countries to seek some

supplies elsewhere. Between the monsoon lands there is a trade in rice which has diminished with the growth of population, and an export of coconut oil from Ceylon to India and Pakistan.

From the temperate to the tropical lands there is no return flow of food which compares with the movement in the other direction. Argentina exports wheat to Brazil, and since the war wheat has been exported from the United States to Japan and India and from Australia to India to make up some part of the deficiency in rice. Canned fruit and canned fish goes from the United States to the Philippines, and canned fish from Europe to Malaya and Indonesia. Venezuela, one of the richest tropical countries, is the third largest importer of canned meat, and Australia maintains a trade in canned meat with the Pacific islands and Malaya. Tinned milk exports from the United States to the tropics and the Far East have increased in recent years, but much of it has been sent under various relief programmes. Nevertheless, these tendencies for a trade in grain crops and canned goods to develop between the temperate lands and the tropics are worth noting for it is in the temperate lands that food production can most easily increase and the tropics will always be deficient in body-building foods.

Since the war the supplies of basic foodstuffs have barely kept pace with – indeed, in parts of the world, have failed to keep pace with – the growth of population, and some authorities would have us believe that the effort to produce enough food is doomed to fail. However, this may not be the case, since crop yields are seldom as high as they could be if the best strains of seed were used, and there is undoubtedly much that men can do to increase food supplies.

The growth of population apart, most of the changes in the world food situation in the past twenty years have arisen out of the Second World War. As a result of that war, the Far East, and particularly Indonesia, became poorer and food production was, for many years, below pre-war levels. Europe became poorer, too, and the United States richer, with a consequent disequilibrium of trade between the two areas and their satellites which has had its effect on North American exports of tobacco, South and Central American exports of sugar and coffee, and Philippine exports of copra. To counteract this loss of foodstuffs which they cannot buy, the countries of Western Europe have tended to increase their own production of sugar-beet, and are endeavouring to stimulate the output of tobacco and vegetable oils in their overseas territories.

If the more detailed chapters on foodstuffs which follow are read with these points in mind, the picture should become clearer and more unified. They are followed in their turn by a section on raw materials, but it must not be supposed that the boundary, even here, is clear cut. Supplies of wool and hides are intimately bound up with meat pro-

duction. Some animal fats and vegetable oils become soap and lubricants or are used in the paint industry. Cotton seed is a by-product of cotton fibre; flax may be grown for either fibre or oil or for both; oil can be expressed from hemp seed though hemp is primarily sown as a fibre crop; and the last two of these at any rate are raw materials rather than food. Finally, synthetic wools are now produced from both milk and groundnuts though, as yet, in no more than very small quantities.

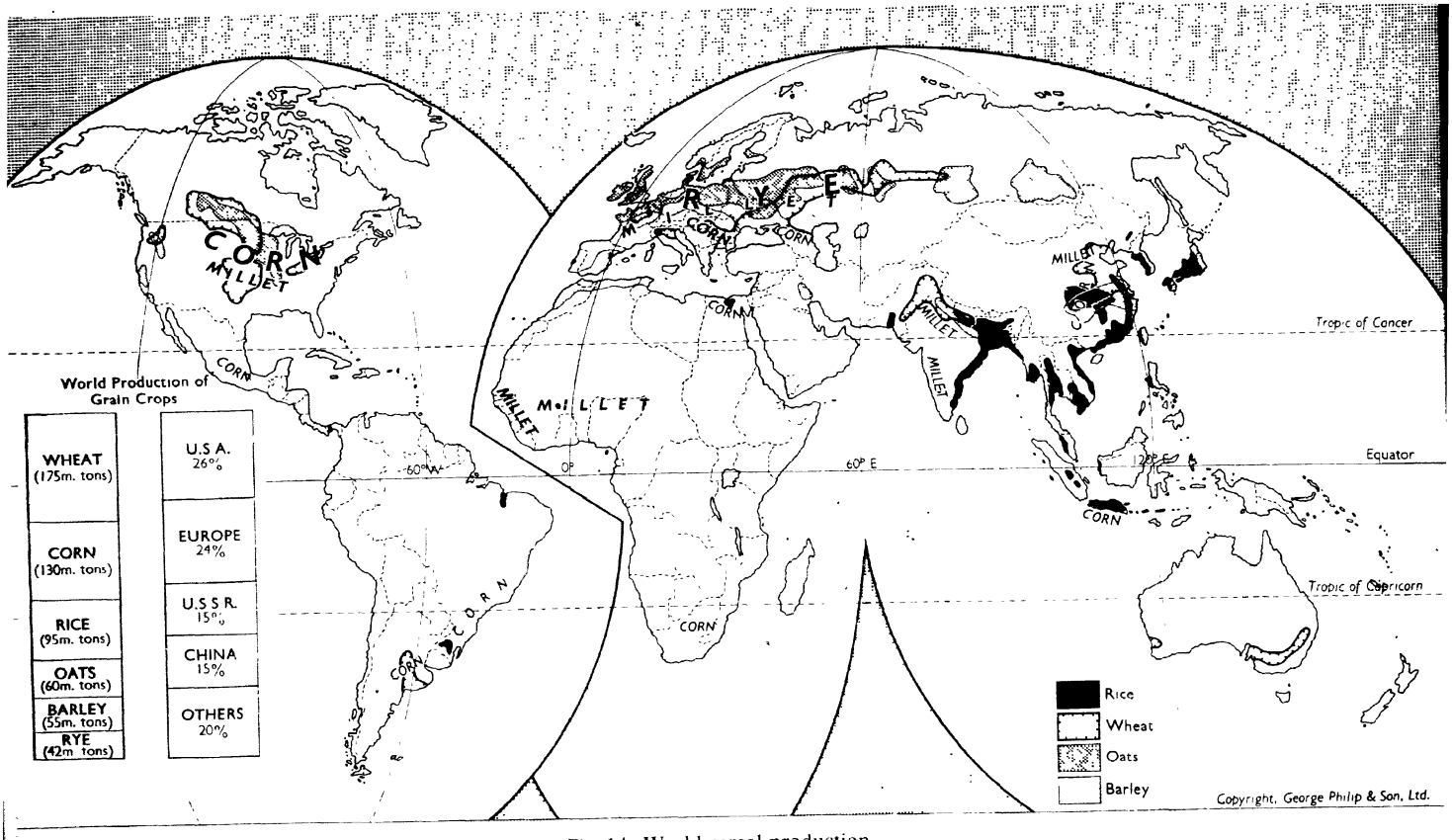


Fig. 14. World cereal production

Chapter 5

Cereals, Potatoes and Other Vegetables

INTRODUCTION

The term cereal is used to describe a number of species of grass: the wheat, barley, oats and rye of the temperate zones, and the rice, corn (maize) and millets of the warmer climates. Together they form by far the most important source of food – the rice, wheat and rye being used, in the main, for direct human consumption, and the barley, oats and corn being fed to farm stock, to enter into human diet as meat. In addition, smaller quantities of grain crops are used for starch, and in the manufacture of beer, whisky, gin and other alcoholic drinks.

Before the war, just under one-quarter of the world's grain was produced in Europe, and rather less than one-quarter was produced in the United States, but since the war United States production has exceeded that of Europe. Of the world total, the U.S.S.R. and China each produce about 15 per cent, India 8 per cent, Canada and Argentina perhaps 3–4 per cent each, Japan 2 per cent, and Australia 1 per cent.

For the world as a whole, production had again reached pre-war levels by 1948, and, outside the U.S.S.R., substantially more wheat, corn and barley is now harvested than was harvested in pre-war days. The United States, however, is primarily responsible for the increased yields of wheat and corn, and rye, oats and potato crops are no higher than they were twenty years ago. In the world at large, grain production has failed to keep pace with the growth in population.

If we examine the figures region by region, we find that European grain consumption is lower despite an increased population and Western Germany has had to replace East German supplies of rye by imports of wheat from abroad. In South America, the Brazilian population has increased with particular rapidity, but there the output of wheat and rice has more than kept pace and, indeed, the rice crop – more than twice what it was in pre-war years – now allows of considerable exports. But in India and Pakistan, where the population has

increased by twenty per cent in fifteen years, the demand for food grains has outpaced supply even though imported wheat has met some part of the need and recent rice crops have been good. In Japan, too, increased imports have been necessary despite a decline in consumption per head and, to some extent, both wheat and barley have had to take the place of rice.

The sections which follow deal with the production of each grain, crop by crop, the last part of the chapter being devoted to a brief survey of potatoes and other vegetables.

WHEAT AND WHEAT-FLOUR

Wheat is the most important of the grain crops and has for centuries been the most important bread-grain in the temperate regions. Consumption per head in the richest of these lands, however, was declining slightly between the two world wars, as diet became more varied. On the other hand, consumption was increasing in tropical countries as living standards rose and this tendency has been reinforced since 1945, not by a rise in living standards but, for at least eight years after the war, by a world shortage of rice.

The development of new varieties resistant to disease and extremes of temperature, and capable of growing where the growing season is short or rainfall slight is still proceeding but wheat is already produced in a great variety of climates. In England it is normally sown in autumn, but in Canada, where the growing season may not exceed three months and winter frosts would damage the seed, it is sown in spring, while in the monsoon lands of Pakistan it is grown as a winter crop, being sown after the rains and harvested before the hot season. It grows best where there is between 15 and 35 inches of rain a year and the temperature of the three months in which the grain ripens exceeds 60 F. on the average, but some varieties will grow in hot climates with an annual rainfall as low as 10 inches.

The quality of the grain varies with the climate, the hot, dry summers typical of the continental grasslands producing hard wheat which yields a 'strong' flour rich in protein, particularly suitable for good-quality bread. A still harder or flintier grain grown in the drier parts of the Mediterranean and parts of the U.S.S.R. is eminently suitable for macaroni and spaghetti. In lands with moister summers the wheat is soft and produces a 'weak' flour which is used for biscuits or cakes, or mixed with imported 'hard' grain for bread making.

More than 420 million acres of the world's lands are devoted to wheat growing and world production amounts to some 175 million tons a year. There is a marked difference, however, between the yields in countries with the intensive cultivation typical of Western Europe, where they are in the main over 1 ton per acre, and those in the large

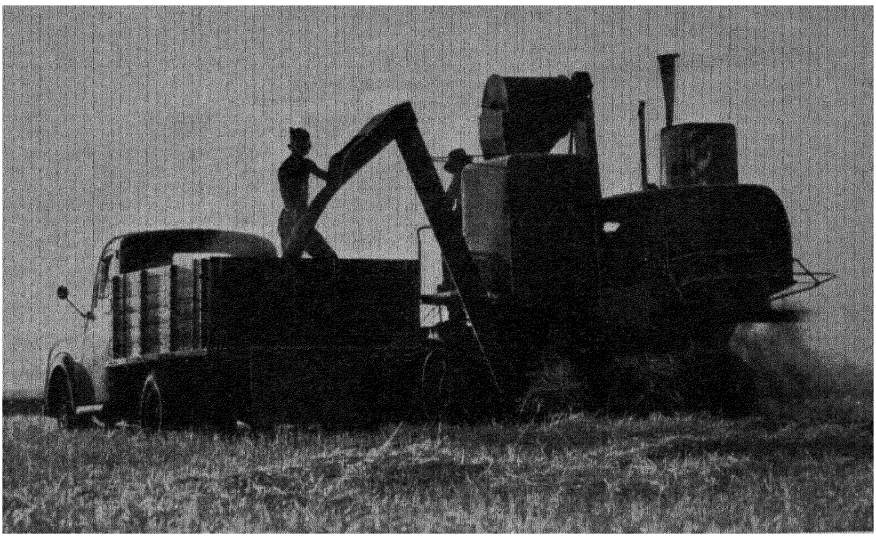


Fig. 15. Unloading grain from a self-propelled combine in Alberta

exporting countries which rely on extensive cultivation, or in countries like India and Pakistan where methods could be much improved. In these latter countries yields rarely exceed 10 cwt. per acre, though it is encouraging to note almost everywhere a tendency for yields to increase. With increased supplies of fertilizers, better farming techniques, greater mechanization and improved strains of wheat they could undoubtedly be raised still further.

The biggest producers of wheat are the United States and the U.S.S.R., each of which produces between 15 and 20 per cent of the world's crop though the harvest varies considerably from year to year. In the United States, for example, wheat production increased from 20 million tons in 1939 to 36 million tons in 1947, but in 1954 was little more than 26 million tons. Russian output before the war was 37 million tons but fell to almost half as much in 1946, increasing rapidly thereafter to 30 million tons in 1950.

British Commonwealth production taken as a whole amounts to as much as that of the United States, but the third largest producing country in normal times is China with an output of about 13 per cent of the world total. Other large producers are Canada (about 8½ per cent of the world total), France, Italy and India (about 4 per cent each), Turkey, Australia, Spain and Pakistan. Argentine production varies considerably but in some years is as high as that of India. After these countries come Western Germany, the United Kingdom (1·3 per cent of the world total), Yugoslavia, Rumania, Persia, and probably Hungary, all of them producing more than 2 million tons a year.

Since the immediate post-war years the amount of wheat (and wheat-

flour) exported has exceeded 20 million tons and, in one year at least, has reached 27 million tons, the principal exporters being the United States, Canada, Australia and Argentina, which between them supply over 90 per cent of the world's imports. Argentina, which, unlike Canada, the United States and Australia, has no large milling industry, exports wheat almost entirely as grain.

After the Second World War the increased shipments of wheat and wheat-flour from the United States went to a wider range of countries than in 1938, much of it under various relief programmes. Europe, and particularly Germany, received the greater part, but a good deal was also sent to India and Japan. The United Kingdom remains the chief market for Canadian wheat, most of the rest going to other European countries, to the United States (largely for feeding purposes), and, since the war, to Japan, India and South Africa. The United Kingdom also continues to absorb much of the Australian export surplus, though there is a tendency for India to replace her as chief importer and Egypt has become a market of considerable importance. Most of the requirements of New Zealand are also met from Australia.

Argentina's largest market is Brazil. Her exports to the United Kingdom have fallen considerably since pre-war days, but India, Italy and Germany are important customers.

In spite of a considerable fall in the volume of her imports since 1938, the United Kingdom remains the largest importer of wheat in the world, imports averaging about 4 million tons a year. Western Germany, which has suffered the loss of East German supplies, Japan, India and Egypt have become large importers since the war, while Italy, Brazil, Belgium and the Netherlands continue to be large importers.

CORN OR MAIZE

As with wheat, there are many different types of Indian corn or maize, some of them suitable for cultivation in most tropical and sub-tropical areas. For maximum growth, corn requires plenty of sunshine, frequent summer rain or irrigation, and relatively high temperatures both night and day. Since it cannot survive frost, the climate must be frost-free for at least six months and, for ripening, the summer night temperatures should not fall below 58°F., though it can be grown in cooler lands as a green-fodder crop and some varieties are excellent for ensilage, that is, for storage in silos or air-tight pits in which they are preserved for fodder. Corn grows best in a well-drained, medium loam soil such as is found in the Mississippi valley.

The two main types entering into trade are dent corn, grown mainly in the United States and South Africa, and flint corn, which is favoured in Europe and Argentina. The former has soft, large, flat grains and crops more heavily. The latter is hard and round, being formed

principally of hard starch, and ripens more quickly. By selective cross-breeding types giving much higher yields are being developed.

Corn is most important as animal food and before the war entered into trade mainly for this purpose. Since the war, however, exports for human food (in the form of cornflour) have been made to Asia, to supplement other grains, and to Africa, where it is a staple article of diet, to supplement home production. In Mexico, Brazil and the Balkans, as well as in the United States where it is eaten as a vegetable (corn on the cob), it is also widely consumed as food while considerable quantities are canned, turned into breakfast cereals, or used in the manufacture of glucose, starch and alcohol.

The world area under corn is estimated at about 20 million acres, the area cultivated having been reduced both in the United States and Argentina since before the war, but increased in Africa, Brazil and other central American countries. World production amounts to about 130 million tons of which the United States produces more than 55 per cent, and in the last fifteen years United States output has increased by nearly 16 per cent despite a reduction by one-eighth of the area cultivated.

Outside the United States, the most important producers are China, Brazil, Rumania, Yugoslavia, the U.S.S.R., Mexico, Italy, Hungary, Indonesia, Argentina, India, the Union of South Africa and Egypt, these countries producing from 5 to 1 per cent of world output each. Yields vary considerably with the weather, and the area planted

Fig. 16. Grain elevators at Fort Williams, Ontario

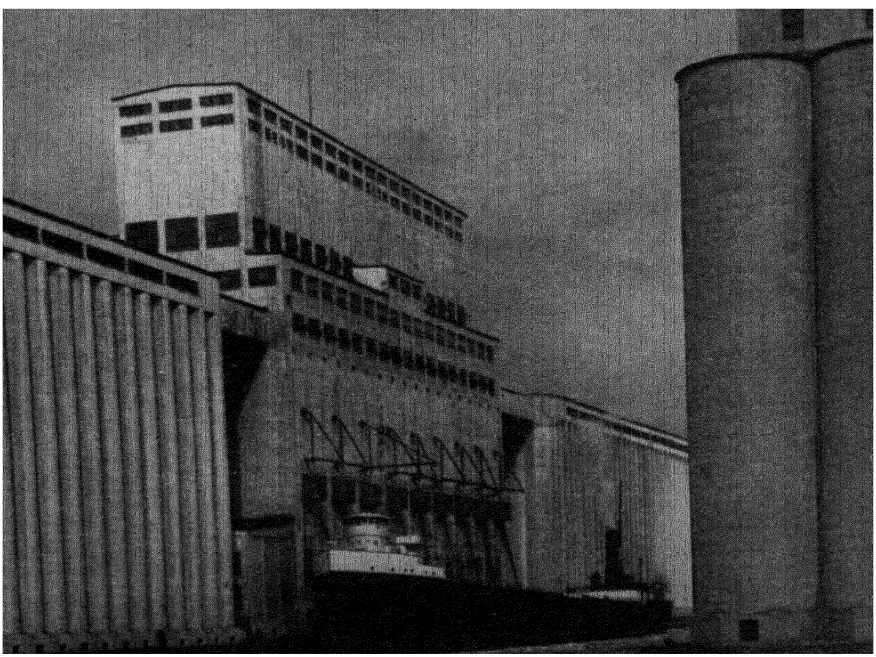


Fig. 17. Some

frequently bears little relation to the crop harvested for the plant may be cut green or grazed off by livestock without being cut. The yield can undoubtedly be improved, as it has been in the United States, by the development of hybrid types and improvements in the technique of cultivation.

Since the war exports of corn, at 4-5 million tons a year, have been running at lower levels than in the immediately pre-war years. The United States has usurped the place of Argentina as the principal exporter and now accounts for two-thirds of the total exports, excluding any from the U.S.S.R. or China, for which countries figures are not available. It would seem, however, that the U.S.S.R. may become an important exporter, her exports to the United Kingdom alone exceeding 250,000 tons in 1951, while China, too, sent considerable quantities of corn to Europe in the early 'fifties. Brazil, South Africa and Yugoslavia remain among the other exporters, but exports from Rumania, Bulgaria and Hungary in Eastern Europe, and Indo China and Indonesia in the Far East have declined considerably since 1938.

The United Kingdom remains the largest individual importer, though her imports of about 1 million tons a year are currently little more than one-third of her pre-war imports. Continental Europe, in the aggregate, still offers the largest market though here too the principal importers – France, Belgium and the Netherlands – have taken considerably less corn than they did before the war. Canada imports large quantities from the United States, mainly for re-export, while in some post-war years Egypt, Japan and India have taken large amounts.

Although United States exports form such a large part of the corn entering into world trade, it should be remembered that no more than

OATS BARLEY RYE MILLET

ergy providers

about 3 per cent of the corn grown there is sent abroad. In recent years some 70 million tons have been used at home for cattle-feed alone.

RICE

Rice is a large annual grass, growing up to about four feet high, which is sown under water. It therefore requires, for its cultivation, either flat fields or terraced hill-slopes which can be flooded, and an abundant supply of water - at least 40 inches of rain a year if it is entirely dependent on rainfall - during the growing season. It is not only the staple food, but almost the only substantial item of diet among the densely populated wetter parts of South-east Asia - in India, Indo China, China, Japan and Indonesia - and is also an important crop in French West Africa and other tropical and sub-tropical areas.

In the husk, it is known as *paddy*. The *husked*, *brown* or *cargo* rice then has the inner skin of the grain removed in the milling process, which may be done either by hand or by machine. It is then known as *milled* rice and is one of the most nutritious cereals there are, though a deficiency of gluten, as compared to wheat, makes it unsuitable for bread. To improve its appearance the grain may be *polished*, but it loses much of its nutriment in this process. If, on the other hand, it is milled from paddy which has been steeped in water, steamed and subsequently dried, it is known as *parboiled* rice, a food which is less attractive to look at but one which is even more nutritious than milled rice.

Besides requiring adequate water, rice needs temperatures exceeding 75°F. to ripen. In some equatorial and monsoon regions it is possible to produce two crops a year, but in cooler areas it is a summer crop and some other cereal may be grown in the winter. In the East,

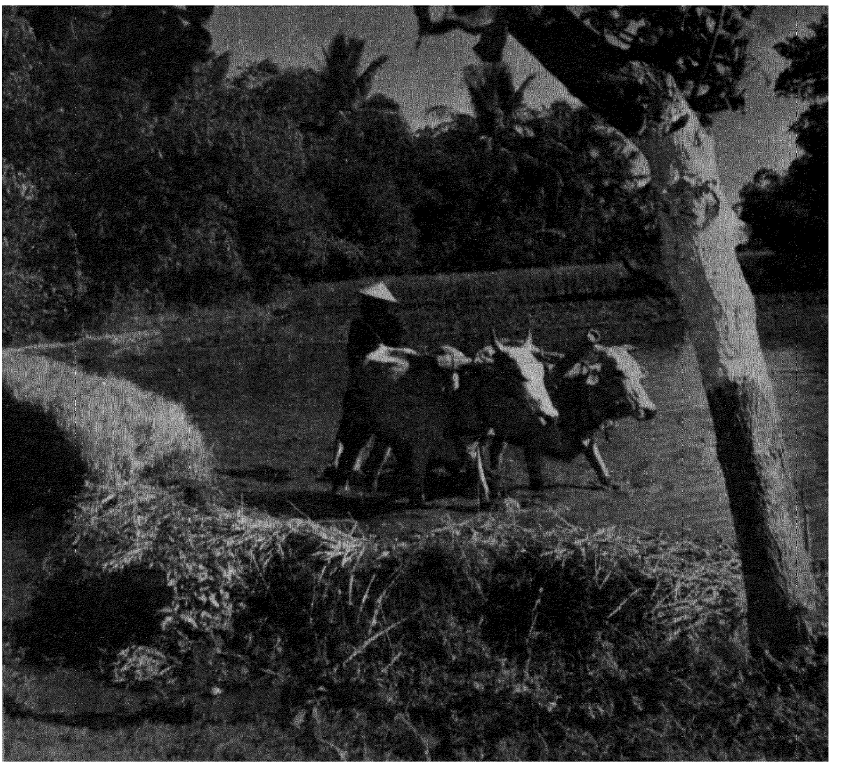


Fig. 18. Ploughing with oxen in a flooded paddy field near Jogjakarta, Indonesia

cultivation is by laborious hand methods, the ploughing being done by buffalo, oxen, or even men and women using a wooden hoe, the seedlings being transplanted by hand when a few inches high, and the crop being harvested by hand.

The grain is grown chiefly for human consumption and, since the war, over 95 per cent of the crop has been consumed in the country of origin, a large part of the remainder being exchanged between Asiatic countries. It is also used in small quantities for the production of flour and starch, and a number of alcoholic drinks are made by the fermentation of the grain – *sake* in Japan, and *arrak* in Java. Very little rice is used for animal-feed.

Over 210 million acres are thought to be devoted to rice cultivation – an increase of 16 per cent over pre-war figures – but the Chinese estimates are of doubtful value, and an apparent increase in India and Pakistan may be the result of better record-keeping. Of the total world crop of some 95 million tons of milled rice (or its equivalent), China produces one-third and India one-fifth – over half the world's crop between them. Japan and Pakistan each produce about 8 per cent

of the world total, and Indonesia, Siam, Burma, Indo China and Korea each produce about half as much as Japan. Outside Asia, Brazil and the United States each produces more than 1 per cent of the world total, and rice is grown in Egypt, Madagascar, the Middle East, Spain, Portugal and West Africa, as well as in all the tropical countries of South and Central America. Like the cereals already dealt with, the yield per acre varies considerably from 25 to 20 cwt. an acre in Italy, Japan and Australia, to 13 cwt. an acre in the United States, and less than 8 cwt. an acre in Siam, India, Pakistan and other eastern countries. In these latter countries the introduction of improved varieties might do much to increase yields.

Before the war world exports of rice were of the order of 8 million tons. Since the war, however, they have not exceeded 5 million tons, partly because of the effects of the war itself on South-east Asia and partly because of the growth in population there. Siam and Burma remain the chief exporters, but exports from Indo China – the third most important exporter in pre-war days – have been less than those from either the United States or Egypt in recent years. Exports from India, Korea and Formosa, which before the war amounted to about 2 million tons a year, have also been very small since the war. This reduction in Asian exports has been partly offset by increased supplies from the United States, Egypt, Italy and Brazil.

Such surplus rice as exists in Asia goes mainly to neighbouring countries, with Japan, India, Malaya, Indonesia and Ceylon as the main importers. In the first eight years after the war Asia also called upon supplies from Egypt and the United States. Outside Asia, Cuba imports the largest quantities, mainly from the United States. In Europe there has been a fairly general reduction in imports since pre-war years.

OATS

Oats are widely grown in temperate regions but, ideally, they require conditions which are both cooler and damper than those for wheat, though the plant is less resistant to cold than either wheat or barley. Adequate rainfall is required, particularly in the early stages of growth, and the temperature should not be too high when the crop begins to mature. The limits of cultivation are fixed by the possibility of early autumn frosts which kill the plant before the grain is ripe, but in countries like Scotland and Newfoundland it grows successfully in places where no other cereal will grow. The seed can be sown either in the autumn or the spring.

At one time the grain was primarily a feed for horses but, with increasing mechanization, particularly in the western hemisphere (a process which has probably reduced the number of horses in the world

by more than ten million) it is now fed to cattle in conjunction with other feedingstuffs. Some of the best quality oats are ground into oatmeal for human consumption or manufactured into rolled oats for porridge and other breakfast foods. Most of the crop, however, is consumed on the farms where it is grown and comparatively little enters into world trade.

The 126 million-odd acres devoted to its cultivation grow some 60 million tons of oats – rather less than pre-war production, largely owing to a fall in Russian output. Before the war the U.S.S.R. was the largest producer but, with nearly 20 per cent of world production, the U.S.S.R. now takes second place to the United States with slightly more than 30 per cent. Canada (12 per cent), Germany and France (about 5 per cent each), the United Kingdom, Poland, Czechoslovakia, Denmark and Sweden (from 4 to 1½ per cent each) are other large producers. American, British, Canadian and Australian production is, in each case, higher than it was before the war, but on the Continent production had still not recovered pre-war levels by 1952 and Argentine production was also well below that achieved before the war.

In Europe yields are generally above 13 cwt. an acre and in Denmark and the Netherlands nearly twice this amount. Elsewhere they vary between 6 and 12 cwt., though over the past twenty years yields have increased almost everywhere, partly through the introduction of improved strains and, in the United States and Canada in particular, through the heavy application of fertilizers.

Only about 1 million tons of oats – less than 2 per cent of world output – enters into international trade though even these amounts are appreciably greater than they were before the war. Canada and Australia, followed by Argentina (before the war the chief exporter), account for most of this, Canadian exports going chiefly to the United States, the rest going mainly to European countries of which the Netherlands, the United Kingdom, Switzerland and Germany are the chief importers.

BARLEY

Barley has a wider range of cultivation than any other cereal and can mature in almost any climate. Since it requires little more than eight weeks between seed time and harvest and ripens even at low temperatures, it is cultivated further north than any other grain and in Norway, at least, well within the Arctic circle. It can also be grown successfully on high ground in the tropics and flourishes in such hot and arid countries as Algeria.

Although it was the bread-grain of the ancient world and has again been used for human food in recent years to supplement supplies of wheat and rice, it is mainly used as an animal-feed or by the malting

industry for beer. The greater part of world production goes for the former purpose, but specialized brewing types, with a low nitrogen content, are grown in certain kinds of soil in the United Kingdom, Germany, Poland, parts of the United States, Chile and the Danubian countries. As fodder it competes with corn, low-grade wheat, rye and beans, and its production as a cash crop depends in part on the prices of these substitutes and the cost of carriage. With a shortage of other feedingstuffs immediately after the war, barley assumed a greater importance in many European countries.

About 55 million tons of barley are produced each year from the 100 or so million acres devoted to its production, of which the U.S.S.R. produces perhaps 15 per cent and China 13 per cent, although the estimates made for both countries are only very approximate. In recent years the United States and Canada have each produced nearly 10 per cent, Canadian production having more than doubled since before the war. Turkey, India, Japan, the United Kingdom, Western Germany, France, Denmark and Spain all produce 3 per cent or more, while Morocco, Poland, Czechoslovakia, Iran and Iraq are not far behind. Again, increasing yields are apparent in the more advanced countries, particularly through the introduction of improved varieties but partly through the heavier use of fertilizers. Yields are highest in Denmark, Western Germany, the United Kingdom and Japan, where they vary from 27 cwt. to 17 cwt. per acre.

Exports of barley amount to between 3 and 4 million tons, half as much again as in pre-war years, largely owing to an expansion of production in North America, particularly in Canada. Trade is not dominated by any one country and there are considerable fluctuations in the amounts exported from individual countries from year to year. Canada, the United States, Iraq, Australia, Argentina, French Morocco and Algeria are all considerable exporters. The United Kingdom remains the principal importer, taking more than 1 million tons a year, mainly from Iraq, Australia and Canada. Japan, which imported little barley before the war, has been the second main importer in recent years, drawing her supplies mainly from the United States. These two countries together take about two-thirds of the world's exports. The rest goes mainly to Belgium, the Netherlands, Western Germany, the United States (almost wholly from Canada), France and Switzerland.

RYE

Rye is the hardiest of all the cereals and is more resistant to cold, pests and diseases than wheat. It will also grow in drier conditions and on poorer, even acid, soils. Used for at least 2,000 years as a bread-grain, it is much less palatable than wheat and, in Western Europe, has declined in popularity as living standards have risen, though it remains

an important foodstuff in Germany, the U.S.S.R., Poland, and the Scandinavian countries. Elsewhere it is grown almost exclusively for cattle-feed, and autumn-sown rye can be grazed over by sheep in the early spring without much impairing the crop. A little is used in the distilling industry, and the long, fine straw can be used for the manufacture of straw goods and for thatching.

Rather more than 100 million acres of land are devoted to the cultivation of rye, nearly three-quarters of it in the U.S.S.R. The total crop is estimated at about 42 million tons – somewhat less than immediately before the war – and over one-half of this is harvested in the U.S.S.R. Poland probably produces a further 15 per cent, and Eastern and Western Germany together very nearly as much again. Czechoslovakia, Hungary, the United States, Spain, France and Turkey are relatively large producers. In South and Eastern Europe – in Yugoslavia, Hungary, Spain and Portugal – there has been a tendency to expanded production since the war, but, the United Kingdom apart (where there has been a fivefold increase since before the war), production has tended to decline in the west and north. United States annual production has declined by more than one-half in the past fifteen years, but Canadian output in the same period has increased considerably. In Argentina weather conditions cause considerable annual fluctuations. Northern Europe, with about 1 ton an acre, has yields more than twice those obtained elsewhere.

Immediately before the war about 1 million tons of rye were exported each year, one-quarter of it from the U.S.S.R. and another quarter from Poland, the bulk of the trade being between European countries. Since the war, exports have probably been much the same but Argentina, the United States and Canada have all played a more prominent part in the trade, sending rye to Europe in part replacement of exports from the U.S.S.R. and Poland, though the latter trade has by no means ceased. Germany, Belgium, Denmark and Norway are normally major importers and Western Germany has become more dependent on imports since it was separated from the Eastern zone. The other three countries have tended to import less since the war, but Finnish imports have increased. In some years the United States imports substantial quantities of rye, mainly from Canada.

OTHER GRAINS

Millet is the name given to a number of related members of the grass family which are cultivated for their small nutritious grain in many of the drier parts of tropical and sub-tropical lands. They enter very little into international trade but, since they are a staple food of many of the inhabitants of the African savannah lands and India, and are also cultivated in Mediterranean Europe, their importance should not be

overlooked. Sorghum is one of the most important millets and its grains are rather larger than those of other varieties. It is grown in the United States as well as in India and Southern Europe.

Buckwheat is not a grass but an annual plant which grows about two feet high and has white flowers and reddish-brown leaves. It is extensively grown in cool climates for chicken-feed or as a fodder crop, while in Canada the seeds are also ground into flour to make buckwheat cakes for human consumption, the cakes being eaten, as a rule, with maple syrup.

POTATOES

The importance of the potato as a food crop is apt to be overlooked although world production, exclusive of the U.S.S.R., is estimated to be no less than 136 million tons, and Russian production may be in excess of 40 million tons. Weight for weight, of course, potatoes are far less nutritious than the grain crops.

Both Poland and Germany are large producers – each harvesting about 32 million tons a year – France grows some 14 million tons, and the United States, the United Kingdom and Czechoslovakia about 8 million tons each. Human consumption is particularly high in Ireland (where potatoes became the staple food in the first half of the nineteenth century), Germany and Poland, but the potato is also fed to livestock and, in Germany and elsewhere, has been used for the production of power alcohol. In the best areas in Britain, main crop potatoes yield up to 12 tons per acre, and comparable yields are found in Belgium and Holland. In Germany, the average yield is $6\frac{1}{2}$ tons, but in Poland, France and the United States it is little more than 4 tons.

There is very little international trade in potatoes because of the high cost of carriage, but early or 'new' potatoes may be imported into Britain from the Canary islands, France and Spain. During the war, the dehydrated potato made an ephemeral appearance.

OTHER VEGETABLES

The term pulse is generally used to indicate certain seeds or crops of the family *Leguminosae* and includes, beans, peas, vetch, lentils, soya beans and groundnuts (peanuts). Soya beans and groundnuts, both of them important foods, are considered among other oil-seeds in Chapter 10.

Other pulses, including chick-peas, constitute an important article of human diet, particularly in warm countries where butchers' meat is scarce, since they supply needs not contained in sufficient quantity in grain and fruits. Elsewhere pulses are used for animal food as well as for human consumption.

Attention in economic geography is usually directed to products

which enter, at least to some extent, into international trade though, as has already been seen, the proportion is often a very small part of total production. It should not be forgotten, however, that there are native foods, particularly in hot countries, which, while of considerable importance in their habitat, are not known in other regions at all except by name. The sweet potato is one of these which is generally known, at least in the United States, and the yam is another. The bread-fruit tree also produces a starchy fruit which is now widely cultivated throughout the tropics. In cooler climates, onions, tomatoes, turnips, mangolds, carrots and parsnips are among the many vegetables which enter into human diet. Onions and tomatoes enter into international trade to some extent – the latter often in canned form – while turnips and mangolds are also important as cattle fodder.

CONCLUSION

The world's production of grain crops, potatoes and pulses may amount to as much as 800 million tons, grown on about 1,400 million acres of land. Of this total, little more than 5 per cent crosses international boundaries and nearly 60 per cent of this trade is in wheat. The rest is consumed or used in the countries in which the crops are grown.

Of the total production, about 42 per cent is used as animal food and only some 58 per cent enters directly into human diet, the most important food crops being wheat, rice and potatoes, with rye, the millets and beans making a significant contribution. In round figures, about one billion (one million million) pounds of these foods are directly consumed each year by a world population of 2,500 million – an average of about 400 lb. a year per head, or a little more than 1 lb. a day. From this source alone if it were evenly distributed, the world would obtain less than two-thirds of the energy which is required to keep its inhabitants completely fit, although for most of mankind these foods are overwhelmingly the most important source of energy.

In Asia and in parts of Central Europe there is little doubt that, in relation to the population, the supply of cereals has fallen since before the war and, in consequence, the average person in these parts of the world gets less energy from these foods than he did in 1938. Nor, in the main, have other foods taken their place. If the world is to become a place fit to live in, one of the first needs is an increase in food production, and particularly in cereal production, and its distribution to the millions who are now hungry. This remains true despite some recent talk of "surpluses" in the main exporting countries. The need remains; it is the ability to pay which is missing.

Chapter 6
Meat and Dairy Produce

GENERAL CONSIDERATIONS

The consumption of meat and dairy produce in any country is one of the most reliable criteria of the standard of living, even though religious beliefs play a part in determining the low levels of consumption in the Hindu and Muslim worlds. The meat-eaters and the milk-drinkers are the rich countries of the world – the United States, the three British dominions of Canada, Australia and New Zealand, the United Kingdom itself and the countries of Western Europe – and trade in meat is largely a movement from the savannah and continental grasslands of South America, Australia and New Zealand to the United Kingdom, with Denmark supplying some part of the requirements of her near neighbours in pig meat.

In the past fifteen years, the numbers of meat-producing livestock in the world have increased considerably: the number of cattle by 12 per cent, the number of pigs by 6 per cent, and the number of sheep by 5 per cent. (The number of horses and mules, on the other hand, has decreased by 17 per cent.) But, despite this growth in numbers, and the consequent increase in meat production, international trade has fallen below the pre-war level, largely because of a rise in home consumption in the chief producing countries.

There have been changes, too, in butter, milk and egg production. Egg production has increased, particularly in the United States, the United Kingdom, Canada and Australia, but the output of butter has fallen as the consumption of liquid milk, processed milk and cheese has gone up. Exports of dairy produce from many European countries have declined, though they have been made up in part by larger United States supplies, some of them forthcoming under various foreign aid programmes. The United Kingdom, despite heavily reduced butter imports, has remained the world's principal market, though other European countries – importers of butter only since the war – have made

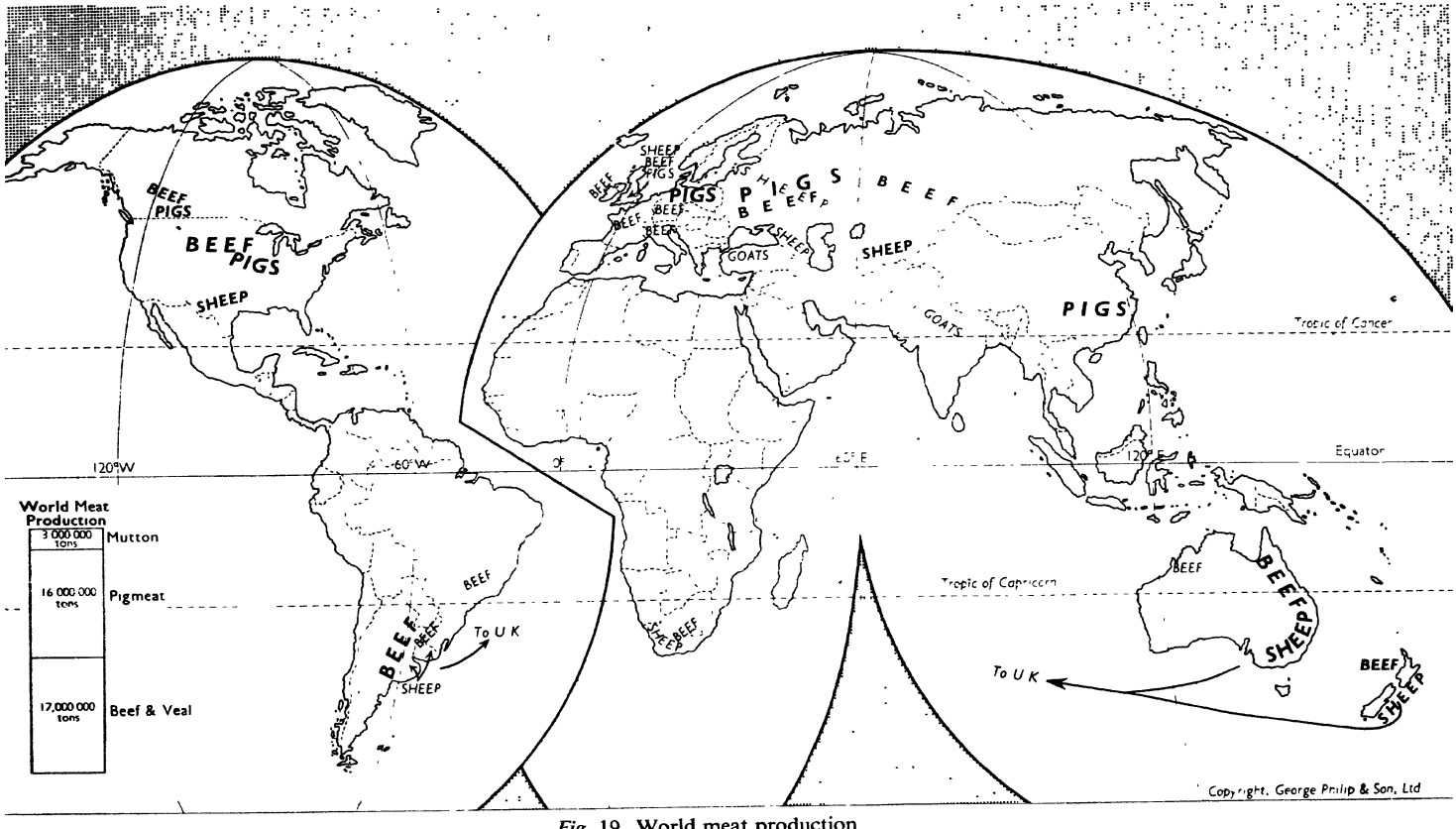


Fig. 19. World meat production

increasing demands upon a diminished supply, and one result has been a general increase in the production and consumption of margarine.

Among the factors which determine the numbers of livestock in any area – and hence the supply of meat and dairy produce – the most important are those geographical ones of climate and topography which determine the basic feed and pasture conditions, and, as was seen in the last chapter, much of the world's grain production – particularly that produced in the temperate regions – is used as animal feed. But breeds can be improved by man and, in this process of improving quality, the United Kingdom and France play a particularly important role.

Since dairy cattle require constant attention (they have, for example, to be milked twice a day) and, on the whole, require a richer and more carefully regulated diet than beef cattle, the dairying industry is characteristic of densely populated areas in the temperate zones where the farms are small and find their markets in the neighbouring towns. Thus, in the United States, the main dairy farming belt stretches from New York to Chicago, round the Great Lakes and along the St. Lawrence. Much of North-western Europe is suitable for dairying, as is the North Island of New Zealand and the south-east coast of Australia. It is in these regions that special types of dairy cattle, such as the Jerseys, which have been bred to give very high yields of milk, have been most widely introduced, and in the U.S.S.R., where dairying is well-organized round Moscow, Leningrad, and in the Ukraine, milk yields are much lower.

Other factors which play their part in meat and milk production are the incidence of such diseases as foot and mouth, the consumers' partiality for veal rather than beef or for lamb rather than mutton, drought and bush fires in the great grassland regions producing beef, and, in the lamb and mutton regions, the price of wool. Of growing importance, too, in recent years, has been governmental intervention of various kinds and, since the war, international trade has been very much regulated by contracts and agreements between governments and quasi-official organizations.

The sections which follow deal first with meat, and then with dairy produce, though it must be remembered that milk and beef production are not entirely separable one from the other, while what is said about mutton must be read in conjunction with the section on wool in Chapter 12, and the production of hides, also dealt with in Chapter 12, is intimately bound up with livestock of all kinds.

BEEF AND VEAL

Cattle are found in all the temperate and tropical lands, except in the densely forested areas or where it is too dry or too rugged for the adequate growth of grass. Ideally, cattle require richer grass than sheep

and it is usual, in such countries as Britain, Argentina, Australia and New Zealand, where both are reared, to find cattle in the wetter regions. Specialization in beef production has gone farthest in those countries in the temperate zones with a high standard of living. Thus we find that in India, a country which boasts the largest number of cattle in the world, cattle are kept largely as draught oxen and the Hindu does not eat beef. In China and Japan, too, cattle are primarily draught animals. In Europe, as a whole, farmers have specialized in dual-purpose animals and look on beef as a by-product of dairy cattle and draught oxen, though Great Britain and France possess very important pure-bred beef herds, and Britain is the country of origin of the finest cattle in the world, whether beef or dairy breeds or dual-purpose. Beef production in Britain, however, is an intensive enterprise, and, in most areas, only economic if the cattle are fattened in yards or courts where their dung is accumulated to be used on the farm as manure. It is on the continental grasslands or savannahs of Australia, Argentina and the western states of the United States that the world's largest herds of beef cattle are ranched or grazed, in conditions where the geographical environment is such that they require comparatively little attention.

Improvements are still being made in breeds and, in tropical and sub-tropical climates, Batavian zebu cattle have been crossed with other types since they possess sweat-glands which cattle evolved in temperate regions do not have. In temperate climates beef steers were not at one time considered fit for slaughter until they were four years old, but with improved breeds and feeding techniques the age at which satisfactory weights are achieved has been reduced to eighteen months or two years.

In Argentina the steers usually run with the herd until they are about two years old when they are fenced in on better pasture, usually alfalfa, for fattening. In Australia cattle-raising is principally carried out in the tropical savannahs of the vast northern territories and Queensland. In the United States, after grazing the high western prairies, the cattle are usually fattened by the corn belt farmers in the middle-west states, with Chicago and St. Louis as the chief sale and packing centres. At this stage they are largely fed on corn silage.

The total number of cattle in the world is estimated to be about 760 million and is still increasing, the largest numbers being found in

Fig. 20. Providers of protein

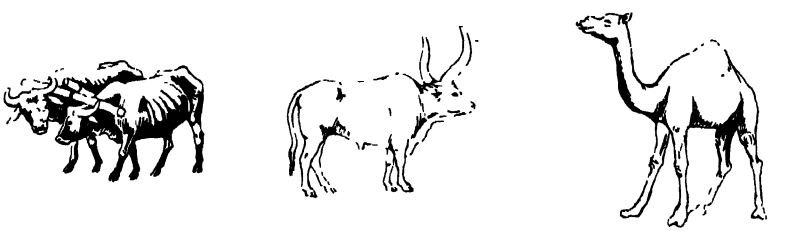
India (20 per cent), the United States (14 per cent) the U.S.S.R., (8 per cent), Brazil (7 per cent), and Argentina (5 to 6 per cent). It is doubtful, however, whether more than 20 per cent of these are reared primarily for beef production. Statistics for beef and veal production are incomplete, but for nineteen countries (from which the U.S.S.R. is the most notable omission) it is about 12 million tons a year, the largest producers being the United States (37 per cent), Argentina (16 per cent), Brazil (8 per cent), and France (8 per cent).

Consumption of beef and veal has increased considerably during recent years in the main producing countries, with the exception of the United Kingdom and North America, being highest in Argentina, with an average consumption per head of 200 lb. a year, as compared with Australia's 125 lb., the United States' 70 lb., and the United Kingdom's 40 lb. In consequence, world exports of carcase meat have fallen and, at about 400,000 tons, are well below the pre-war figure. The chief exporters are Argentina (one-third of the total), Uruguay (17 per cent), and Australia, New Zealand and Canada (with about 12 per cent each), though there are considerable fluctuations from year to year in the quantities exported.

Despite a very sharp reduction in its imports since pre-war days, the United Kingdom remains the chief importer of beef and veal, drawing its supplies from Argentina, Australia, New Zealand and Uruguay. The United States sometimes imports large amounts of beef from Canada, while Italy, Germany, Belgium and other European countries import appreciable quantities, mainly from South America. There is also a small movement – involving perhaps 1·5 million animals a year – of live cattle across international frontiers, mainly from Eire into the United Kingdom, from Canada into the United States, and from Denmark into Germany.

PIG MEAT

The merits of the pig were not fully recognized in Britain until the end of the eighteenth century, after improvements had already been made in breeds of sheep and cattle. During the following half-century



- and beasts of burden

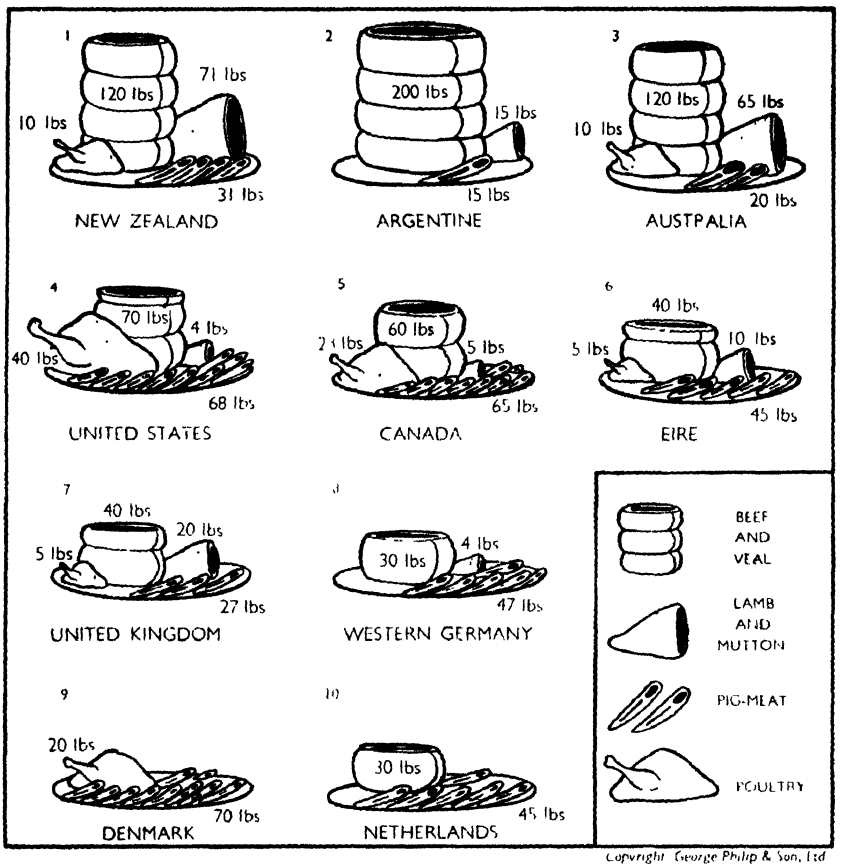


Fig. 21. Average annual meat consumption per head in certain countries

they were imported from South China and the Mediterranean countries, and improvements in breeds have continued up to the present day and are still continuing. Pigs can be kept largely on waste and refuse and can be reared in a great variety of climates, from monsoon to cool temperate, but are largely excluded from the Muslim world because the Muslims regard them as unclean – yet another indication that more than geographic and economic factors enter into the determination of world living standards. In China, on the other hand, fat pork is a favourite food, as readers of Charles Lamb will remember. Pigs are also abundant in the corn belt of the United States, in North-western and Central Europe, and in Brazil. Of the world total of 310 million, 20 per cent are found in China and a further 20 per cent in the United States. The U.S.S.R. and Brazil each account for another 8½ per cent, Western Germany has 4½ per cent, Poland 3 per cent, and France nearly 2½ per

cent. Numbers have increased considerably in China and the United States since 1938.

Figures for the production of pig meat are available for neither the U.S.S.R. nor China, but some idea of the quantities involved may be gained from the fact that the United States produces some 5 million tons, Western Germany 1 million tons, and France 0·7 million tons. World production might be as much as 16 million tons.

Consumption of pig meat is highest in the United States, Denmark and Canada, where it is between 72–68 lb. per head per year, these figures comparing with 46 lb. per head in Western Germany, 26 lb. in the United Kingdom, and 17 lb. in Australia.

In world trade, pig meat is most important in the form of bacon and hams, though exports of fresh pork have increased in recent years. At rather more than 250,000 tons, exports of the former are still well below pre-war levels and, of the total, Denmark accounts for no less than 60 per cent. Poland, the Netherlands and the United States are the other principal exporters and, in some years, Canada contributes large amounts, the bulk of all the bacon exports being destined for the United Kingdom. Pork exports are only half as large but, even so, are considerably greater than they were twenty years ago. There has been a very large expansion in Danish shipments and Denmark now accounts for more than one-quarter of the pork entering into world trade, Western Germany being the major outlet and the world's chief importer. Imports into the United Kingdom have declined considerably since before the war and the United Kingdom now draws supplies mainly from New Zealand and Australia. The United States, Argentina, the Netherlands and Canada also enter into the export market, Canadian supplies in recent years going mainly to the West Indies.

There is a relatively large movement of live pigs from China and the East European countries to near neighbours, and as many as one million pigs may be exported each year from China, Poland and Hungary alone. In the east, Hong Kong is the main importer. Elsewhere this trade is small and erratic though Germany and France are usually net importers.

MUTTON AND LAMB

Sheep yielding the best meat do not yield the best wool and generally need a better climate and better pasture than sheep bred for wool, so that they thrive best in such cool temperate climates as those of New Zealand and Britain. Sheep for one purpose or the other, or for both, however, are widely distributed throughout the warm and temperate climates, in Australia, the U.S.S.R., the Americas, South Africa, the North African coast and the Middle East, and India, particularly the northern Punjab, though since sheep-keeping is considered fit only for

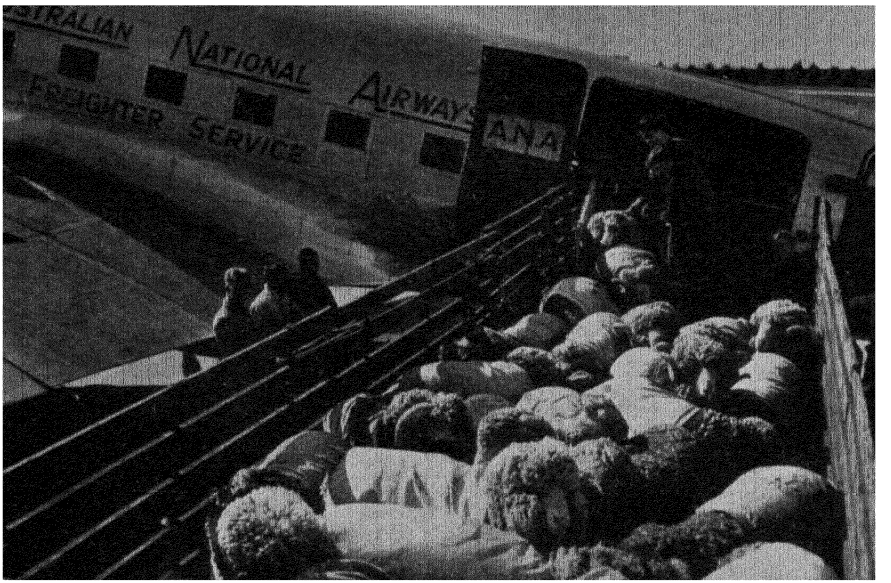


Fig. 22. Air-freighting of stud sheep in Australia is well organized

people of low caste the industry has not developed in the latter country to the extent justified by its large population. They thrive best where rainfall is moderate to light and evenly distributed over the year. In countries with severe winters, like Canada, the keeping of sheep becomes less economic because the animals have to be housed in the winter time. Certain types of cheese, e.g. Roquefort, are made from ewes' milk and in some areas of France and Italy the milk is of commercial importance.

The largest flocks are found in Australia (which has 15 per cent of the world sheep population of about 780 million), the U.S.S.R. (12 per cent), Argentina (6 per cent), the Union of South Africa and New Zealand ($4\frac{1}{2}$ per cent each), the United States (4 per cent), Turkey, Uruguay, Spain and the United Kingdom (each about 3 per cent). In the U.S.S.R. the number has increased considerably since before the war, but in the United States it has fallen, largely because other livestock have been found more profitable. Sheep are particularly important in British farming and, in addition to supplying a considerable part of the home requirements for both mutton and wool, British sheep are exported to form the nucleus of pure-bred flocks elsewhere or to grade up native stocks.

The production of mutton and lamb would appear to be not much more than one-tenth of that of pig meat. Outside the U.S.S.R., for which country figures are not available, New Zealand, Australia and the United States are the most important producers, followed by Argentina and the United Kingdom. Production in the United States, however, has fallen considerably since before the war, and Australian

production is heavily influenced by wool prices, being lowest when wool prices are high.

In New Zealand and Australia far more mutton and lamb is eaten per head than anywhere else in the world. The New Zealander eats about 75 lb. a year and the Australian 64 lb. In the United Kingdom, Argentina and the Union of South Africa consumption is only 15 lb. a head, while in the United States it is now as low as 3 lb.

New Zealand is also far and away the leading exporter, exporting more than two-thirds of the 270,000 tons or so of the mutton and lamb which enters into world trade. Argentina and Australia take second and third places, though shipments from both countries fluctuate violently from year to year. The United Kingdom receives practically all the exports from the two British dominions and takes by far the largest proportion of world exports. In many years, world trade in mutton and lamb has been largely a flow from Australia, New Zealand and Argentina to the United Kingdom.

In recent years something over 1·2 million live sheep per annum have crossed national frontiers in addition to the trade in meat, but this is considerably fewer than in pre-war days. France imports live animals from Algeria, the Lebanon from Turkey, Chile from Argentina, and a fluctuating trade goes on between a number of other countries.

CANNED MEAT

Exports of frozen and chilled meat from the great grassland regions were made possible by the development of cargo-liners fitted with refrigerating machinery. Nowadays there is also a growing world trade in canned and partially cooked meat; indeed, the trade in canned meat is already as important as the trade in pig meat, beef or mutton, if each of these is considered separately.

Production of canned meat outside the U.S.S.R. now exceeds 1 million tons, the United States producing some 70 per cent of the total. Of the total of 1 million tons, about 360,000 tons – more than twice as much as in pre-war years – is exported, the principal exporters being Argentina (27 per cent), Australia (15 per cent), the Netherlands (13 per cent), Denmark (12 per cent), and France (10 per cent).

Before the war exports of canned meat from Argentina were mainly destined for the United Kingdom, but in recent years the United States has taken an increasing proportion. The United Kingdom, however, remains by far the chief importer, and is the main market for Australian and New Zealand shipments. The United States comes next, with Venezuela third. It is worth noting that Australia and New Zealand also have a considerable trade with the Pacific Islands, following upon the trade in copra from these islands. From the economist's point of view, this would represent a rise in the standard of living of the Pacific

islanders, though it is doubtful whether stewed beef and dumplings from a can is better for the islanders than their native fish.*

In addition to canned meat, a considerable amount of fresh, frozen and chilled offals enter into world trade. Figures for recent years are incomplete but they amounted to 65,000 tons in 1938. Argentina, New Zealand and Denmark are the principal exporters, and the United Kingdom is again the chief importer.

	1939	1953
Cattle	680	760
Sheep	732	780
Pigs	290	310
Horses	95	76
Mules (excluding U.S.S.R.)	18	15

Fig. 23. Estimated world livestock population (millions)

POULTRY MEAT

The domestic fowl is believed to have originated from the Indian jungle fowl, though the heavier breeds may well have descended from a bird now extinct or one which, like the horse and the dog, has passed completely into domestication. They are now found all over the world, and the numbers, including turkeys, ducks and other table-game, are probably not far short of 2,500 million – perhaps one for every inhabitant of the globe! Of those countries for which statistics exist, the United States has 460 million head of poultry, China perhaps 300 million, France 140 million, the United Kingdom 95 million, and Italy 72 million. In most European countries the number has increased since the war.

Details of poultry meat production are available for no more than a handful of countries. United States production is nearly 2·5 million tons a year, nearly twice the figure for 1939 and far more than Canadian or British production, at about 150,000 tons and 80,000 tons a year respectively. It is not surprising, therefore, that American consumption should be some 36 lb. a head per year, compared with 23 lb. in Canada or 6 lb. in the United Kingdom.

Poultry meat is a less important item of diet than other kinds of meat, and world trade in it is specialized in character and limited in volume. Prior to the war Yugoslavia and Hungary were the main exporters of dead poultry, but their place seems to have been taken by Eire, Denmark, the Netherlands and Australia, each of which exports 8–9,000 tons a year. China and the Netherlands also export large numbers of live poultry and, in some years, Canada has made a significant contribution to this trade. The United Kingdom is the only important market for

*For an interesting account of the effects upon the inhabitants of Raroia, the island on which the Kon-Tiki raft landed, see Bengt Danielsson, *The Happy Island* (Allen & Unwin).

dead poultry, importing about 30,000 tons a year. Before the war the United Kingdom, Malaya and Germany imported large numbers of live poultry but the trade has been small in recent years, and Northern Rhodesia has become the major recipient. Canadian birds go, of course, to the United States.

MILK

Owing to differences in classification, no accurate comparisons can be made between the dairy herds of different countries, but some idea of proportions can be gained by comparing the number of cows, as is done in Fig. 24 for the main countries, while Fig. 25 indicates milk

	1938	1953
U.S.S.R.	28·0	24·3
United States	24·5	23·7
France	8·7	8 4
Western Germany	6·0	5·8
United Kingdom	3·8	4·5
Poland	6·3	4·2
Italy	3·8	3·9
Canada	3·7	3·5
Australia	3·2	3·2

Fig. 24. Estimated number of cows in certain countries (millions)
(*It should be remembered that the milk yield in the U.S.S.R. is lower than that for most other countries listed.*)

production in those countries for which these statistics exist, together with the percentages used for manufacturing purposes. Fig. 25 is the most useful, and shows a clear trend towards the increased consumption

	1938			1951		
	Production (million gallons)	*Percentage used in manufacture*	*Consumption per head of liquid milk (gallons)*	*Production (million gallons)*	*Percentage used in manufacture*	*Consumption per head of liquid milk (gallons)*
United States	10,273	57·3	32 8	11,222	48·9	38·3
France	3,094	52 9	21·8	3,276	53·3	24·0
Western Germany	3,211	61·3	n a.	3,247	53·7	n.a.
United Kingdom	1,249	31 2	21 1	1,792	12 1	34·0
Italy	1,451	47 6	n.a.	1,656	50 3	n.a.
Canada	1,536	64 7	29 2	1,591	57·7	34·7
Netherlands	1,140	73 6	30 8	1.217	59 6	41·7
New Zealand	892	88 8	40 7	1,086	88·6	48·0
Australia	1,189	86.1	23·4	1,058*	75·9	30·0
Denmark	1,160	84 6	36·2	1,121	80·6	39·0
Sweden	997	58·7	42·7	1,022	59·8	47·5
Switzerland	580	45·7	51·4	574	43·8	48·8

n.a. = not available

*Australian production is well below the post-war average (about 1,200 million gallons) owing to drought in 1951.

Fig. 25. Milk production and consumption

of milk in liquid form, an increase of more than 25 per cent since 1938. Total milk production is some 5 per cent greater than in 1938, for which higher yields per cow are mainly responsible. Thus, in the United States average output per cow rose from 449 gallons to 514 gallons between 1940 and 1951, and in the United Kingdom average yields have risen from 542 gallons to 590 gallons in the past twelve years.

BUTTER

As the consumption of fresh milk has gone up, the production of butter has gone down and, at some 55 million cwt. (exclusive of Russian production) a year is 10 per cent or more below pre-war levels. The biggest producers are the United States (27 per cent), Western Germany and France (11 per cent each), New Zealand, Denmark and Australia (7–8 per cent each), and Canada (5½ per cent). United States production has latterly been one-third below pre-war levels owing to the changed pattern of milk utilization, with an increased emphasis on liquid milk, ice-cream and processed milk. New Zealand production, on the other hand, has increased considerably since before the war.

In the United States consumption per head has declined from 16·4 lb. to 9·7 lb. in the last fifteen years, and in the United Kingdom from 24·1 lb. to 14·6 lb. The decline has also been marked in Canada, the Netherlands, Western Germany and Denmark. The only countries which have registered any increase over these years are Belgium (from 17·9 lb. to 23·9 lb.), New Zealand (from 42·8 lb. to 43·5 lb.) and Eire (from 32·2 lb. to 40·4 lb.). Consumption is much higher in the two last-named countries than it is elsewhere.

Exports of butter amount to some 9 million cwt. a year – 30 per cent less than in 1938 – the principal exporters being New Zealand (38 per cent), Denmark (33 per cent), and the Netherlands (12 per cent), though Australian exports are normally considerable and, before the war, the Baltic countries, Latvia, Lithuania, and Estonia, had an appreciable share of the trade. Exports from New Zealand are much higher than they were before the war.

The bulk of New Zealand and Australian exports goes to the United Kingdom which, with Germany, remains the world's principal importer, the two countries together taking three-quarters of the world's exports. New Zealand and Australia also export to Eire and British Commonwealth countries in the Far East, as well as to continental Europe and Canada. Danish exports go to many of the countries of Western Europe and to Canada, as do those from the Netherlands and Sweden.

CHEESE

During the war, world production of cheese was well maintained, often at the expense of butter, and at some 40 million cwt. (exclusive of

Russian production) is probably 30 per cent above pre-war levels. The principal producers are the United States (26 per cent), Italy (14 per cent), France (13 per cent), Western Germany and the Netherlands (7 per cent each), New Zealand and Argentina (5 per cent each), and Denmark (3–4 per cent), the bulk of the expansion in world output having been in the United States and in continental Europe. Norway, Sweden and Switzerland have the highest consumptions (about 18 lb.) per head; in the United Kingdom it is 10 lb. per head per year, and in the United States 8 lb.

Exports from the principal countries amount to about 7 million cwt. a year - 25 per cent more than pre-war – the main exporters being New Zealand (26 per cent), the Netherlands (21 per cent), Denmark (13 per cent), and the United States (10 per cent). Danish exports have increased fivefold since before the war, and before the war, on balance, the United States imported rather than exported cheese. Canada, Italy, Switzerland and France also export considerable quantities of cheese.

The United Kingdom takes some 55 per cent of the world's exports, being the main market for cheese from New Zealand, Australia, Canada and the United States, besides receiving considerable quantities from continental Europe. Germany receives large quantities from the Netherlands and Denmark, and Belgium from the Netherlands. The United States is the fourth largest importer, receiving supplies from both the British dominions and European countries. French exports go, in the main, to French North Africa.

OTHER MILK PRODUCTS

World production of *condensed milk* (over 52 million cwt., excluding the U.S.S.R.), exceeds that of cheese and very nearly equals that of butter. Condensed milk, milk powder and casein production together probably amount nowadays to as much as the combined butter and cheese production. To the total of condensed milk, however, the United States contributes no less than 70 per cent. World exports of condensed milk, at about 8 million cwt. a year, rank above those of cheese and not far below those of butter.

The principal exporters of condensed milk are the Netherlands and the United States, and the principal importers the United Kingdom, British Malaya, the Philippines and other Asian countries. Before the war, except in the United States, sweetened condensed milk formed the bulk of the world's production and trade, and remains the preference in Asia. The large rise in world production, however – some 50 per cent since 1938 – has been almost wholly in unsweetened condensed or evaporated milk, which is important as a baby-food, and suitable for military supplies and civilian 'stock-piling'.

Similar factors have resulted in the doubling of world production of

milk powder since 1938. Milk powder can be reconstituted as liquid milk, used as a baby-food, and in the manufacture of ice-cream, confectionery, chocolate and other food products. In some countries it is added to bread, while skimmed milk powder and whey powder is also used in the manufacture of animal feedingstuffs. In recent years a good deal of milk powder has also been used in various relief programmes to Asian and Central and South American countries, the United States and, to a lesser extent, Canada being the main contributors. Exports amount to about 3·5 million cwt. a year, the United States, New Zealand, the Netherlands and Australia being the principal exporters, and the United Kingdom and Venezuela the main importers.

Casein, which is a product of skimmed milk, is a raw material for the plastics industry in its rennet form, and is used in a variety of industries, notably in the paper trade, in its lactic form. It is also used in the manufacture of a synthetic wood fibre (see Chapter 10), and is of some importance in the patent medicine trade in the United Kingdom. The main producer is Argentina and production has increased considerably since before the war, but output is subject to marked fluctuations as butter and cream manufacture and the price of synthetic substitutes vary. Argentina and France export nearly two-thirds of the 1 million cwt. or so which enter into world trade, though New Zealand and Denmark also have large shares. The United States and the United Kingdom have been the main importers since the war, though it is probable that German and Japanese imports will grow.

Fig. 26. Hen battery at Stoke Mandeville

EGGS

Egg production and consumption statistics are highly unreliable because of the difficulty of calculating 'backyard' output. In the United States, for example, it is reckoned to be about 10 per cent of total production, whereas in the United Kingdom it is probably at least 25 per cent. Fig. 27 gives estimates of production in a number of countries in a pre-war and in a post-war year

and, in most of these, there has been a considerable increase. The Americans, with an average annual consumption of nearly 400 eggs per head, are the world's biggest egg-eaters and consumption has increased by about one-third in the past twenty years. The Canadians eat about 280 eggs a year each, the Australians 220, the British 200, and the Dutch 100. Consumption levels, generally, are much lower in Europe than in the United States, and lower in the main exporting countries, like Denmark and the Netherlands, than in the chief importing countries, such as the United Kingdom, Western Germany and Switzerland.

	1938	1951
United States	3,500	5,500
United Kingdom	560	690
Western Germany	350	490
Italy	440	430
Canada	220	330
Poland	n.a.	280
Argentina	140	250
Australia	150	200
Netherlands	190	190
Denmark	180	180
Japan	280	140

Fig. 27. Egg production in certain countries (million dozens)

Rather more than 400 million dozen eggs are now exported each year, but this total is 25 per cent lower than it was before the war. Denmark exports about 120 million dozen, the Netherlands more than 100 million dozen, and China about 30 million dozen, while the United States, Eire, Poland, Australia, France and Sweden are also important exporters. The principal importers are Western Germany, which takes about 140 million dozen, and the United Kingdom, with imports of similar size, though United Kingdom imports are still little more than one-half of what they were before the war.

During the war, Canada, Australia and the United States manufactured large quantities of dried eggs for export in order to conserve shipping space. By 1952, however, virtually no dried egg was being manufactured for export and the trade in egg products had reverted again to the liquid or frozen egg. In this field China is the main source of supply, though her exports fluctuate very considerably from year to year. The United Kingdom is by far the largest importer, Australia and China supplying the bulk of her liquid and frozen egg requirements.

CONCLUSION

Even though every allowance be made for the incompleteness of the statistics – and they are more unsatisfactory in the case of meat and dairy produce than they are in most other fields – it is doubtful whether

world meat production each year can exceed 40 million tons, as compared with, perhaps, 800 million tons of grain and vegetables. As has been pointed out in the first section, the meat-eaters and the consumers of dairy produce are the rich countries, though among these would have to be included two large meat-producing countries, Argentina and Uruguay, which would otherwise appear only among those countries which are moderately well-off.

No more than about 3 per cent of total meat production enters into world trade, and the bulk of this goes to feed the United Kingdom, with the rest being sent largely to Western Europe and the United States. It is as well to note, however, a small but growing trade in canned meat to the richer countries of the tropics, notably Venezuela and the Pacific islands. If the poorer nations in the tropics were able to raise their living standards, this trade and the similar trade in milk products would probably grow further.

Chapter 7
Fish and Marine Mammals

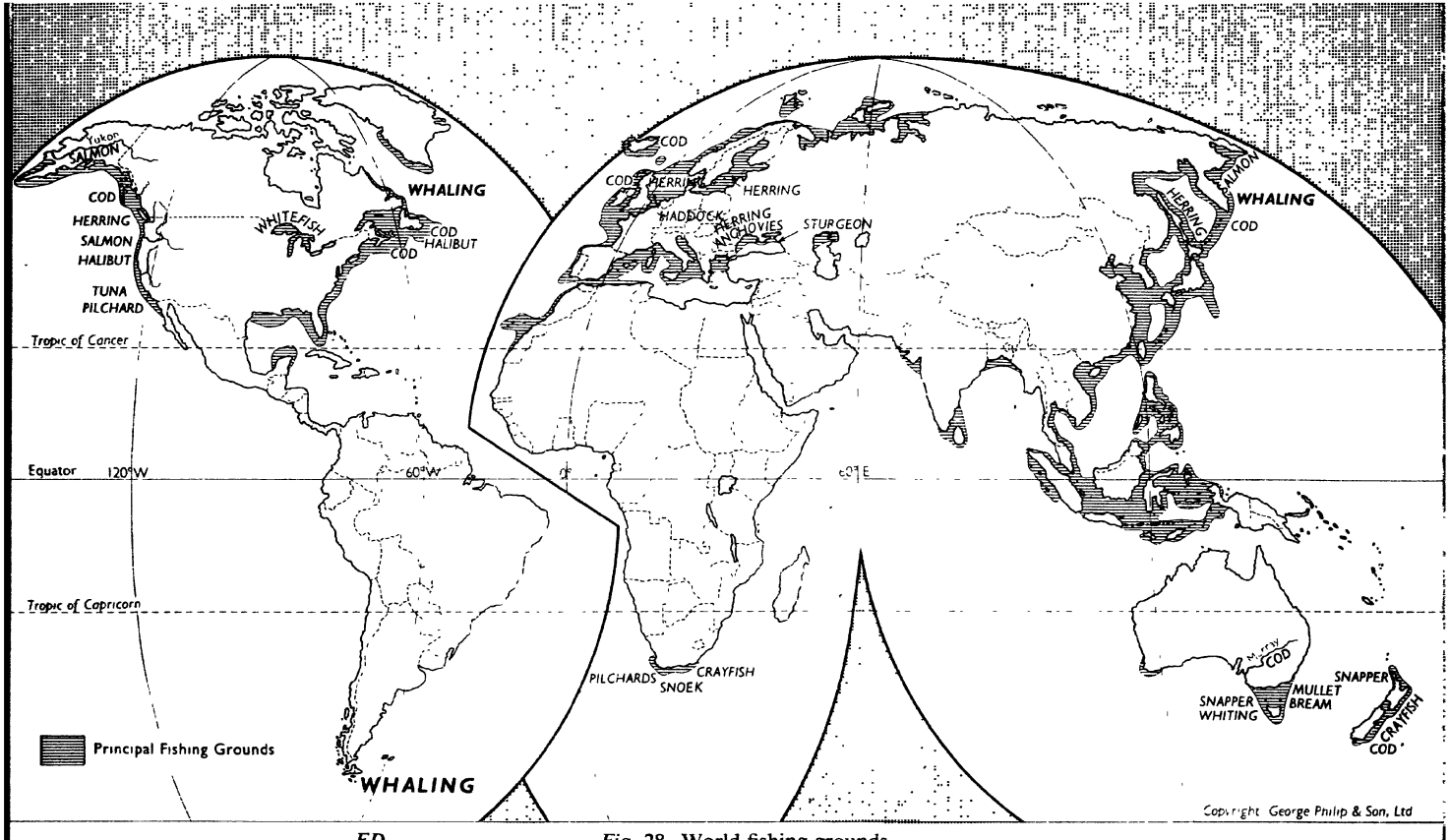
INTRODUCTION

Edible fish are most prolific within the 200-fathom line, that is, on the continental shelf bordering the great land masses or in the shallower parts of the slope down to the ocean depths, and they abound most in the cool seas where warm and cool currents come together. These cool seas are richest in the nitrates and nitrites which form the basis of plankton life, the simple, floating forms of both animal and plant life which constitute the chief form of nourishment for sea-dwellers. The shallow continental shelf also permits the sunlight to penetrate the water, an essential condition for the growth of vegetation, which also supplies food for fish and their prey. Near thickly populated coasts, waste from the land is a further source of food.

Where warm and cool currents come together, the sudden changes of temperature and salinity kill vast quantities of plankton, making these areas particularly rich feeding grounds. It follows that the most important fisheries are found in the North Atlantic where, in the east, the polar drifts meet the warm North Atlantic drift and, in the west, the cold Labrador current meets the Gulf Stream, and in the North Pacific, where the warm Kuro-Siwa current meets the cold current off the Kurile Islands. Similar conditions are met with off the coast of South Africa, where the cold Benguela current meets the warm Agulhas current.

TYPES OF FISH

The term 'pelagic', which is derived from the Greek word for 'sea', is now applied to fish which swim at or near the surface, and these include the herring family (herrings, pilchards, sprats, sardines, shad, whitebait and anchovies) and the mackerel. Pelagic fish are migratory – the herring, for example, moves south round the British coast as the year progresses – and are usually caught by drift nets, though the herring itself, which goes deep by day, may also be trawled for. The drift net is really a series of nets submerged vertically in the water in the meshes



FD *Fig.* 28. World fishing grounds

of which the fish become entangled. The seine-net, which was formerly used principally near the shore, is now used for the same purpose and is said to be more efficient; the seine-net is spread between two specially built vessels which work against the tide and gradually draw together, with the catch entrapped between them. The herring family alone accounts for 25 per cent of the world's catch.

Demersal fish are those which live on or near the bottom of the continental shelf and seldom move far from their feeding ground. Of these the most important are the so-called whitefish – including cod, haddock, whiting, ling and hake – and the flatfish – halibut, flounder, plaice and sole. Together they account for more than 11 per cent of the world's catch and are mainly fished for by trawl, seines and long-lines, the trawl being a triangular bag, with otter boards to keep its mouth open, which is drawn along the sea-bottom at the rate of from two to six miles an hour. Trawling is the most important method of fishing and the modern deep-sea trawler may operate far from its base. The fish are stowed in ice but, since this only keeps them really fresh for about twelve days, research is being carried on to devise an economical method of deep-freezing. Asdic devices are used nowadays to help locate shoals of fish, and it has recently been reported that the Germans are experimenting with a suction pipe fitted to the narrow end of the trawl which will draw the fish on board and thus cut out the need for hoisting the trawl itself inboard while the vessel is on the fishing grounds.

Anadromous fish, of which the salmon is the most important commercially, live in the sea for the major part of their life but spawn in fresh water. They are consequently caught, in the main, at the mouths of rivers as they return for spawning, in pound nets or 'traps', purse seines or gill nets.

Other marine species of importance include tuna, barracudas, mullets, jacks, pompanos, perches, basses, croakers, breams, sharks, rays, skates and sturgeons. Together they account for a further 25 per cent of the world's catch. The purely freshwater species, too, should not be forgotten for, all told, they amount to 18 per cent of the fish caught.

Included in these figures, although they are not true fishes, are the crustaceans (lobsters, crawfish, crabs, prawns and shrimps) and molluscs (oysters, mussels, clams, etc.). Together, they make up some 10 per cent of the world's catch. In addition, small quantities of other marine flora and fauna – bêches-de-mèr, turtles and seaweeds – are gathered for human consumption, and various animal 'residuals' like pearls, mother-of-pearl, sponges and coral enter into world trade.

PRODUCTION

Nearly 30 million tons of fish are caught each year in the world as a whole, perhaps three-quarters as much by weight as the total quantity

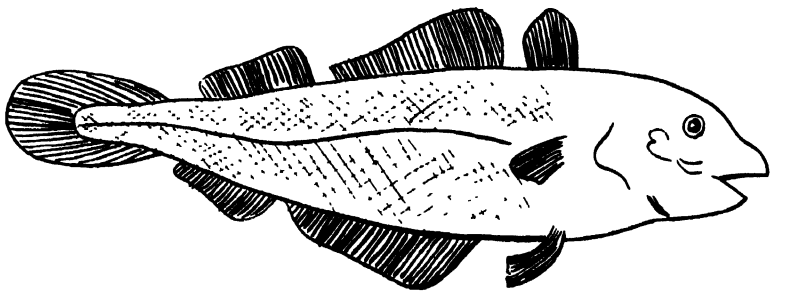


Fig.

COD (*Demersal*)

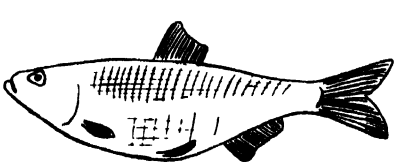
of meat killed. Of this immense total, the eleven main fishing countries produce about one-half. In order of importance, these are: Japan (15 per cent), the U.S.S.R. (10 per cent), the United States and Alaska (9 per cent), Norway (7 per cent), the United Kingdom (4 per cent), India (3 per cent), West Germany and Canada (2½ per cent each), Spain, France and Iceland (less than 2½ per cent each).

The main sea-fisheries have already been briefly indicated. Off Western Europe, they extend from the Arctic Ocean to the Mediterranean. The North Sea is still the most important area, but also of great significance are the waters in the neighbourhood of Iceland, the Lofoten Islands off Norway, the Faroe Islands and Greenland, and the White and Barents Seas. Norway, the United Kingdom, Western Germany, France and Iceland are the nations principally engaged in fishing these waters, and herring, cod and haddock are the principal fishes landed.

The second great area of fishing grounds consists of the continental shelf off the east coast of North America and, in particular, the Grand Banks of Newfoundland which are very rich in cod and halibut. Newfoundland (now, of course, a province of Canada) and Portugal are among the nations fishing off the Grand Banks.

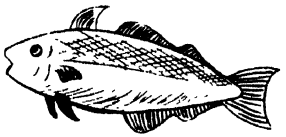
In the third great fishing region, the Pacific coast of North America, salmon is of prime importance, the fish breeding principally in the Columbia and Sacramento rivers in the United States, in the Fraser, Skeena and Nass rivers of Canada, and in the rivers of Alaska, espe-

HERRING (*Pelagic*)



MACKEREL (*Pelagic*)

Fig.



HADDOCK (*Demersal*)

PLAICE (*Demersal*)

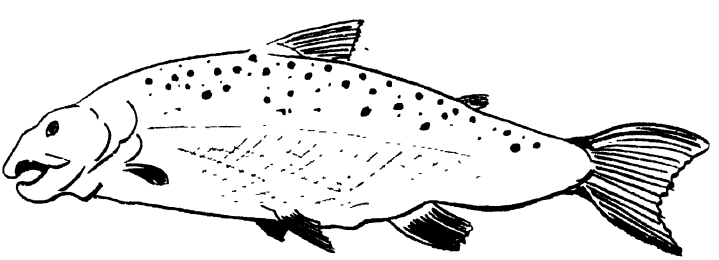
cially in the Yukon. Although salmon are sold fresh, frozen, dried, smoked and salted, they are mainly canned, and canning is an important industry in both the United States and Canada. There has been a serious depletion of salmon by over-fishing and, before the war, Japanese floating canneries were a menace to the industry since they operated outside the limit of territorial waters and caught fish without consideration of the number needed for re-stocking the rivers. Halibut, cod and herring are also fished in these waters while, off the United States coast, a tuna and pilchard industry has been developed.

In the western Pacific, the most important fishing grounds are found in the cool seas in the neighbourhood of Yezo and Sakhalin which are well stocked with varieties of cod and herring, while in the rivers of these islands and of Kamchatka, and on the coasts of the Okhotsk and Bering Seas, salmon are important. The Japanese fishing industry, as well as being the biggest in the world, is unsurpassed in its organization, range and diversity. It should also be noted that large quantities of fish are normally caught in China and Korea; in 1938 very nearly 2 million tons of fish were caught in Korea, and the Chinese catch was estimated to be as much as 3 million tons in 1949.

The Russian fisheries are based mainly on inland waters, the annual catch in the Caspian Sea alone probably exceeding 600,000 tons. The principal fishes in this region are sturgeon (the roe of which is caviare), herring, 'vobla' and salmon. Salmon and herring are also caught on the Pacific coast of Siberia, and perch-pike, bream, anchovies, herring

SARDINE (*Pelagic*)

SALMON (*Anadromous*)



and sturgeon in the Azov and Black Sea region. Most of the fish in all these areas are caught during the migration to shores and rivers. In Europe, the Russian industry is mainly confined to trawl fisheries in the Barents Sea.

Inland fisheries are important elsewhere in the world, particularly on the Great Lakes, in India and Malaya, and in the rivers of South America. Australia has large fishery resources – mullet, bream, snap-

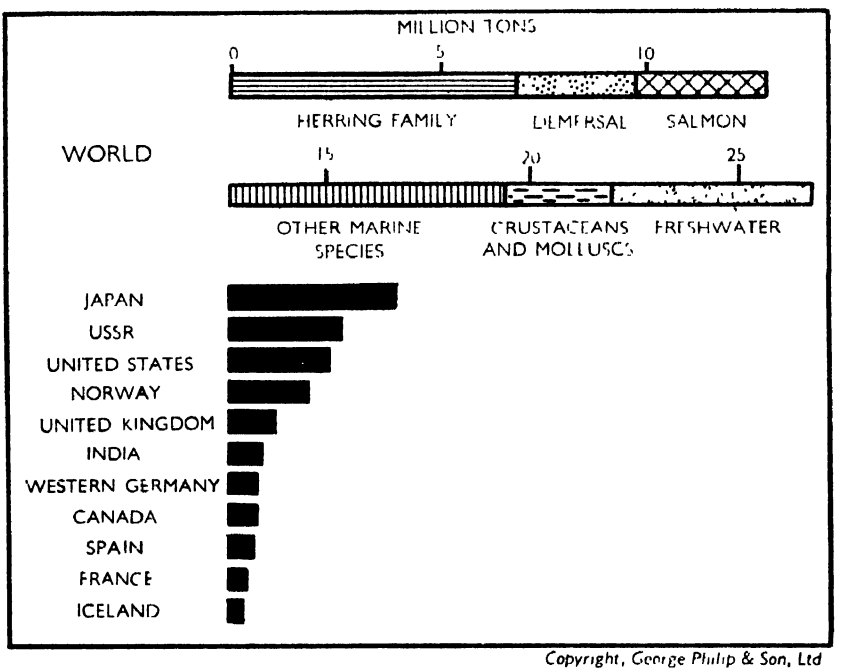


Fig. 31. The annual catch of fish

per and whiting in the seas, and Murray cod in the rivers – but commercial exploitation is on a small scale, and frozen fish are imported from New Zealand where, in relation to the size of the population, greater progress has been made. The South African industry has expanded rapidly since 1938 and the catch now amounts to about 350,000 tons, pilchards, stockfish, crayfish and snoek being the principal fishes caught.

In the monsoon and equatorial lands of the Far East fish is an important article of diet and the chief source of protein. Production in China and India has already been noted, and the annual catch in the Philippines, Indo China and Malaya exceeds 180,000 tons a year in each case. In Malaya, India, Pakistan, and elsewhere, research is being carried on

to examine the possibility of farming freshwater fish in the paddy fields. In India, many of the rivers have been over-fished but could be developed by proper cultural methods, while important sea fisheries await capital development.

THE UTILIZATION OF FISH

For some of the principal countries it is possible to discover how the fish is used. In Fig. 32, total production is given, together with the percentages marketed fresh or frozen, cured (i.e. dried, salted, smoked, spiced, etc.) or canned, and the percentage which is reduced to oils (e.g. cod liver oil) or to animal feed and fertilizers.

In addition to part of the quantities in the last column of Fig. 32, large amounts of fish offal are used for fertilizer.

It is interesting to note how much of the British and French catches is marketed fresh, and how much of the catch in other countries, where markets are at a distance, is cured, canned or reduced to oil and meals.

Country	*Catch in tons*	*Marketed fresh/frozen*		*Cured*	*Canned*	*Reduced to oils and meals*
		(% *of total catch*)				
Japan	3,800,000	44	3	34	3	7
United States	2,400,000	32	13	2	28	24
Norway	1,800,000	8	4	28	3	57
United Kingdom	1,000,000	73	3	15	2	7
Canada (excluding Newfoundland)	700,000	22	16	18	16	23
France	460,000	60	--	28	10	--
Iceland	420,000	16	28	25	—	30
Newfoundland	320,000	4	17	70	—	4

Fig. 32. The utilization of fish

TRADE IN FISH

Most fisheries supply only home markets, but over 1·5 million tons of fish enter into world trade, exclusive of fish oils or fertilizers, and of this total 40 per cent is fresh fish, mainly exported from Norway, Iceland and Denmark to the United Kingdom, Germany and other European countries, and from Canada and Mexico to the United States. A further 35 per cent is cured, going mainly from Norway, Newfoundland, Iceland, Canada, the Netherlands and the United Kingdom to the Catholic countries of Southern Europe and, in the form of pickled herrings, to the Baltic countries, though there is also some trade in cured fish between the countries of the Far East. About 17 per cent is canned, being exported from the United States (principally to the Philippines), from Canada (principally to the United States), from Norway,

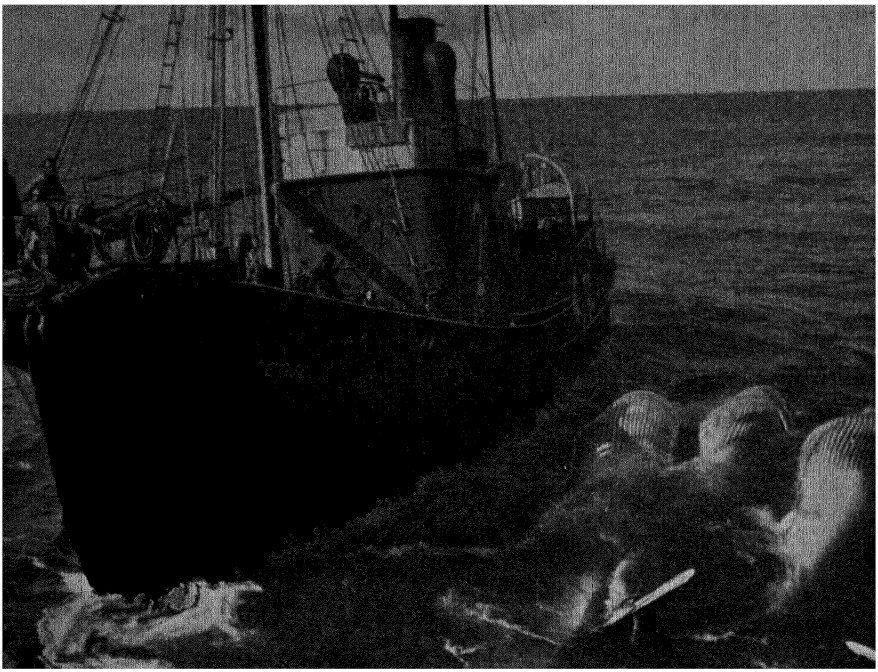


Fig. 33. Hunting whales in the Antarctic – a catcher with catch

Portugal and Japan to France and other European countries, and to the countries of the Far East, notably Malaya and Indonesia. The remainder consists of the trade in crustaceans and molluscs from Canada and Mexico to the United States and between European countries. In addition, Norway, Canada and Iceland export considerable quantities of fish meals, the United States being the chief importer, and Norway exports a good deal of fish oil.

The United States, the United Kingdom and Germany are the principal importers of fish.

MARINE MAMMALS

Of the marine mammals, the whale is by far the most important commercially and, at one time, whale oil was of major importance for lighting purposes. In this use it has been displaced, but the oil obtained from blubber is still sought after for use in margarine manufacture, soapmaking, and for lubricants, while sperm oil (which is a wax) forms the basis of cold creams and other cosmetics. Whale meat is used as animal food and in some countries, particularly in Japan, enters into human diet. Both flesh and bones make good fertilizer, and the whalebone yielded by some species is valuable for other purposes.

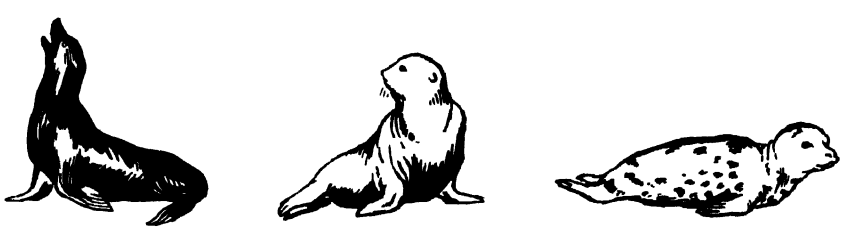
Whales are hunted in the Arctic Ocean near the Bering Straits, and in the North Atlantic, but the industry is now almost entirely centred in the Antarctic, where the blue whale – the largest animal in the world –

is the most important species. Here, the Falkland Islands are one of the main whaling centres, and there are three land stations in South Georgia.

Modern developments, in the shape of whale factory ships, high-speed catchers, the echo-whale-finder, the spotting aircraft, and the electric harpoon, give the whale no chance of survival and international agreement has become essential to preserve it from extinction. The International Whaling Convention, set up in 1949, restricts both the season (which runs from January to April) and the catch. Currently, a catch of about 15,000 'blue whale units', or some 30,000 whales, is allowed in any one season, and there is keen competition among the whaling fleets, particularly between those of Norway and the United Kingdom, to obtain as much of this quota as possible. Despite restrictions, an increased catch since the war has yielded less in the way of oil because of the increasing number of young and immature whales taken, and the danger of eventual extinction remains.

In recent years, the seasonal catch has yielded about 2 million barrels or rather less than 500,000 tons of whale oil, together with about 60,000 tons of by-products. The leading countries are Norway (40 per cent) and the United Kingdom (nearly 20 per cent), followed by South Africa, Japan, Panama, the U.S.S.R. and France.

The sea-lion is a mammal hunted not for its blubber but for its fur. The most valuable species is actually called the sea-bear, a north Pacific



SEA-LION SEA-BEAR SEAL

Fig. 34

species now almost entirely restricted to the Pribylov Islands where it is protected by international agreement. Fur seals are also found round Cape Horn and the Falkland Islands. The true seal is hunted in arctic waters, where killing is now allowed only during the spring; the arctic seal yields pelts and oil, and insulin is extracted from the livers.

CONCLUSION

Technological discovery over the past century has enabled men to catch and dispose of a vastly increased quantity of fish. On the one

Fig. 35. Seine-net fishing in a Thailand river

side, there have been great improvements in fishing vessels, their handling and storage capacity, and the technical aids which fishermen have at their command. On the other side, improved transport facilities, the development of cold storage, and improved canning and curing processes enable the industry to tap wider markets.

As a result, the natural resources of the sea show signs of having limits or of being actually reduced. Over-fishing in some areas was already apparent before the First World War. That war itself did something to replenish the stock in the North Sea because the great majority of fishermen were otherwise engaged, but the danger became even more obvious between the wars. More distant grounds were opened up and technical improvements enabled the catch to be increased, if only temporarily. Various attempts were made, and are still being made, to reach international agreement, but such agreement is difficult because most fisheries lie beyond the limit of territorial waters, and 'poaching' even within territorial waters is not unknown and difficult to control. In the Pacific, the Japanese practised offshore fishing for salmon which was detrimental to stock, and disputes arose between Japan and the U.S.S.R. over fishing in the neighbourhood of the Kamchatka Peninsula. But while only four nations are involved in the North Pacific, at least five are concerned in the Newfoundland fisheries, and twice that number in the east Atlantic. Consequently, agreement in these areas is a matter of great difficulty and no more than unsatisfactory compromises have been reached. Since the Second World War new disputes

have arisen between Iceland and the United Kingdom, and between certain South American republics and other countries, over the extent of territorial waters and further attempts to control fishing in the North Sea have been only partially successful.

A great number of scientific investigations into the feeding habits and life history of fish have been made with good results. Already there are several hatcheries for young plaice in the North Sea, and they have been successfully transplanted from inshore waters to the rich grounds of the Dogger Bank. In New England there are lobster hatcheries, and shad hatcheries on the rivers further south, while on the Newfoundland Banks and elsewhere mesh of a larger size than hitherto has been used by trawlers fishing for haddock and cod to allow the young and immature fish to escape. In Oregon and Washington there are several salmon hatcheries, and the United States and Canada have worked together to preserve the halibut fishery based on Seattle and Vancouver. Scientific breeding and methods of fishing could be greatly extended, if concerted action were possible everywhere, and the importance of the oceans and rivers as a source of food supplies perhaps increased. In the world as we know it, however, the danger is one of rapid and serious depletion of the oceans' stocks of fish and whales.

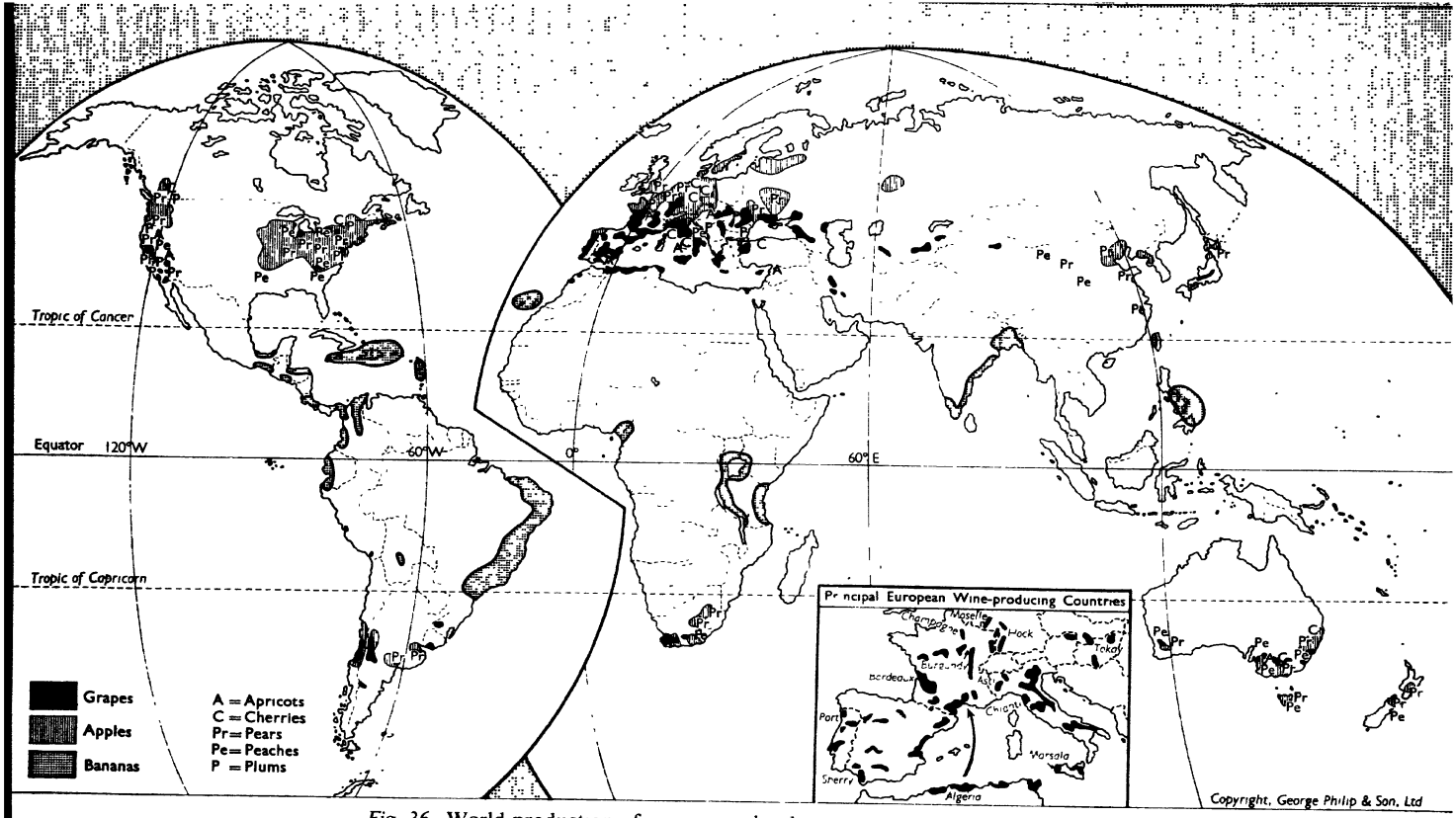


Fig. 36. World production of grapes, apples, bananas, stone fruits and wine

Chapter 8
Fruits, Wine and Tobacco

FRUITS AND WINE

There are three fruits of major importance in world trade and each is the product of very different climates. They are the apple, which is grown in cool, temperate lands, the orange, which is now largely grown in countries with a Mediterranean-type climate, and the banana, a product of the tropics. The consumption of all these has greatly increased during the past half-century, largely because of improved transport facilities, the introduction of cold storage, and the development of fast and regular shipping services, which, taken together, enable fresh fruit to be marketed cheaply in all parts of the world throughout the year.

In recent years the average output of deciduous and citrus fruits in the principal producing countries has been about 33 million tons a year, compared to an average of 26 million tons a year just before the war. In the past twenty years, the production of citrus fruits (oranges, lemons and grapefruit) has increased by 40 per cent, while the production of deciduous fruits (principally apples, pears, plums, cherries, peaches and apricots), has risen by 20 per cent. The United States is the leading producer of both categories and the increased output is due in no small measure to heavier crops in that country, though production in the United Kingdom, Italy and France has also been notably higher, the output of deciduous fruit in the United Kingdom having doubled since before the war.

From these figures a number of other important fruits – bananas, grapes and pineapples being the most important – are excluded. Reliable estimates of banana production are not available, though it is believed that output was maintained fairly well throughout the war, except in Jamaica, the leading pre-war exporter, where yields have been seriously affected by both disease and hurricane. Grape production has regained its pre-war level, and the output of pineapples has increased appreciably.

In addition, the world output of canned fruit has expanded steadily, being now more than 30 per cent higher than before the war, but the production of dried fruit has suffered some decline.

The expansion of world production of fruit, like that of meat, has not been accompanied by an expansion in world trade, though current exports of fresh fruit – about 6 million tons a year – are not far below the pre-war volume. Since the war there has been a marked recovery in the trade between West European countries, but currency difficulties have led to a fall in European imports from the United States.

DECIDUOUS FRUITS

Apples are the most important and most widely grown tree fruit, and are cultivated extensively in the cool temperate zones of Europe and North America, as well as in Australia, New Zealand, South Africa, China and Japan. Dessert and cooking varieties are the most important and most of the fruit is consumed fresh, but in France, Germany, the United Kingdom, and certain other European countries, cider apples are grown on a large scale.

Altogether, it is estimated that about 7 million acres and some 450 million trees are devoted to growing apples, the recent tendency having been to reduce the number of trees and improve the methods of cultivation, a process of specialized production which has been carried furthest in the United States and the British dominions. The crop varies considerably from year to year – in post-war years from as much as 15 million tons, exclusive of Russian production, to as little as 10 million tons – late frosts, rain during the blossoming period, or wet summers, all contributing to a decline in the yield in certain years. The principal producers are France (23 per cent), the United States (23 per cent), Germany (8 per cent) and the United Kingdom (7 per cent), but it must be remembered that the great bulk of the French crop and part of that in both Germany and the United Kingdom goes to make cider. In recent years, a great expansion in apple production has taken place in the United Kingdom, Italy, France and Austria, and there has been some increase in the United States and Canada. In the two latter countries nearly one-third of the crop is canned, dried or otherwise processed, but elsewhere processing is not common.

About 700,000 tons of apples a year are exported normally, and Italy, the Netherlands, the United States, Canada, Australia and Argentina are the principal exporting countries, with Germany and the United Kingdom the principal importers. The United Kingdom is the main outlet for Australian and New Zealand apples, but Australia has an increasing trade with Asiatic countries, particularly Malaya. Canadian apples go principally to the United States and the United Kingdom, while United States exports have tended to go more to Hong Kong, the

Philippines and Cuba than to Europe, which was their chief pre-war outlet. Germany is the chief market for supplies from Italy and the Netherlands.

Pears are cultivated in most countries where apples are grown but the crop is only about 3 million tons, Europe and the United States providing the bulk of the supplies, though Australia, South Africa, Argentina and Japan all produce fairly large quantities. In France, perry pears (used in the manufacture of an alcoholic drink) normally account for about one-half of the crop, but elsewhere most of the fruit is produced for dessert or cooking purposes. Canning is important in the United States and Australia.

Exports of fresh pears amount to about 160,000 tons a year, Italy, the Netherlands, Argentina, Australia and the United States being the principal exporters, and the United Kingdom, Germany and, to a lesser extent, Brazil, the main importers. The United Kingdom takes the bulk of the British Commonwealth exports but also draws on Italian and Dutch supplies. Most of the United States supplies go to other American countries, and Brazil is the principal importer from Argentina.

Plums, with an annual crop of about 2·5 million tons, usually rank third in importance among the deciduous fruits and are mainly produced in Central and South-eastern Europe and the United States. They are used for dessert and cooking purposes, for jam-making and canning, while those of the prune variety are dried. In the United States alone the output of prunes amounts to about 200,000 tons a year and, apart from dates, the prune is the most important dried tree fruit. Italy and Yugoslavia are normally the leading exporters of fresh plums and the United Kingdom the chief importer, but exports, at about 40,000 tons, are currently less than half those in 1938.

Cherries are grown throughout Europe, but particularly in Germany, Italy and other Central European countries. Outside Europe, commercial production is mainly confined to the United States, though in parts of Canada and Australia, and in Turkey, the fruit is grown fairly extensively. Annual production is normally about 1 million tons.

Italy is the only large exporter of fresh cherries, about 16,000 tons going, in the main, to the United Kingdom, Switzerland, Germany, Austria and Belgium. A large part of the world output is used for various processing purposes, and considerable quantities in the baking trade. Difficulties of packing limit international trade in the fresh fruit.

Peaches can be grown in most warm temperate climates but the United States accounts for 65 per cent of the world production of some 2·3 million tons, and Italy for a further 12 per cent. The trade in fresh fruit – no more than about 50,000 tons a year – is usually between neighbouring countries, Italy being by far the main exporter. Considerable quantities of peaches, however, are canned or dried, and in

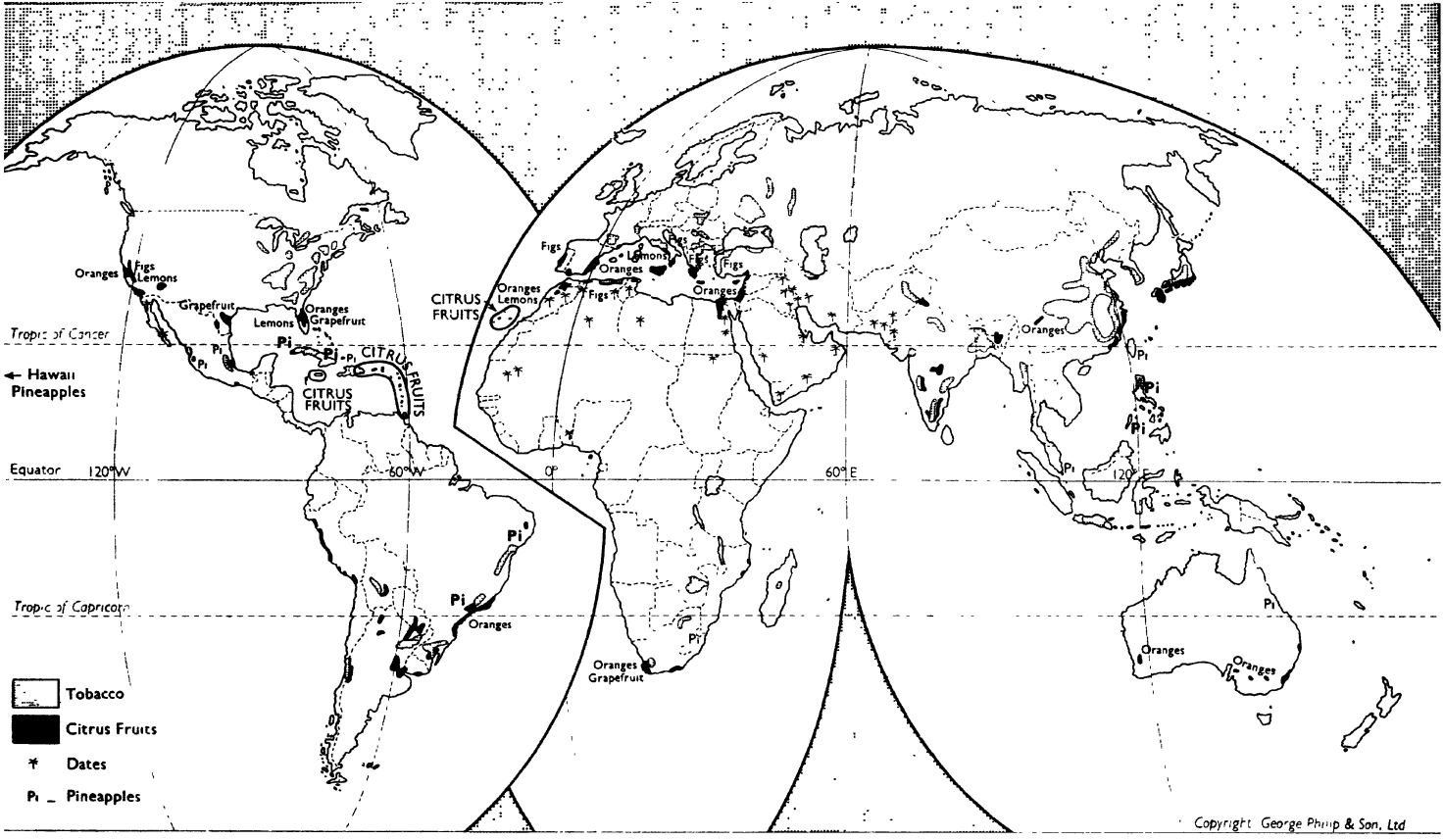


Fig. 37. World production of citrus fruits and tobacco

California nearly 75 per cent of the crop is used in this way. Since the war the production of clingstone peaches, the main variety used for canning, has increased considerably. Half or more of the Australian and Canadian crop is processed.

Apricots are grown mainly in the United States, but also in most Mediterranean countries, in Persia, Australia and South Africa, total production being about 600,000 tons. The trade in fresh fruit is small and local, but there is a fairly large demand for canned and dried apricots and for apricot paste and pulp.

All the fruits considered above belong to the vast family of *Rosaceae*, related to the rose, and so do a good many soft fruits which are grown in cool temperate climates for consumption fresh or for jam-making. These include strawberries, loganberries, raspberries and blackberries. The red, black and white currants, and gooseberries, used for similar purposes, belong to the family *Grossulariaceae*. In the warm temperate zones almonds, walnuts and chestnuts are grown for consumption and small quantities enter into international trade.

CITRUS FRUITS

Citrus fruits flourish in and are native to the warm east coasts but are now cultivated most extensively in the warmer, mainly frost-free* areas of countries with a Mediterranean-type climate.

Despite an increase of some 30 per cent since 1938, the crop of *oranges* in the principal countries, now close on 10 million tons, still falls short of world production of apples, though the amount which enters into international trade (nearly 2 million tons) is more than twice as high. The most common kinds are such sweet varieties as Navels and Valencias, but mandarin oranges (tangerines) and bitter oranges are important in some countries. In recent years, and especially during the war, there has been a marked increase in the production of processed orange juice, particularly in the United States.

The chief growing countries are Spain, Italy and Israel in the Mediterranean, the United States and Brazil in America, and Japan, China and India in Asia, but there is a large and increasing production in a number of other countries, notably South Africa, Australia, the British West Indies, French North Africa, Mexico and Argentina. Altogether about 2¾ million acres and 270 million trees are devoted to oranges. The United States alone accounts for very nearly one-half of world production and in recent years expansion has been particularly rapid in Florida; production in the United States is now 70 per cent greater than just before the war. Brazil comes next with 12 per cent of world production, followed by Spain with 8 per cent.

Since the war Spain has regained the position which she lost during

*In 1946 frost did extensive damage to Spanish orange trees.

the Spanish Civil War of being the world's principal exporter of oranges and now accounts for nearly 40 per cent of the oranges entering into trade. The other main exporters are the United States, Italy, Algeria, South Africa, Israel, French Morocco and Brazil. The Mediterranean countries and the British West Indies export oranges in the northern winter, and South Africa and Brazil in the northern summer, so that supplies are available throughout the year. Before the war, the United Kingdom was the principal market, taking about 35 per cent of the total quantity entering international trade. In recent years, France, the United Kingdom and Germany have all been large importers (taking 15–25 per cent of the total each), followed by Canada, Belgium, Sweden, the Netherlands, and other European countries. France is now the main market for Spanish oranges, but also receives considerable quantities from Algeria and French Morocco. Germany draws upon these same sources as well as Italy, while the United Kingdom imports from South Africa and Israel, Spain and Brazil. South Africa, Israel and Spain also supply Belgium, the Netherlands and Scandinavia. The main markets for the United States and Brazil are Canada and Argentina respectively, and Belgium has been the only European country to take large quantities of United States oranges since the war.

Grapefruit came into prominence after the First World War and are now grown in most citrus-growing countries, though, of the world production of 1½–2 million tons, the United States produces 90 per cent or more, Florida and Texas being the main growing areas. Before the war about two-thirds of the United States crop was sold for consumption fresh, but the canning industry has expanded rapidly since then and now accounts for rather more than one-half of the heavier supplies. Elsewhere, grapefruit production has been extended in Cyprus, French North Africa and Spain, and there have been developments in Jamaica, Trinidad and British Honduras, the latter primarily for canning or juice extraction.

Trade in the fresh fruit, at about 130,000 tons a year, is now well above the pre-war average, with the United States, Israel and South Africa sharing the bulk of the trade between them, though Cyprus is also an important supplier. Nearly one-half of world trade consists in United States grapefruit being sent to Canada. The United Kingdom takes the bulk of what remains, being the principal outlet for South African and other Commonwealth supplies, as well as for those from Israel.

Unlike that of oranges and grapefruit, the world production of *lemons* has shown little or no expansion in the past quarter of a century, though the position of the two principal producers has been reversed. From 1924–8 Italy (mainly in Sicily) produced an average annual crop of about 460,000 tons, and the United States 225,000 tons. From 1949–51, the United States produced 426,000 tons and Italy 276,000

tons. Together they produce about 80 per cent of the total crop (excluding Communist countries) of some 900,000 tons, though Spain, Argentina, Greece, French North Africa, Australia, the Lebanon, Israel, South Africa and Cyprus all contribute to total output. Most of the fruit is disposed of fresh, Italy marketing well over half of the 200–230,000 tons that enter into trade, Spain being the next largest exporter. In recent years Germany has been the largest importer, followed by France, the United Kingdom and Canada, with many European countries taking smaller amounts. Canada has recently imported lemons from Italy as well as from the United States.

In each of the principal producing countries fairly large quantities of lemons are used for the manufacture of juices and pectin. At one time citric acid was an important by-product in Italy, but other means are now used to produce this chemical.

GRAPES AND WINE

The annual production of grapes ranges from about 25–35 million tons – more than all the other fruits grown in temperate regions put together – but since 85 per cent or more is used for making wine, only some 2 million tons are consumed fresh and, of these, not more than 200,000 tons enter into international trade. A further 2 million tons are dried, yielding about 500,000 tons of raisins and currants of which 2-300,000 tons enter into trade.

About 20 million acres are devoted to viticulture, 16 million acres of this total being in the countries bordering the Mediterranean. France, Italy and Spain are the principal countries, followed by Algeria, Portugal, Hungary, Yugoslavia, Rumania, Bulgaria, Greece and Turkey. The vine is also cultivated in Syria, Cyprus, French Morocco and Tunisia, and, outside the Mediterranean, in Germany and Austria. The United States (mainly California), Argentina and Chile have the largest acreages outside Europe, followed by South Africa and Australia. In all these countries steady progress is being made in extending the cultivation of grapes.

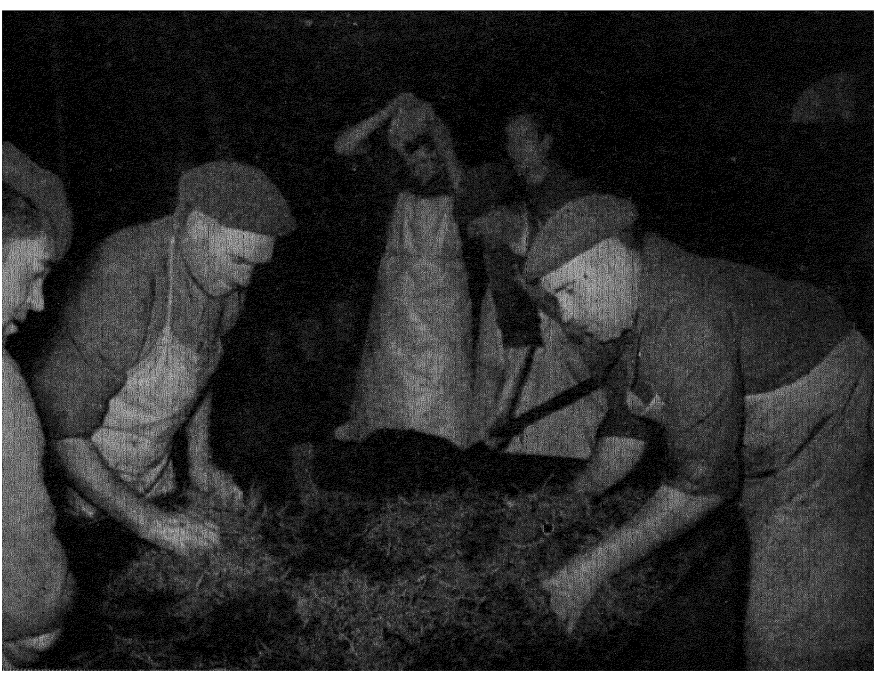
The vine has a long tap root which enables it to draw water from great depths, so that production can be carried on where total annual rainfall is small, but a long, hot, dry summer is essential, with an average temperature of at least 60°F. in September. Outside areas with a Mediterranean-type climate, it is necessary to plant the vines on hill-slopes with a southerly aspect, as is done above the Rhine and the Moselle. Too much moisture promotes the spread of fungi and the vine is subject to other diseases. In the 'sixties of last century, phylloxera, which spread from America, damaged millions of acres in France.

Wine production requires much capital and skilled labour, and its character is greatly affected by slight variations in soil and climate so

that the various types are limited to particular localities. In France, champagne is produced from the fruit grown on the chalk hills of the province of that name; burgundy from the Côte d'Or, near Dijon. The neighbourhood of Bordeaux is famous for the production of many well-known wines, red wines, which are known as claret, and such white wines as Sauternes and Graves. Hock is the name applied to the German white wines grown on the banks of the Rhine, and Chianti is the best-known red wine of Italy. Sherry, port and madeira are 'fortified' wines – that is, wines to which brandy has been added before fermentation has ceased – the first coming principally from Spain, the second from the basin of the Douro, in Portugal, and the third from the volcanic soils of Madeira.

The output of wine is about 4,000 million gallons a year, of which France and Italy each produce about 25 per cent and other Mediterranean countries a further 25 per cent. Outside Europe, the United States and Argentina each produce about 5 per cent and Chile, South Africa and Australia smaller quantities. The consumption of wine is large in all Mediterranean countries and only Algeria exports a large part of its total production, mainly to France. Of the total exports of some 335 million gallons, Algeria exports about two-thirds. Exports from Portugal, France, Spain and Italy – between 20 and 30 million gallons in each case – account for most of the rest. South African exports, though small, are increasing. The principal importers, apart from France, are Germany, Switzerland, the United Kingdom, Angola and Belgium.

Fig. 38. In the Mèdoc, the grapes are sieved to separate the stalks



In *fresh grapes* there is a fairly large trade between European countries and between the United States and Canada. Overseas shipments are largely confined to exports from South Africa to the United Kingdom.

The bulk of the commercial output of *raisins* is produced in the United States (about 200,000 tons), Turkey, Australia and Iran (each about 40–50,000 tons), followed by Greece, Spain and South Africa. *Currants* come almost entirely from Greece (80,000 tons) and Australia (15,000 tons). Practically the whole of the United States output is produced in California. Of the quantities entering into trade, Greece provides about 31 per cent and the United States, Turkey and Australia about 15 per cent each. The chief importers are the United Kingdom, Germany and Canada, though Eire, New Zealand and the Netherlands also take considerable amounts. The trade has not yet resumed pre-war proportions.

TROPICAL FRUITS

Bananas are the fruit of a soft-stemmed tropical plant which grows from 8 to 12 feet high and has very large leaves. The plant is subject to damage both by tropical storms and disease, and requires careful cultivation and weeding, but the fruit is highly nutritious and the yield is forty times as great as that of the potato and over one hundred times that of wheat. The fruit is commonly grown on comparatively small and widely scattered plantations so that statistics of total production are not everywhere available, but it is the staple diet of many of the natives of the tropics, and is eaten raw or cooked, or crushed into meal and made into cakes. The stem is used in the paper industry and as manure, and the soft inside as sponge and soap combined, while the juice produces a fast dye. The plant is propagated from the side shoots or suckers from the stem since the cultivated banana has no seeds, and each plant produces one branch or stem of bananas weighing about half a hundredweight.

In temperate lands the banana owes its importance to the development of the refrigerated ship and exports now amount to about 2 million tons each year, as compared with an annual average just before the war of nearly 2·3 million tons. The principal exporters are the Republic of Honduras, Costa Rica, Brazil, Ecuador, the Canary Islands, Guatemala, Mexico, Colombia and Panama. Before the war Jamaica was the chief exporter, but the effects of the war itself, which resulted in a cessation of shipments to the United Kingdom, and of hurricanes and disease, have reduced Jamaican exports to less than those of all the countries listed above, though extensive re-planting is taking place and exports may be expected to increase. Formosan exports too, which used to be considerable, seem to have been a war casualty. On the other hand, the British Cameroons, Guadeloupe and Ecuador have become exporters

on an increasing scale. An increase in African and South American production as a whole has gone a long way to make up for a decline in exports from Central American and Caribbean countries.

The United States is by far the world's largest market and takes well over one-half of the bananas entering into international trade, including nearly all those from Honduras, Panama, Guatemala and Cuba, and a large part of the Costa Rican, Ecuadorian and Colombian supplies. France, the United Kingdom and Argentina come next, France importing mainly from French possessions and the United Kingdom from Jamaica, the British Cameroons and, to a lesser extent, the Canary Islands. Other European countries account for the bulk of the remaining trade, and Japan, which imported large quantities from Formosa in pre-war days, has imported very few bananas since the war.

Pineapples are the fruit of a low plant which sends up long, pointed leaves in the middle of which grows the pine. Indigenous to Brazil, it has now been introduced into most tropical and sub-tropical lands and grows best near the sea, in a moist, light and fertile soil. Production in the principal countries amounts to about 1·3 million tons, one-half of this growing in Hawaii. Brazil, Mexico and Cuba all produce considerable quantities, and the Philippines, Formosa, South Africa, Australia, Malaya and Puerto Rico smaller amounts. Formosan and Malayan production, in particular, has not yet recovered from the effects of war, but elsewhere there has been a considerable expansion. The trade in fresh pineapples is small and amounts to no more than about 60,000 tons a year, the bulk of these supplies coming from Cuba and Mexico and going to the United States and Canada. South Africa, Brazil, the Azores and Australia are all regular exporters on a small scale and supply the rest of the world, particularly the United Kingdom.

There are many other tropical and sub-tropical fruits, such as the mango, the mangosteen, the papaw and the alligator pear, which are highly prized in the areas in which they grow but remain little known to commerce. Small quantities of Brazil nuts and ivory nuts from the South American forests enter into international trade.

DRIED TREE FRUITS

Of the tree fruits which enter into trade mainly in the dried form the date is the most important, followed by the prune and the fig.

Dates are produced mainly in South-west Asia and North African territories – a product of hot desert regions, wherever water is to be found. Reliable estimates of production are not available but over large parts of these areas the date is the staple food, each tree producing from 100–200 lb. of fruit a year. Commercial production in Iraq alone amounts to 300,000 tons or more a year; Persia, Egypt and Algeria each produces more than 100,000 tons a year, and French Morocco,

Tunisia and the Sudan perhaps half this quantity. Pakistan also produces dates on a fairly large scale and world production cannot be less than 1 million tons.

The dates entering into international trade (370,000 tons in the record year of 1951) come mainly from Iraq and India. The United Kingdom, the United States and Egypt are usually the principal markets, though there is a considerable native trade between neighbouring countries in Asia and Africa.

The production of *prunes*, now about 200,000 tons a year, has declined since before the war, largely because of a decline in Californian production, the United States being by far the leading producer. Production in other countries, of which Yugoslavia and France are now the most important, fluctuates considerably. Since the war exports have fluctuated from a high level of 150,000 tons to a low level of 35,000 tons, the United States supplying over 60 per cent and Yugoslavia much of the remainder. The United Kingdom is normally an important market but, in some post-war years, has taken no imports at all because of currency difficulties. Canada, Sweden, the Netherlands, Belgium and Germany are the only other markets which have taken more than token quantities from the United States in recent years.

Figs are native to the Near East but are now produced chiefly in Italy and have been successfully established in California, where part of the product is canned. The production of dried figs in Italy, Turkey, the United States, Greece, Algeria and Portugal – the principal producers – amounts to about 170,000 tons, rather less than before the war owing mainly to a decline in the Italian crop. About 50,000 tons a year have been exported since the war, principally from Turkey, Greece, Algeria and Italy. The United Kingdom, France, Germany and Sweden are normally important markets.

The drying of other tree fruits – peaches, apricots, apples and pears – is of little importance except in the United States, though Australia, South Africa and Canada all have a share in the trade. Before the war exports amounted to about 50,000 tons a year and of this as much as 90 per cent originated in the United States and was marketed in Western Europe. In recent years exports have been no more than about 10,000 tons a year.

CANNED FRUITS

The bulk of the world's canned fruit is both produced and consumed in the United States. Since 1938, world production has increased by more than 50 per cent and United States production (including Hawaiian and Puerto Rican canned pineapple) alone has doubled, but of the total American production of 1·5 million tons only about 40,000 tons is exported – less than one-third of the pre-war figure. Canned

peaches, pineapples, fruit salad, apples, pears, apricots, cherries, grapefruit and plums all go to make up the total.

Outside the United States, the British Commonwealth (the United Kingdom, Australia, Canada, South Africa and Malaya) produce nearly 300,000 tons of canned fruit a year, the Philippines, Cuba, Mexico and Formosa all can quantities of pineapple amounting to about 90,000 tons in the aggregate, and Japan cans oranges and small quantities of other fruit. Malaya's contribution is confined to pineapples but production has not yet reached anything like the pre-war figure. Pineapple-canning factories have also been established in Fiji and Jamaica but, up to the present, output has been small. These figures exclude the production of canned citrus fruit juices, the output of which has increased tremendously.

Most canned fruit goes into domestic consumption and currency difficulties have led to a big fall in United States exports which, before the war, provided one-half of the 300,000 tons of fruit which entered into international trade. World exports now amount to about 200,000 tons, with Australia and the United States each exporting about 20 per cent of this amount, and South Africa and the Philippines each about 15 per cent. The United Kingdom, though importing considerably less than before the war, remains the chief importer, followed by the United States (which imports large quantities of pineapple from the Philippines, Cuba and Mexico, as well as from Hawaii and Puerto Rico, which latter amounts are included in domestic production), Canada, Belgium and New Zealand.

TOBACCO

If the immense value of fruit in the human diet has become increasingly recognized in the past half-century and led to a considerable increase in both production and consumption as a result, it must be admitted that the tobacco industry has no such weight of opinion to commend it. Most doctors believe that the smoking habit is not unconnected with certain bodily conditions detrimental to health, not the least of them being cancer of the lung; tobacco has no food value; yet consumption has continued to rise up to the present time, despite the discovery by governments that they can raise considerable proportions of their income simply by taxing it. Indeed, the price of tobacco to the smoker is now determined less by the price of the leaf than by the amount of duty levied on it. In the United Kingdom, £84 million was derived from customs duties on tobacco in 1938 and £651 million in 1954, although the value of tobacco imports had only risen from £23 million to £83 million between these dates. Nevertheless, British consumption had gone up. In the United States, consumption has increased by 40 per cent since before the war; in Canada by even more than this.

Marked increases in consumption have taken place in most European countries, and everywhere the increase has come in cigarette smoking; the demand for pipe-tobacco, cigars and snuff has declined.

Since it was introduced to the Old World by Spanish sailors who learned its uses in America, tobacco cultivation has spread throughout the six continents. The plant, which is related to the potato and tomato family, grows best in sub-tropical and temperate climates, the chief areas of cultivation being the south-eastern United States, the West Indies, the Philippines, South-east Asia, Australia, various parts of East and South Africa, and, in Europe, from the Mediterranean to as far north as Sweden. No plant, however – not excepting the vine – is so easily modified by climate, soil and methods of cultivation and, since there are also different methods of curing, there is a wide range of types which compete with one another in different degrees. In the last half-century the Virginia-type cigarette has gained much in popularity at the expense of those of Oriental type, and the cigarette has gained ground which has been lost by tobacco in its other uses, mainly through the spread of smoking among women. These changes and differences in taste influence the type of tobacco which growers produce and the areas from which manufacturers draw their supplies.

Tobacco cultivation covers about 8 million acres and world production is estimated to be about 7,000 million pounds wet weight* (against an immediate pre-war average of 6,500 million pounds) of which the American and Asian continents each provide about 40 per cent. Of this total the United States, where increasing yields per acre have maintained production well above pre-war levels, produces 33 per cent, China 16 per cent, India 10 per cent, and Brazil, Japan, Turkey, Italy, Indonesia, Pakistan, Canada, France, Greece, Burma and Southern Rhodesia from $3\frac{1}{2}$ to $1\frac{1}{2}$ per cent each. In Canada and most Latin American countries, in Europe and the Near East, and in British territories in East and South Africa, production has increased considerably since before the war, but in Indonesia, the Philippines, India and Pakistan production has fallen, either because of political troubles, material and fertilizer shortages, or the need to increase the amount of food grown.

Of the world's total production not more than one-fifth enters into international trade, mainly because the largest producers – such as the United States, India, China and the U.S.S.R. – consume the greater part of their output. To total exports the United States contributes about 44 per cent, Turkey 11 per cent, India 10 per cent, and Southern Rhodesia, Brazil and Greece appreciable amounts. The smaller exporters include Indonesia, the Dominican Republic, Cuba, Algeria,

*The leaf loses about 10 per cent of its weight in drying and, when dry, may be stemmed or stripped, thus reducing the weight still further.

Nyasaland and Canada. As a proportion of the crop, United States exports have fallen considerably since before the war. Exports from non-dollar countries, particularly Turkey, Southern Rhodesia, Nyasaland and Northern Rhodesia, have tended to increase rapidly with post-war currency difficulties.

The United Kingdom, since it is dependent entirely on imported supplies, is the world's chief importer, taking perhaps one-third of the total. Imports from the United States are still very considerable but, faced with the difficulty of earning dollars, the United Kingdom has taken more tobacco from Southern Rhodesia and Turkey since the war. Germany, the Netherlands, and the United States itself (importing Turkish tobacco) are the other main markets, each of them taking about 10 per cent of the world's exports. Other West European countries, Egypt and Australia import on a smaller scale. The Chinese market, at one time the second largest outlet for United States tobacco, has now disappeared, but Hong Kong has, on occasion, imported fairly large quantities from India since the war. Much of Nyasaland's production goes to markets in British West Africa, Egypt and the Belgian Congo. It should not be overlooked that some countries re-export some of their tobacco imports, usually in manufactured form. In recent years, for example, the United Kingdom has exported about 50 million pounds of cigarettes each year, mainly to Malaya and Australia, and Hong Kong formerly imported large quantities of unmanufactured tobacco from China for the production of cigarettes for re-export.

In some countries, including the United States and the United Kingdom, tobacco is normally matured for anything up to thirty months before being withdrawn for manufacture. Thus, in a recent year, stocks in the United States stood at 3,300 million pounds, and in the United Kingdom at 450 million pounds (dry weight).

CONCLUSION

In this short survey of fruits and tobacco three things stand out: (1) the dominating position of the United States so far as actual production and consumption are concerned; (2) the general tendency for consumption to increase; and (3) the search by the rest of the world outside the dollar countries for alternative sources of supply. In the years immediately after the Second World War, United States exports of tobacco and canned fruit, for example, were only maintained at high levels by that country's contribution to various recovery programmes. It remains to be seen in this, as in other fields, how far the rest of the world can afford to buy from the United States in future. If the United States is not to continue to give away large gifts, this depends on how much the United States buys from the rest of the world.

Chapter 9

Sugar, Beverages and Spices

INTRODUCTION

The commodities dealt with in this chapter, like tobacco and rubber, are sometimes known as 'plantation' crops, recalling the time when they were produced mainly or entirely by 'planters' working with native labour on plantations overseas. The cultivation of most of them, however, is not now entirely confined to large estates and, with cocoa at least, the contribution of small, peasant holdings is by no means negligible. Since the war, too, the production of European beet sugar – one of the products of mixed and small-scale farming – has reached new high levels.

In general, the production of these commodities has regained or, in the case of tea and sugar, surpassed pre-war levels, but the trade in pepper has declined considerably owing to the effects of war on the Far East. The United States remains the principal importer of sugar, coffee and cocoa, and the United Kingdom the chief market for tea and the second most important outlet for sugar and cocoa.

SUGAR

Sugar occurs in the juices of many plants, but the commercial product is derived almost exclusively from the sugar cane and the sugar beet.

The *sugar cane* is a strong, perennial grass with a cylindrical stem which grows from 8 to 12 feet high, the sap of which when ripe is rich in sugar. It is grown as far north as southern Spain and as far south as Natal and New South Wales, but by far the greatest amounts are grown within the tropics. The climate should be hot and moist, with a total annual rainfall (or its equivalent by irrigation) of 40 to 100 inches, according to the slope of the ground and the degree of evaporation. Too much water makes the juice watery and favours the spread of cane diseases, but during its growing period the plant is highly susceptible to drought. In India and Java irrigation is often necessary, while on the coastal plain of Peru it is essential. The best yields are obtained where there is a temperature of from 75°F. to 80°F. all the year round, though

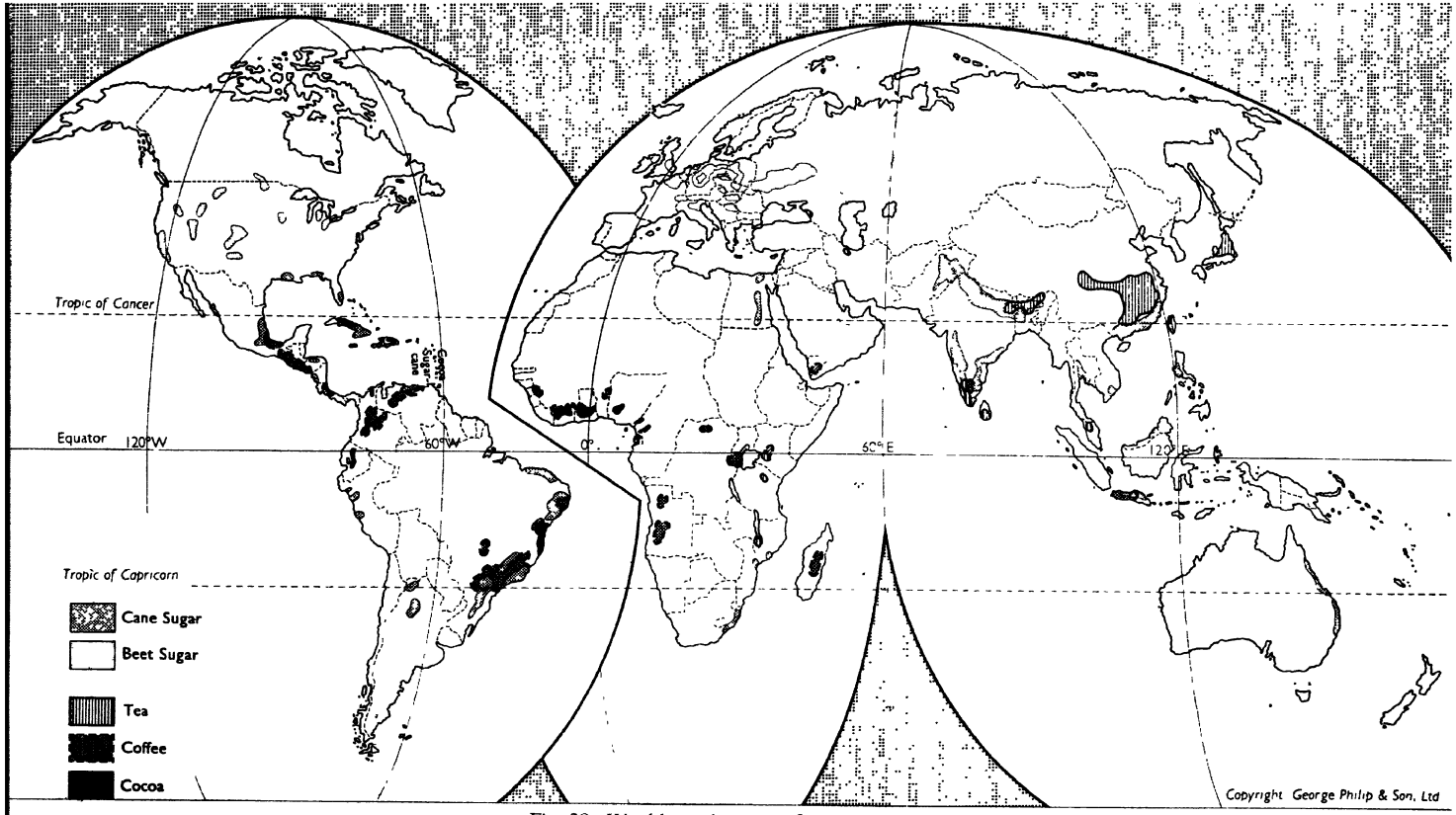


Fig. 39. World production of sugar and beverages

the greatest sugar content is found where temperatures are somewhat cooler as the plant ripens. The growth of the young plant is seriously checked by frost, which is a southern limit to production in the Australian cane region, and a northern limit in Louisiana. The sugar cane benefits from sea breezes, but violent winds are harmful to it and the occurrence of hurricanes is a disadvantage in some West Indian islands.

As there is no system of crop rotation, the soil tends to become exhausted, but vast areas exist in moist tropical lowlands where the cane can grow. Weeding is important and must be done by hand, so the industry has grown up where cheap labour was made available, in the first instance by the importation of Negro slaves and subsequently, in some plantations, by a migration of Indians. In recent times, however, mechanical harvesters have been introduced successfully and production elsewhere has been subsidized by governments.

After the stems have been cut, they are crushed between heavy rollers which extract three-quarters of the weight of the cane as juice. The juice is then boiled, with the addition of lime to thicken it, the raw sugar crystallizing out of the thick syrup, leaving molasses as a by-product. Molasses is used to make rum, alcohol and motor-spirit, and, with the crushed cane, to make a nutritious cattle food. The crushed cane is also used as fuel for the boilers of the sugar mill, or is made into cane-board or paper. Nowadays large capital investment is required for economical production, and owing to the low cost of sea transport, it is predominantly an island industry.

Sugar beet requires a cool climate with a sunny late summer for ripening, and summer temperatures between 60° F. and 70° F. Annual rainfall should be between 20 and 35 inches and should fall chiefly in spring and summer. Sugar beet is therefore grown on the cooler margins of the cattle and corn areas in North-west and Central Europe and in North America, primarily in the former where labour, though dear in relation to that of the tropics, is relatively cheap, for sugar beet requires a great deal of hand labour for planting and hoeing.

In the autumn, the tops are pulled off and the beets ploughed up and sent to refineries, where they are cleaned by machinery and cut up, the sugar being extracted with hot water. By-products produced include alcohol and cattle food, and methods of extraction have improved tremendously over the past century, so much so that, weight for weight, more sugar is obtained from beet than from cane, though cane yields more sugar to the acre.

The final refining process is the same for raw sugar obtained from both beet and cane. The sugar is dissolved and filtered to remove impurities, and further treated with animal charcoal to remove the colouring matter. The pure, colourless syrup is then evaporated and crystallized. Refining

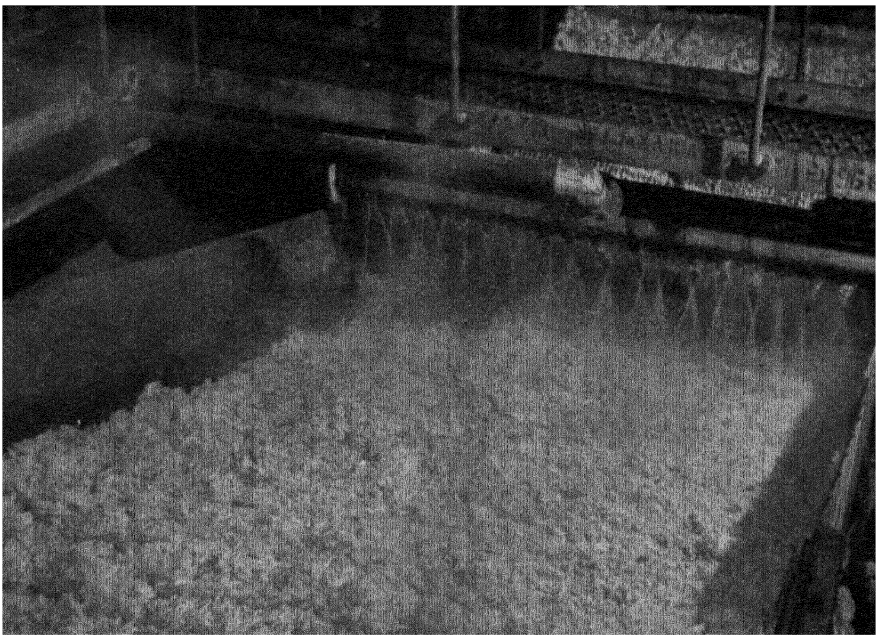


Fig. 40. Cut sugar-cane being passed through a mill in Jamaica

is usually done in the countries of consumption because of the difficulties of obtaining pure water, skilled labour and fuel in the tropics.

In addition to beet and cane sugar, small amounts of *maple sugar* are made, mostly in North America, from a juice exuded by the maple tree, the maple syrup having a flavour of its own. In tropical countries sugar is also obtained from many species of palm, including the Indian date palm, the coconut palm, the toddy palm and the sago palm. Glucose is derived from the starch of corn (maize) and potatoes, and sugar has even been manufactured from sawdust. Saccharin bears no relation to ordinary sugar except in sharing its quality of sweetness but, since its accidental discovery in 1887, has been widely used as a sugar substitute, particularly in times of war. It is especially valuable to persons suffering from such illnesses as diabetes, where sugar cannot be taken.

SUGAR PRODUCTION AND TRADE

World production of sugar now amounts to about 35 million tons, exclusive of 6 million tons or more of low-grade sugars, as well as molasses and other by-products. This total represents an increase of 40 per cent in production since the years immediately prior to the war, and consists of some 22 million tons of cane sugar and 13 million tons of beet sugar, the output of the former having increased by nearly 40 per cent and the latter by about 20 per cent.

The post-war increase in the production of cane sugar has been

particularly marked in the western hemisphere, and in Indonesia and Formosa production is still well below pre-war levels. The biggest producers are Cuba (20 per cent of the total of all sugar), India, Brazil and Puerto Rico (4–5 per cent each), Hawaii, the Philippines, Australia and Mexico, though Argentina, the Dominican Republic, Formosa, Peru, South Africa, Mauritius and Indonesia all produce quantities exceeding 400,000 tons, and the United States is not far behind. In addition, India and Pakistan together produce some 4 million tons of low-grade sugars.

So far as beet sugar is concerned, the only major producer outside Europe and the U.S.S.R. is the United States, though cultivation has increased considerably in Canada, Turkey and Iran. In Europe, in particular, weather conditions cause considerable annual variation in yields. In normal years, the biggest producers are the U.S.S.R. (about 7½ per cent of the world total of all sugar), Germany (5 per cent), the United States (4 5 per cent), France (3½ per cent), Poland, Czechoslovakia, Italy and the United Kingdom.

Cane sugar, of course, accounts for the bulk of the sugar entering into international trade and is an important export crop in most producing countries. In Cuba, Mauritius and Barbados the export trade is almost entirely dependent on sugar and sugar products, and they account for about one-half of the value of all exports in British Guiana, Hawaii, Fiji, the Dominican Republic and Puerto Rico. Beet sugar, on the other hand, is produced primarily for domestic consumption, although some beet-producing countries – notably the United Kingdom, France, Czechoslovakia, the Netherlands and Belgium – maintain an export trade in sugar which they have imported and refined. In recent years exports have not increased in the same proportion as production owing to increased domestic consumption of cane sugar among such producers as South Africa, Mexico and Brazil, and to the development of beet production in some countries with the object of reducing dependence on imported supplies.

Between 12 and 13 million tons of sugar now enter into international trade each year, and no less than 40 per cent of this total is exported from Cuba, approximately one-half of the Cuban total going to the United States. Indonesia, the second largest exporter before the war, has exported negligible quantities since, and Formosan exports have been very considerably reduced. In recent years the other main exporters have been Puerto Rico (7 per cent), Hawaii (7 per cent), the Philippines, the United Kingdom (the export of imported sugar after it has been refined), Mauritius, the Dominican Republic and Australia.

The principal importers are the United States (taking 40 per cent of world exports) and the United Kingdom (18 per cent), followed by Japan, Germany and Canada. Imports into Western Germany and

into Middle Eastern countries are much higher than they were before the war, but Japanese and French imports are still below pre-war levels.

Hawaii, Puerto Rico and the Philippines all produce quota consignments destined for the United States market. Cuba also fills large quotas for the United States, but is exporting substantially increased quantities to other markets, including the United Kingdom, other West European countries and Japan. Up to the end of 1959, British Commonwealth countries have a guaranteed market in the Commonwealth, and the United Kingdom also takes large quantities from the Dominican Republic. France and Portugal continue to take the bulk of the exportable surpluses of their own overseas territories, and Formosa continues to send much of its sugar to Japan, though it has a growing trade with other Far Eastern countries. Peru supplies other South American countries as well as exporting overseas to the United Kingdom, the Netherlands and Japan. Mexico and Brazil find their principal markets in Western Europe, and there is some trade between the European producers of beet sugar and their neighbours.

INTERNATIONAL AGREEMENTS

Sugar is a commodity the supply of which can be increased with relative ease and, as with certain other agricultural commodities, it is possible to speak of 'over-production' in some years in the sense that, in these years, the price which sugar fetches in the world market may fall so low that economic distress is widespread among its producers, particularly among the producers of cane sugar. An early attempt, in 1931, to regulate production failed because of expanded production in non-participating countries. In 1937 all the more important producing and importing countries concluded an international agreement and a further conference was called in 1953. In the meantime, in 1951, an agreement was concluded between the countries of the British Commonwealth making arrangements for the import of sugar into the United Kingdom from Commonwealth sources in certain quantities at agreed prices, the agreement to run at least until 1959. The problem of the disposal of the sugar surplus in the dollar area remains, and is not made easier by the desire of certain European countries to maintain partial self-sufficiency, even if the production of beet sugar is subsidized. The object of international agreements is to introduce some element of stability into the production and marketing of sugar and, at the same time, to provide efficient producers with what is agreed to be a reasonable remuneration.

COFFEE

There are two principal varieties of coffee – Arabian and Liberian – but Arabian (originally native to Ethiopia) is overwhelmingly the most

important in world trade and, by importers, the broad division usually adopted is into 'Brazils', meaning all coffees grown in Brazil, now by far the largest producer, and 'mild' coffees, 'mild' coffees being those which originate from other parts of the world.

Arabian coffee is usually propagated from seeds and allowed to grow about six feet high. It grows best in deep, virgin soils rich in vegetable humus and, since it cannot stand continued frost, has a narrower range than tea. The average summer temperature should exceed 70°F., the mean temperature of the coolest month being generally over 52 F. On the other hand, during the period of early growth the coffee plant cannot withstand the direct rays of the sun and, where grown in lowlands, is propagated under shady trees like the banana and cinchona or catch crops like maize and beans. In most areas rainfall is between 75 and 120 inches a year, but coffee can be grown in dry regions, the yield being low but the coffee of high quality. It flourishes best on well-drained slopes at heights of 3,000 feet or more, and on the leeward side of hills where it is protected from strong winds and where shade trees or mists shield it from brilliant sunshine. The famous mocha coffee, for example, grows best on the coffee plantations of Yemen in southern Arabia where it is sheltered by the mists of the Red Sea coastlands. Jamaican Blue Mountain coffee is another variety of high quality.

The berries are usually picked when dark red and, when dried, are 'hulled' or peeled and graded according to size, the larger berries usually fetching a higher price. At the place of consumption they are roasted and ground, and sometimes mixed with chicory, which is prepared from the root of a plant found wild in North Africa, North India, Siberia and over a large part of Europe.

Production in the principal producing countries now amounts to rather more than 2 million tons, and of this total Brazil produces about 54 per cent, and Colombia, the second largest producer, a further 15 per cent. El Salvador, Guatemala, Mexico, Uganda and Venezuela all produce 2 per cent or more of the total, and coffee production is significant in other Central and South American countries, in Indonesia, India, Angola, Madagascar, French West Africa, Tanganyika and Kenya. Brazilian production declined steadily from 1938 to 1944 when the crop amounted to only 13·5 million cwt., or about half the 1938 total, a decline which was attributed to low prices, a drift of labour to the towns and a succession of bad seasons. Since then there has been a slow recovery to 22·0 million cwt. in 1954, a total still well below pre-war levels, though high post-war prices have encouraged new planting and heavier crops may be expected in the future. One of the most prominent features in the post-war coffee situation has been considerable expansion in African production, particularly in French West

Fig. 41

Africa, Angola and Uganda. The African continent as a whole now accounts for some 15 per cent of world output as compared with about 8 per cent before the war. Production in Asia, on the other hand, has fallen sharply, largely because of the great decline in Indonesia.

In recent years, no less than 85 per cent of the total crop has been exported, so that, despite some decline in production, exports have exceeded pre-war levels. Brazil contributes more than 50 per cent of the total, followed by Colombia (15 per cent), El Salvador, Angola, French West Africa, Mexico, Guatemala and Uganda. Indeed, most of the main producers export the bulk of their crop.

Before the war world trade in coffee consisted mainly of shipments from Latin America to the United States and countries in Central and Western Europe. The European trade was disrupted by the war and has never been restored to anything like the pre-war dimensions owing to currency difficulties. The United States has thus become even more important as the outlet for Latin American coffees. Since the war, the United States has imported about 24 million cwt. of coffee each year – 60 per cent more than the pre-war average – and takes about 64 per cent of the Brazilian exports as well as 90 per cent or more of those from Colombia, El Salvador, Guatemala, Mexico, Honduras and Nicaragua.

France, the second largest importer, now imports about 3 million cwt. a year, Belgium 1 million cwt., and Italy, Germany, Sweden and the United Kingdom rather smaller amounts. In Germany imports are now only one-quarter of what they were before the war, and French imports are also below pre-war levels. United Kingdom imports, however, have increased considerably. Even before the war, tropical dependencies were supplying an increasing proportion of Europe's coffee requirements and, since the war, dollar currency difficulties have strengthened this tendency. Portugal now depends almost entirely on Angolan supplies, Spain on those of Spanish Guinea, and France on those of her overseas territories. Outside Europe, Canada and Argentina

have become more important markets for the countries of Latin America.

As is apparent from these details, the bulk of the world supplies of coffee is consumed in America and especially in the United States, where consumption at about 16 lb. per head is 3 lb. more than before the war. Consumption in Belgium is as high and has also increased. In Scandinavian countries, France and the Netherlands, consumption, although still comparatively high, has declined, and German consumption in particular remains well below pre-war levels. Coffee has become more popular in British Commonwealth countries since pre-war days but, even so, annual consumption is only about $4\frac{1}{2}$ lb. per head in Canada and $1\frac{3}{4}$ lb. per head in the United Kingdom.

TEA

Tea is the name given to the dried leaves of several shrubs and trees allied to the camellia, one of the hardiest of sub-tropical plants. It has been known for thousands of years in China but was not introduced into England until the seventeenth century and did not become the most popular beverage there until the nineteenth century.

For cultivation tea requires from 60 to 300 inches of rain and a generally warm temperature, though the plant will withstand occasional frosts. Since it will not bear excessive moisture round its roots, it must be grown on well-drained hillslopes, on a soil with a high iron and vegetable humus content, and acid in character. Tea can be grown as far west as Gibraltar, as far north as Tiflis in Trans-Caucasia, and along much of the east coasts of North and South America, Australia and South Africa, but since it requires cheap hand labour and skilled picking extensive commercial production is confined to the skilled labour regions of the monsoon lands, China, India, Ceylon, Pakistan, Indonesia and Japan.

The shrub is kept to a height of about five feet by trimming. In China, there are only three or four pickings a year, but in Assam there are as many as sixteen and in Ceylon even more. The fermented 'black' tea, popular in England, requires machine manufacture and is largely associated with plantation cultivation which assures a regular supply of leaf to the factory. The plucked leaf is 'withered' for twenty-four hours, rolled, sifted, fermented and dried, and then sorted into grades. The unfermented 'green' tea of China and Japan is predominantly peasant produced, the leaf being steamed, rolled and fire-dried. Generally speaking, the slower the growth, the more flavour there is in the leaf. Broken leaves, stalks and fragments are compressed into brick tea which is sold in Central Asia and eaten as a vegetable. 'Maté' or 'Paraguay tea' is not really tea at all, but is prepared from the leaves of the South American holly.

India, Pakistan, Ceylon and Indonesia are parties to an International Tea Agreement which allows of some expansion in production in the near future. In recent years production in the main producing countries, excluding China, has amounted to nearly 1,300 million pounds, an increase of nearly 30 per cent over the average annual output immediately prior to the war, though this is due as much to the growth of heavier-yielding strains as to an increase in acreage. India contributes 50 per cent to this total, Ceylon 25 per cent, Indonesia 8 per cent, Japan 7½ per cent and Pakistan 4 per cent. The Soviet Union, Formosa, Nyasaland and Kenya are all producers on a smaller scale, and small quantities of tea are produced in Iran, Uganda, Malaya and Tanganyika.

Total exports, at close on 1,000 million pounds, have recently reached record levels and are rather higher than those immediately before the war. These figures do not include Chinese exports to the U.S.S.R. and Eastern Europe but do include 15 million pounds of Chinese tea exported to other parts of the world. Total exports from China in 1938 amounted to 92 million pounds.

Of the total, India exports 45 per cent, Ceylon 31 per cent, Indonesia 9 per cent, and Pakistan 5 per cent. The whole of the Nyasaland crop is exported, and most of that from Formosa and Kenya. Apart from China, Japan is the only other important exporter.

The bulk of the world trade in tea is between countries of the British Commonwealth, the United Kingdom alone taking more than 400 million pounds a year, or about one-half of the world's imports. Other Commonwealth countries, together, import about 130 million pounds of tea, and consumption in most of them has increased since pre-war days. The United States, however, is the second largest single importer, taking about 100 million pounds a year and remaining an important market for Formosa, Japan and Indonesia. Other tea-drinking nations of importance include Eire, Egypt, French Morocco, the Netherlands, Iran and the U.S.S.R. A noteworthy change in the tea trade has been the large decline in United Kingdom re-exports since before the war, her old markets, in the main, now importing directly from producers.

The United Kingdom, Australia, New Zealand and Eire are the world's chief tea drinkers, each of them consuming between 6 lb. and 8 lb. of tea per head of the population each year. Canada and French Morocco come next with about 3 lb. per head, followed by Ceylon, Egypt and the Netherlands with 1½–2 lb. per head. In the United States consumption is less than ¾ lb. per head, and in India and Pakistan – two of the chief producing countries – less than ½ lb.

COCOA

Cacao or cocoa beans were first brought to Europe by Columbus, and

South and Central America continued to provide the bulk of the world's needs until a generation ago. Nowadays, however, the British and French territories of West Africa are the main sources of supply.

The tree is an evergreen which grows from 12-25 feet high and the fruit – large, round, tapering pods about four inches broad and ten inches long – is borne on the main stem and branches. The conditions of growth include a uniformly high temperature of from 75°–85°F., and well-distributed rainfall totalling from 45–150 inches a year, so that the plant is confined to sheltered lowland areas within 13 degrees of the equator. Deep rich soils are essential, and cocoa attains its greatest economic importance in those parts of West Africa where population pressure compels the native to work. The pods are cut by hand, usually by skilled men pickers since the tree is easily damaged, and then collected by women, cut open, and the beans removed to be fermented and dried. The product is graded according to quality, 'fine' cocoa being grown in Ecuador, Venezuela, Trinidad, Ceylon and Indonesia, while 'ordinary' cocoa, which accounts for about 90 per cent of output, is produced in the West African territories and Brazil.

Cocoa is subject to severe damage by both insect and virus disease, and disease has, at times, seemed to threaten both world supplies and native economies. In British West Africa continuous efforts have been made to encourage the improvement of quality with considerable success, and nearly all the cocoa comes from small native plantings of a few acres or more. Prices fluctuate considerably and, with them, the prosperity of the Gold Coast where cocoa now accounts for some 70 per cent of the value of all exports. Marketing Boards have been set up in both the Gold Coast and Nigeria in an attempt to introduce some stability. The importance of maintaining the British Commonwealth cocoa industry, which is a dollar-earner, has also led to the examination of the possibilities of cultivation in Malaya, North Borneo, Sarawak and elsewhere, but it will be some time before production in these areas becomes significant.

World exports of cocoa – and most of the crop is exported – amounted to nearly 750,000 tons in 1939, three times as much as in 1913. By 1954, after the decline caused by the war, they had recovered to about 700,000 tons and current world production is not a great deal more than this. Of the total the Gold Coast exports 35 per cent, Nigeria 19 per cent, Brazil 15 per cent, and French West Africa and the French Cameroons together 16 per cent. Ecuador, the Dominican Republic and Venezuela export smaller quantities, and cocoa production is also of importance in Spanish Guinea, Sao Thomé and Príncipe, French Togoland, Trinidad, Costa Rica, Grenada, Ceylon and Western Samoa.

The United States is by far the biggest importer and takes 40 per cent of total exports, being the chief market for both British West African

and Brazilian cocoa. The United Kingdom, which imports about 16 per cent of the cocoa entering world trade, takes the bulk of the remaining Gold Coast and Nigerian crops as well as some part of Brazilian exports. France, the Netherlands and Germany each import about one-half as much cocoa as the United Kingdom, and there is some trade with other European countries, as well as with the U.S.S.R., Canada, South Africa and Argentina. There is a small trade in cocoa butter, which is removed from raw cocoa during the manufacture of drinking chocolate and added in the making of eating chocolate, the Netherlands and the Gold Coast being the principal exporters.

SPICES

Trade between East and West was built upon spices in the days when their use in food preservation (or to make ill-preserved foods tastier) was all-important. Their importance in world trade has long since diminished though they are still used for preservation purposes in the canning industry, and oils and extracts from spices have found new uses in pharmaceutical products and beverages. Synthetic vanillin, which was developed to replace the expensive vanilla bean, is a product of oil of cloves. In their native lands, particularly in tropical Asia, spices remain important for flavouring the food of rice-eating peoples, and an increasing population has strengthened local demands. They are now grown in a large number of tropical and sub-tropical countries, but commercial cultivation is still largely confined to the countries of origin. From the point of view of international trade, pepper, cloves and ginger are the most important, and to Zanzibar and Grenada spices are of major importance in the export trade.

Pepper, both black and white, is derived from the berries of a creeping vine native to Southern India, Ceylon and Malaya, but now cultivated extensively in Indonesia, Indo China and Sarawak as well. About 500,000 cwt. have entered into international trade in recent years (rather less than half the pre-war amount), the main exporters being India, Malaya and Indonesia. Indonesian exports have been very much lower than they were before the war. Indian exports, on the other hand, have expanded considerably and have become an important source of dollars since the United States takes about one-half of world exports, largely in the form of black pepper for the meat processing and canning industry. The United Kingdom, France and Germany are the other large importers but the amounts involved are considerably smaller than in pre-war days, particularly in Germany. Malaya has an import and re-export trade for Indonesian produce which has fallen with the decline in Indonesian production.

Cloves are the flower-buds of the clove tree, native to the Moluccas but long established in Zanzibar and Madagascar, which two places

now account for practically the whole of the commercial production. Exports, which amount to about 400,000 cwt. a year, have increased since before the war, the chief importers being Indonesia and India. Small quantities are used in the United States, the United Kingdom and elsewhere for perfumes, medicines and flavouring. Malaya handles practically the whole of the import trade on behalf of Indonesia, an interesting counterpart to its export trade in pepper.

Ginger is obtained from the underground tuberous stems of the plant *zingiber officinale* which is cultivated in a number of tropical countries. Sierra Leone, India, Jamaica and Nigeria together export about 150,000 cwt. of dried ginger, while China is the main producer of preserved ginger. The United Kingdom, the United States and Canada take most of the Jamaican and Sierra Leone exports, while Indian supplies go mainly to Aden (for re-export to Arabia and Africa) and to Arabia direct.

Nutmegs and *mace* are the product of the same tree (*myristica fragrans*), nutmeg being the seed and mace the dried outgrowth from the base of the seed. The plant is a native of the Moluccas but has long been established in the West Indies. Indonesia and Grenada supply most of the world's needs, together exporting about 130,000 cwt. a year, mainly to the United States, the Netherlands and the United Kingdom.

Cinnamon is the bark of a tree native to Ceylon and that island provides the bulk of the world's needs, though it is also grown in Indo China and the Seychelles. *Cassia* is a similar spice coming largely from China, Indonesia and Malaya. The United States, Mexico and the United Kingdom are the chief importers.

Capsicums and *chillies* are indigenous to Central and South America but are now grown extensively in India. They are eaten fresh or dried, and, finely ground, provide Cayenne pepper. Paprika is of the same genus and is cultivated in Spain and Portugal as a vegetable. India is the chief exporter, though the quantities involved have declined, and Mexico, Uganda and Nigeria also take part in the trade. Ceylon is the main market, followed by the United States and Germany.

Pimento or *allspice*, the dried unripe fruit of a tree related to the clove, comes principally from Jamaica and is exported mainly to the United States, the United Kingdom and Germany.

Cardamoms are the dried seed of a plant of the family of gingers, and India and Ceylon are the main sources of supply, though Indo China was an important exporter before the war.

Vanilla is the cured pod of an orchid indigenous to Central America but now cultivated commercially in Madagascar and French Oceania. The United States, Italy and France are normally the chief importers.

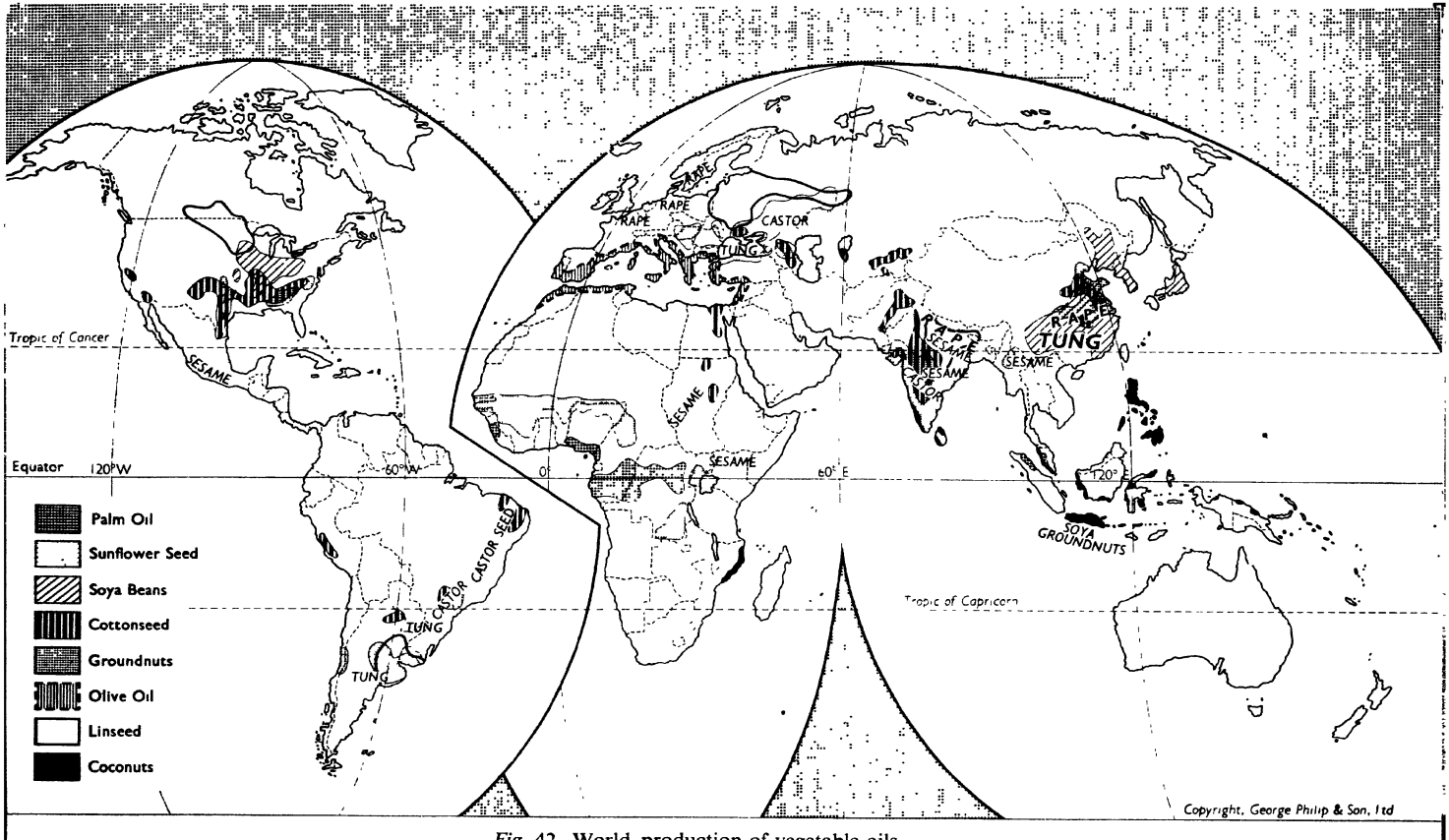


Fig. 42. World production of vegetable oils

Chapter 10
Vegetable Oils and Oil-Seeds

INTRODUCTION

There are a large number of fruits and nuts which are primarily of importance because of the vegetable oil which they contain. Commercially, the chief of these are coconuts, the fruit and kernel of the oil palm, groundnuts, linseed, soya beans and cottonseed and, together, these seeds and nuts account for 90 per cent of the vegetable oil which enters into trade.

There are others, however, which are grown extensively for consumption at home – rapeseed, sesame, sunflowers and olives in particular – and, of these, a growing proportion of sunflower seed and oil has entered into trade in recent years. Two more, castor seed and tung, are grown mainly for export, but are of relatively minor importance.

Most of these fruits and nuts assumed a new commercial significance at the end of the nineteenth century when the 'hydrogenation' or hardening process was discovered. By this means it became possible to raise the melting point of the oils which they yield, so that they were hard at normal temperatures and could be used in the manufacture of soap and margarine. Thus it was that a rapid expansion of production took place in tropical and sub-tropical regions, despite the fact that at this time, in the western hemisphere, mineral oils were largely replacing vegetable oils as an illuminant, a purpose for which they had hitherto been important. Nowadays, in addition to the use made of vegetable oils in the margarine and soap industries, large quantities are used in the manufacture of cooking fats, paints, varnishes, linoleum and lubricants, and, in almost every case, cattle-cake is a by-product of the seed- and nut-crushing processes.

Although, with modern technical discovery, the different oils are becoming increasingly interchangeable, it is still useful to distinguish between three broad groups. First, there are the 'edible' oils – groundnut, soya bean, cottonseed, sunflower, sesame and olive. Second, there is the 'edible-industrial' group, widely used for soap production as well

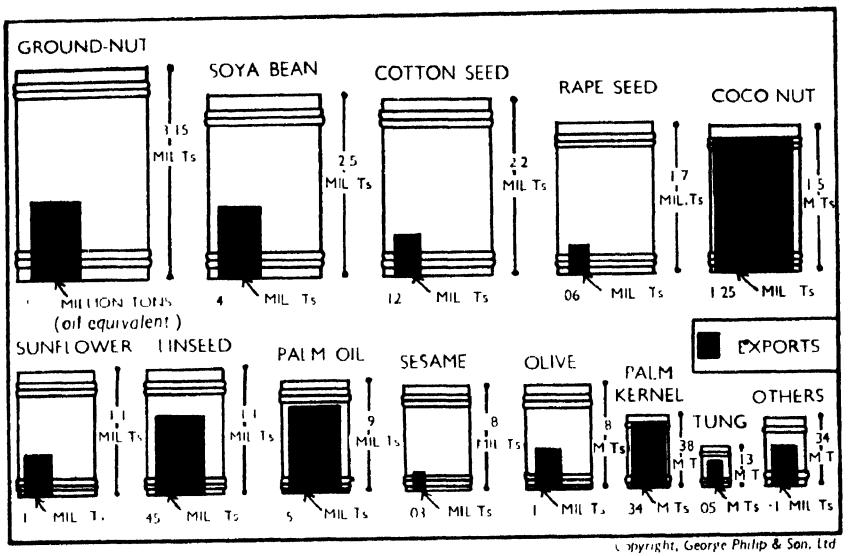


Fig. 43. World production and export of oil-seed crops

as for margarine, and comprising the palm, palm kernel and coconut oils. Third, there is the 'industrial' group, used chiefly for drying agents in the paint industry and for purposes of lubrication, and consisting of linseed, rapeseed, tung and castor oils.

Of these, coconut, palm kernel, palm, groundnut, cottonseed, soya bean and rapeseed are the oils most generally used for margarine manufacture, though in the United States animal fats are the principal source of margarine. Cottonseed and, more recently, soya bean and groundnut oils are of most importance in the manufacture of compound cooking fats; and coconut, palm and palm kernel are the chief soap oils.

All told, total world production is now round about 16·5 million tons a year, measured as oil or oil-equivalent, and, of this, nearly 4 million tons enter into international trade. Trade is rather smaller than it was before the war, though production is well above the pre-war level. Nearly two-thirds of the total is comprised of 'edible' oils, as defined above, but the 'edible-industrial' group, which accounts for less than one-fifth of total production, is relatively more important commercially since it supplies more than one-half of the oil-seeds entering into world trade. The principal producers of oil-bearing fruits and seeds are China (24 per cent), the United States (15 per cent), India (12 per cent) and the U.S.S.R. (8 per cent), while the principal importers are the United Kingdom and the other countries of Western Europe.

Although production has been stated in terms of 'oil equivalent', it must not be thought that oil is actually extracted from all the oil-

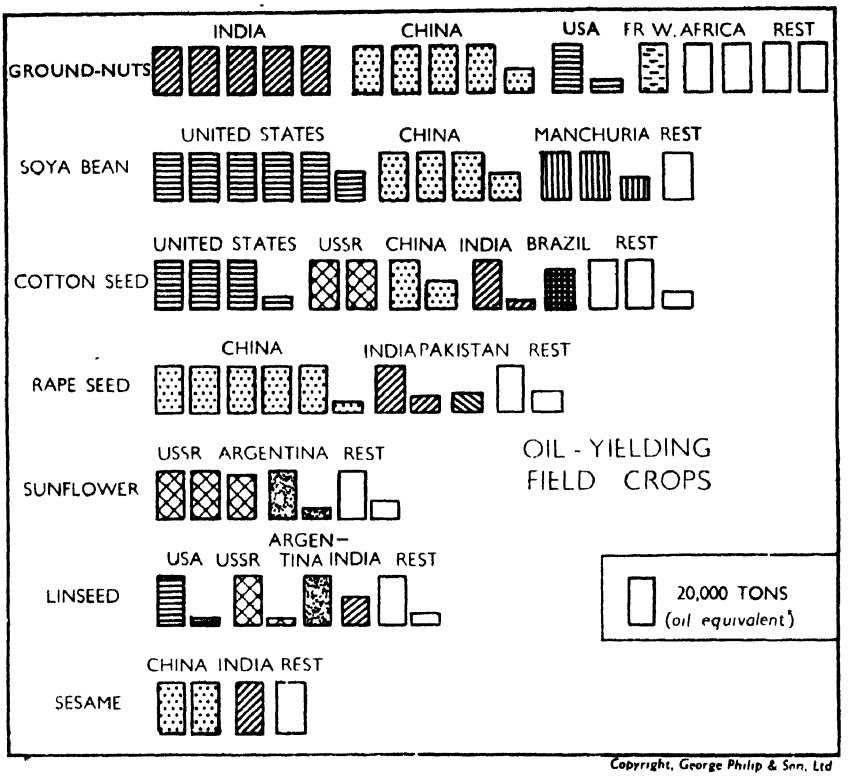


Fig. 44. Main producers of oil-yielding field crops

seed crops which are harvested. Groundnuts, for example, are used extensively for human consumption in most producing countries, and probably 40 per cent of the crop goes to satisfy human or animal needs directly. In China and other Eastern countries soya beans are grown primarily as a food crop, and large quantities of the cottonseed, sesame, sunflower, rapeseed, linseed and other crops are used in the same way.

In the post-war period the western hemisphere – particularly the United States – has tended to become more important as a producer of oil-seed, and hence the proportion crushed for oil has tended to increase. World production, however, although well above pre-war levels, has barely kept pace with the increase in world population and, if the animal fats – mainly butter and lard – which supplement the vegetable oils are included, the world, on a *per caput* basis, was slightly worse off for oils and fats in the early nineteen-fifties than it was in the nineteen-thirties.

The sections which follow give details of the cultivation and production of particular crops, and these are divided into field crops and tree fruits.

FIELD CROPS

1 – *Groundnuts*

Groundnuts or peanuts are the fruit of a leguminous plant – that is, a plant allied to the pea and the bean – which is widely grown in hot countries with a moderate rainfall, and particularly in India, China, West Africa and the United States. After fertilization, the flower-stalk bends over and forces the fruit into the soil (which should preferably be light and sandy) and there it develops into the familiar peanut. The plant itself can be utilized for fodder, and the groundnuts are one of the main sources of edible oils as well as a direct source of food for both human beings and livestock. The residue after crushing is made into oil-cake for fodder purposes and, recently, a synthetic wool-fibre, known as ardil, has been developed from the groundnut protein. Most of the nuts which enter into commerce are shelled before shipment in order to save shipping space, but the finest grades of oil come from unshelled nuts.

Some 28 million acres are devoted to growing groundnuts in the world as a whole, and the annual crop yields about 10 million tons of unshelled nuts, or 1·5 million tons more than before the war. Of this total India produces 35 per cent, China 30 per cent, the United States 10 per cent, French West Africa 6 per cent, and Indonesia, Nigeria, the Belgian Congo, Uganda, Brazil, Burma and the French Cameroons smaller quantities. United States production, in particular, has increased markedly since before the war, but there have been increases, too, in many of the countries with a relatively small total production. Both France and the United Kingdom plan to increase groundnut cultivation in the more sparsely populated areas of Africa by the use of mechanical methods, though the British have had to abandon some of their more grandiose schemes in Tanganyika. The aim in both cases is to raise native standards of living and, at the same time, to increase the supply of oil to Western Europe.

Exports of groundnuts – about 900,000 tons a year in recent years – are now less than half the amounts exported before the war despite the increase in production. This is largely because of increased domestic consumption in India – the world's leading exporter in 1938 – and disturbed conditions in a few minor exporting countries. But it is also due, in part, to the expansion of crushing industries in India and French West Africa which has led to a substitution of oil for nuts, though total exports of oil (about 190,000 tons a year) are no higher than they were before the war. The principal exporting regions nowadays are British

and French West Africa, and the United Kingdom and France are the chief importers, though other European countries take fair quantities. Altogether, groundnuts contribute some 14 per cent of the world's total vegetable oil supply, in addition to the large quantities directly consumed in the producing countries.

2 – *Cottonseed*

The cotton shrub flourishes in tropical, sub-tropical and warm temperate climates, provided there is an adequate water-supply and a comparatively long growing period. Since it is grown primarily for the fibre – the production of which is dealt with in Chapter 12 – it follows that cottonseed is a by-product. Nevertheless, it is a by-product of considerable economic importance, particularly in the United States. In other, less industrialized, countries, the necessary crushing plant is often lacking, and so is cheap transport from the ginnery (where the lint is separated from the seed) to the crushing plant – both of these being essential to economic oil production. Where these facilities do not exist, the seed is often fed direct to cattle or used as fuel or manure. Where it is produced, the oil is used principally in the manufacture of compound cooking fat and margarine, the residual cake being fed to cattle or used as a fertilizer.

The acreage devoted to cotton declined during the war and, in India particularly, has failed to make a complete recovery since owing to the pressure upon the land for growing food. Nevertheless, the estimated production of cottonseed, at 12–13 million tons, is not much below pre-war levels, though commercial utilization is much less than production. The main producers are the United States (30 per cent), the U.S.S.R. (16 per cent), China (13 per cent), India (10 per cent), and Brazil (7 per cent), but, in India (and Pakistan), particularly, most of the seed is fed directly to cattle.

Immediately before the war about 230,000 tons of cottonseed and cottonseed oil, in oil equivalent, entered into international trade, about 40 per cent of it in the form of oil. In recent years less than 200,000 tons, in oil equivalent, have been exported but 60 per cent has been in the form of oil and, as with other seeds, there is a tendency for crushing to take place in producing countries. The leading exporters of seed are now Pakistan, the Sudan and Uganda, and, of oil, the United States, Argentina and Egypt. The United Kingdom is the main outlet for seed from the Sudan and for oil from Argentina and Brazil. Pakistan seed goes mainly to India and United States oil largely to Canada, but exports generally are widely dispersed. Before the war the United States was the leading purchaser of cottonseed oil.

3 – *Soya Beans*

The soya bean, like the groundnut, is a leguminous plant the seeds of

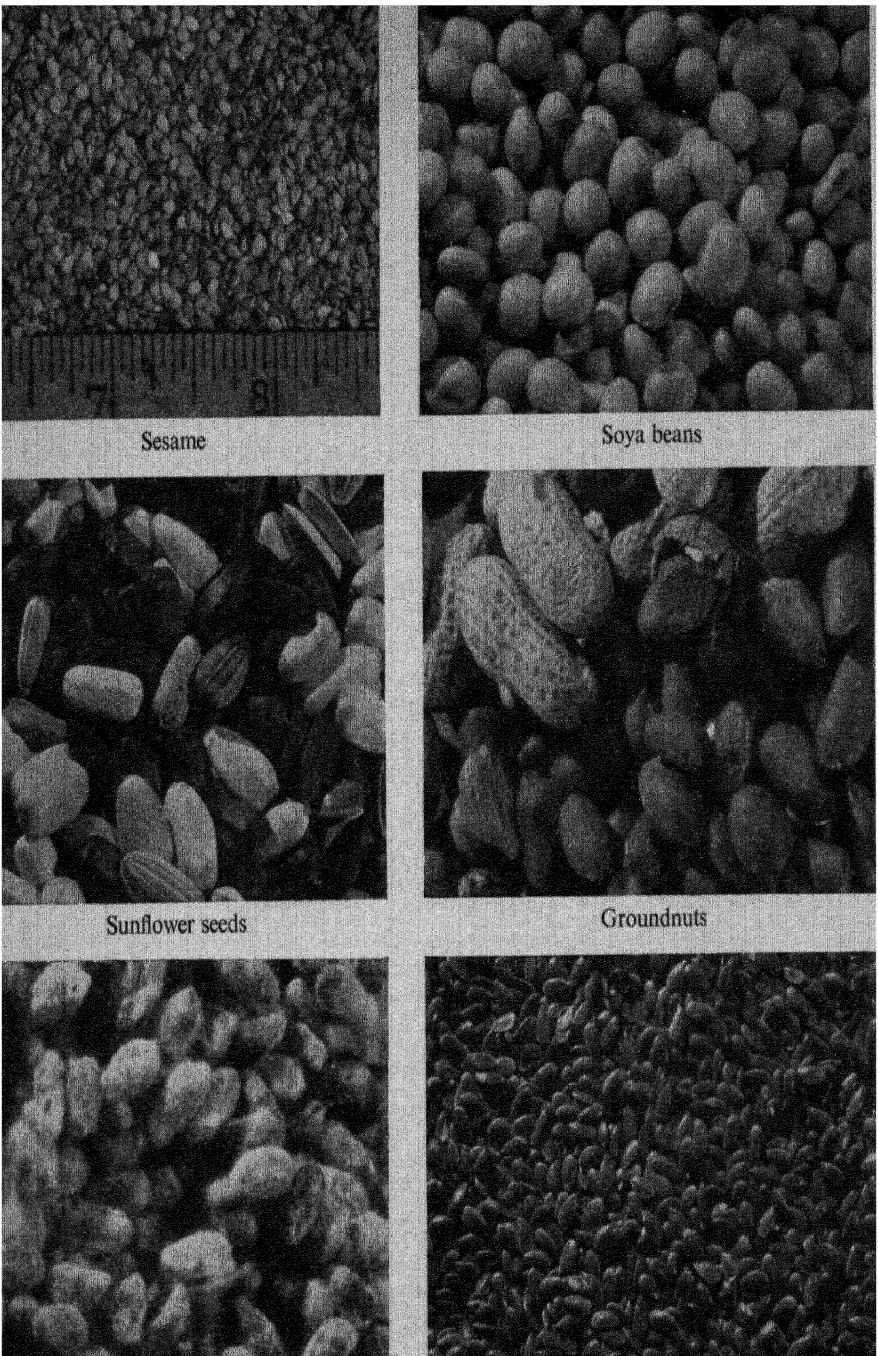


Fig. 45. Some oil-seeds (actual size)

which resemble peas and grow three to six to the pod. Until a generation ago its production was centred in China, Manchuria, Japan and Korea, to which part of the world it is indigenous, but the soya bean is now cultivated throughout the world in warm countries with a long, hot summer, and particularly in the United States. In the Orient it is a staple food, but the bean has many uses and is made into flour, soy sauce, adhesives and plastics, paper size and textile fibre, and has recently been used to produce cortisone, a drug used in the treatment of arthritis. The oil is mainly employed in the manufacture of margarine and cooking fats, but also in paints, varnishes and printing ink, while, as with other seeds, the residue is used for cattle fodder or fertilizers, or may be converted into flour or paste for human consumption.

World production has expanded by over 40 per cent in the past fifteen or twenty years and is now nearly 18 million tons a year. The United States has contributed most to this increasing total and has become the world's largest producer, growing 45 per cent of the crop. China, the world's leading producer before the war, comes next with 30 per cent, followed by Manchuria with 18 per cent, though Manchurian production, which is still well below pre-war levels, might be expected to increase given more settled conditions and better marketing opportunities. The rest of the world cannot approach these giants, but the soya bean provides a crop of some importance in Japan, Korea, Indonesia, the U.S.S.R. and Canada. It is also grown in parts of South-eastern Europe and Brazil.

In 1938 over 2 million tons of beans and 90,000 tons of oil entered into world trade, the leading exporter by a long way being Manchuria. Exports of beans have fallen well below this total since, owing to the smaller output in Manchuria. In the western hemisphere, the United States has become a leading exporter of both beans and oil, the oil equivalent of her exports amounting to 211,000 tons in 1950. In the immediate post-war years American exports went to Europe (largely under the European Recovery Programme), Japan and Canada, and Manchurian exports were largely diverted, it is thought, to the U.S.S.R. and China. Oriental exports to Western Europe might be resumed on a larger scale if there were any change in trading conditions.

4 – *Rapeseed*

Rapeseed is obtained from a number of species of the *Brassica* family and widely cultivated in temperate and warm temperate zones, often for sheep grazing. The oil is used as a lubricant and for 'quenching' steel plates and, in the East, for lighting purposes and as an item of diet, but neither the seed nor the oil enters much into world trade.

World production is estimated at about 5 million tons, an increase of 25 per cent over pre-war production, China contributing over 60 per

cent to this total. There is also extensive cultivation in India and Pakistan, and rapeseed is traditionally the most important oil-seed crop in Western and Central Europe, though the area under cultivation has diminished since the days when it was an important source of illumination. In Sweden, France and Germany, however, output has greatly increased since 1938, and Sweden is now the main source of exports.

5 – *Sunflower Seed*

The sunflower is native to Central America but was introduced into Europe in the sixteenth century and is now grown as far north as 55 °N. The kernels are eaten unprocessed by the peasants of the U.S.S.R. and the Balkans, and the stalks and leaves make good forage or ensilage for livestock. As an oil crop, the sunflower was first developed in the Caucasus and the Ukraine, though, in recent years, cultivation has tended to shift to the north-east, to Kazakhstan and western Siberia. The better quality oils are used for margarine, cooking fats and salad oils, while inferior grades are used in soaps, paints, varnishes and lubricating oils.

World production has expanded from 2·7 million tons in 1938 to about 4·5 million tons at the present time, expansion being most rapid in Argentina and, on a much smaller scale, in Hungary, Turkey, Uruguay, Yugoslavia, Chile and South Africa. The U.S.S.R. remains the principal producer, harvesting about 54 per cent of the crop, followed by Argentina with 21 per cent, but sunflower seed is important in most Balkan countries.

As primary producing countries have increased their crushing capacity the trade in seed has fallen sharply and, since the war, has rarely exceeded 25,000 tons, Turkey being the most important source of supply. In recent years Argentina has contributed over 90 per cent of the total quantity of oil exported – 110,000 tons in the peak year – and the United Kingdom has been the main market.

6 – *Linseed*

Unlike cotton, flax is grown for either fibre or seed since oil-flax yields an inferior fibre, although in some parts of Europe a dual-purpose variety is grown. Linseed is used largely in the manufacture of paints, varnishes, linoleum and printing inks because of its special drying qualities; in parts of Asia it is used as food and small quantities are made into soft soap.

Between 3 and 4 million tons of linseed are produced each year, mainly in the United States (about 30 per cent), the U.S.S.R. (20 per cent), Argentina (17 per cent), India (12 per cent) and Canada (4 per cent). United States and Canadian production has increased very greatly since

before the war, but Argentine production has fallen. Uruguay, Poland, Mexico, Sweden, Brazil and Turkey all produce smaller quantities.

In recent years exports from the principal exporting countries, as oil or oil equivalent, have amounted to more than 400,000 tons, the chief exporter being Argentina. with the United States, India, Canada and Uruguay all exporting considerably smaller amounts. As with other oil-seeds, the trend is towards the export of oil rather than seed. The United Kingdom is the principal importer, and the Netherlands, Germany, France and Belgium are normally important markets. Before the war the United States was the world's leading importer, but the increase in domestic production has resulted in a cessation of imports.

7 – *Sesame Seed*

Sesame, til or gingili, is the seed of an annual plant grown in many parts of the tropics as well as in sub-tropical and warm temperate regions. The poorer soils give the richest yields of seed. The oil is used for cooking and lighting purposes, and small quantities are employed in the manufacture of margarine and cooking fats, and as a vehicle for medicinal drugs. The residue can be consumed as meal or used for animal feed and is highly nutritious.

Cultivation is mainly on small peasant holdings since the plant, as grown at present, does not lend itself to mechanical harvesting. Total production is probably something less than 2 million tons a year to which total China contributes about 50 per cent and India a further 25 per cent. Outside these countries, Mexico, Burma, the Sudan, Uganda and Turkey are the main producers, and the crop is of some importance in Egypt and Greece. Nearly all the seed is consumed as seed or oil in the producing countries and little more than 70,000 tons of seed and 1,400 tons of oil enter into world trade, the main exporters of oil being China, Ceylon and the Netherlands. The metropolitan countries of Europe are the main importers.

8 – *Castor Seed*

The castor plant grows wild in most tropical and sub-tropical areas and is an ideal crop for the small peasant farmer since it is perennial and grows well on refuse heaps and the borders of cultivated fields. In the main producing countries – Brazil, the U.S.S.R. and India – and in cooler regions, however, it is usually grown as an annual. World production of seed probably amounts to 4–500,000 tons of which between 40 and 50 per cent is grown in Brazil, about 25 per cent in India, and at least half the remainder in the U.S.S.R. Manchuria, Indo China, Indonesia, Mexico, Argentina and Paraguay are also producers. while wild seed is picked in Haiti for export to the United States. The United States itself is now planting castor seed because of the

strong industrial demand for the oil, and a similar development seems likely in French Morocco and French West Africa.

The oil is used for medicinal purposes and also in the manufacture of lubricants, soaps, paints, varnishes, plastics and other industrial products. In India it is used as an illuminant. The residue is employed mainly as a fertilizer. World demand for castor oil is increasing and recent exports of both seed (approximately 200,000 tons) and oil (about 50,000 tons) are well above pre-war levels and constitute a major part of production. Brazil and India are the leading exporters and the United States, the United Kingdom, Canada, and the leading countries of Western Europe the principal importers.

TREE CROPS

1 – *The Coconut Palm*

The coconut palm thrives best on alluvial soils under conditions of intense heat and abundant rainfall, and hence is restricted in the main to coastal areas within 15 degrees of the equator. The palm has spread throughout the tropical islands of the Pacific and, to the native islanders, is as important as the banana in the West Indies. Every part of the nut, and the palm on which it grows, is put to some useful purpose; the leaves are used for thatch or as food for elephants, the stalks provide fences or tool handles, the unripe nuts contain one drink and the ripe nuts another, while 'toddy', an intoxicating beverage, is obtained from the flower. The fruit itself, which may be about 18 inches long and weigh 12 pounds, is protected by a fibre husk, $\frac{1}{2}$–3 inches thick. This is peeled off by banging the nuts on an iron spike set in the ground and, after a few days' soaking in brackish water, is beaten with wooden mallets, thus separating the strong fibres from the cork-like powder in which they are buried. The powder is used for humus by gardeners, and especially by orchid growers. The fibre, or coir, is an important commercial product, the shorter lengths being used for stuffing mattresses, while the longer and tougher lengths can be turned into ropes or used for brushes and matting. The shells are used as drinking vessels and as fuel, and can be made into such articles as buttons and buckles since they take a high polish. As charcoal, the shell burns with intense heat which makes it useful in metal-working, and the 'activated' charcoal has been widely used as a filtering medium in gas-masks.

It is the dried 'meat' of the kernel (copra) and the coconut oil which is expressed from it, however, which makes the coconut of importance in international trade. The oil content of copra is high and the oil is used for the manufacture of soap, margarine and cooking fat, the residue being sold as cattle-cake. Trade in shredded or desiccated coconut is relatively small.

Each mature tree produces from 50 to 70 nuts a year and it has been

calculated that between 3,000 and 4,000 million nuts are harvested annually, world production of copra being about 2·5 million tons. The principal producing countries, in order of importance, are the Philippine Islands, Indonesia, Ceylon, India, and Malaya; other producing areas include New Guinea and Papua, British Borneo, British and French Oceania, Indo China, Siam, East and West Africa, Central America and the Caribbean Islands. In Ceylon and some other countries a fairly large proportion of the collected coconuts are grown on commercial estates, but the bulk of copra production comes from small native holdings and output varies considerably with prices. In the Philippines alone 7–900,000 tons are produced each year, and perhaps two-thirds as much is produced in Indonesia.

Exports of copra amount to about 1·4 million tons a year, and exports of oil to about 0·3 million tons a year, the principal exporters being the Philippine Islands, Indonesia, Ceylon and Malaya. The United States is the leading importer and the chief market for the Philippines. The Netherlands, the main outlet for Indonesian exports, comes next, followed by the United Kingdom and Germany. Germany, the United Kingdom and the Netherlands are the principal markets for Malayan production, while India and Pakistan take much of Ceylon's output. The United Kingdom is the leading market for copra exports from Oceania.

2 – *The Oil Palm*

The oil palm grows wild in West Africa and, until comparatively recently, this was the only area where the trees were commercially exploited. The palm bears a fruit which yields two kinds of oil, the orange-yellow palm oil from the fleshy exterior or pericarp which is widely used in the manufacture of soap and in the candle and tin-plate industries, and palm kernel oil, a hard, white fat which has quite distinct properties and is used in the manufacture of margarine, cooking fats and soap. A good bunch of fruit weighs about 30 lb. and full-grown trees yield four or five bunches a year.

In West Africa, where production is mainly from wild oil palms, much of the output is consumed locally and statistics are therefore incomplete. In Indonesia and Malaya, where large estates were planted after the First World War, the bulk of the output is exported but these newer areas yield more palm oil, relatively speaking, than palm kernel oil. Several Central and South American countries have planted palms in recent years but commercial production is as yet of minor importance. Of the 750,000 tons of palm kernels produced commercially each year, Nigeria provides 50 per cent, the Belgian Congo 17 per cent, French West Africa 11 per cent, Sierra Leone 9 per cent, and Indonesia, the French Cameroons, French Togoland, and Malaya smaller amounts.

Of the 540,000 tons of palm oil, the Belgian Congo provides 33 per cent, Nigeria 30 per cent, Indonesia 23 per cent and Malaya 10 per cent. In each case production is rather higher than it was before the war.

Palm kernels are processed mainly in importing countries but, in recent years, an important crushing industry has been developed in the Belgian Congo. British West African palm kernels and palm oil are

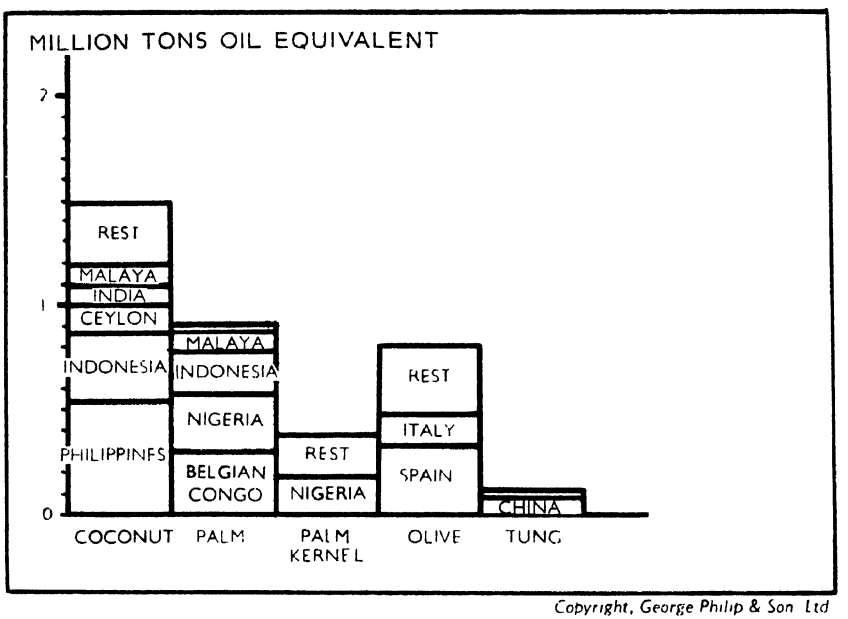


Fig. 46. World production of oil-yielding tree crops

sent almost wholly to the United Kingdom and the United Kingdom is a leading exporter of palm kernel oil. France, Belgium, Germany and the Netherlands import the bulk of the rest of the world's supplies, though the United States is normally an important market for palm oil from the Belgian Congo.

3 – *The Olive Tree*

The olive tree, probably native to Western Asia, flourishes only in countries with a Mediterranean type of climate. A dry, gravelly soil and a sheltered position produce the best fruit, and it can thrive on a total annual rainfall of only 8 inches. It needs more sunshine than the vine and is more sensitive to frost, a warm autumn being essential. The tree does not give its first full yield of fruit until about fifteen years after planting, but it may then be harvested for centuries, though it requires considerable attention. The oil, which is contained in the fleshy

part of the fruit, is one of the finest edible oils and is generally used without refining or further processing. In the Mediterranean it goes far to replace animal fats, being used as a salad or cooking oil. The lower grade oils, obtained after the first crushing, are used in soap manufacture, wool combing and other industrial processes.

Altogether there are about 630 million olive trees in the world but the production of olives varies considerably with the weather. In 1946, for example, 2·5 million tons of olives, yielding 0·5 million tons of oil, were harvested, while in 1950, 6 million tons of olives yielded 1·1 million tons of oil. Spain is the most important producer and is normally responsible for about 40 per cent of the world total. Italy ranks second, producing about 20 per cent of the world total, and is followed by Greece, Portugal, Turkey and Tunisia. As yet, the United States and Argentina are the only countries outside the Mediterranean basin where olive oil is produced in anything but insignificant quantities, and even in these countries production is very small.

Exports of olive oil naturally fluctuate with the crop. In 1949 they amounted to only 51,000 tons, but in the following year rose to 167,000 tons. The principal exporter was Tunisia (47 per cent of the total), followed by Spain (29 per cent) and Italy (about 11 per cent). Smaller quantities are exported from Algeria, France and Portugal. The amount of olive oil entering into world trade has tended to fall as home demands in producing countries have increased and importing countries have substituted cheaper oils; Spanish exports have never recovered to the pre-Civil War amounts.

France is the leading importer, taking mainly Tunisian supplies, followed by the United States and Italy. Spanish Morocco, the Canary Islands, Brazil and the United Kingdom are also important markets.

4 – *Tung Oil*

Tung oil or Chinese wood oil comes from the fruit of a number of trees cultivated mainly in warm temperate climates such as the South-Central provinces of China, the Black Sea coastal regions of the U.S.S.R, and the south of the United States. Another variety grows best in still hotter climates. The oil has unique drying properties, akin to those of linseed, and is used in the manufacture of paints, varnishes, enamels, synthetic resins, linoleum, oilcloth and wallboards.

Production suffered greatly as the result of the Sino-Japanese War, but has recovered to some extent in the post-war period, recent output being estimated at about 100,000 tons, of which 60–80,000 tons enters into trade. China still produces 80 per cent or more of the tung oil entering world trade and Argentina is the only other exporter of major importance, though Paraguay, Nyasaland and Brazil export small quantities, and the U.S.S.R. has a considerable domestic production.

The United States takes two-thirds of the world's exports. The United Kingdom is the second most important market, followed by Germany, Canada, France, Norway and the Netherlands.

5 - *Other Oil-seeds*

In addition to the oil-seeds and oils considered above there are a number which enter little into world trade but which are important for various reasons in producing countries. They include babassu kernels, oiticaca, perilla, hemp, kapok, tea, niger and poppy seeds, and corn oil.

Babassu palms and the *oiticaca* tree both grow wild in north-east Brazil. Kernel oil from the former has properties similar to those of coconut oil and a special use in the manufacture of bullet-proof glass, but commercial exploitation is hindered at present by a shortage of labour, poor transport facilities, and a lack of mechanical means for cracking the nut; about 70,000 tons of kernels are produced each year and small quantities exported, mainly to the United States. The seed of the oiticaca tree yields an oil which is used as a quick-drying agent in paints and varnishes.

Perilla is cultivated mainly in Asia and produces an oil with properties similar to those of linseed and oiticaca and, before the war, Manchuria exported seed to Japan and oil to the United States.

Hemp is grown for seed in the U.S.S.R., Manchuria, Turkey, China and elsewhere, the oil being used mainly in paints, varnishes and certain kinds of soap. Manchuria was the chief exporter before the war but very small quantities enter into trade now and most of these come from Turkey.

Fig. 47. The last processes in the manufacture of margarine

Kapok seed comes from a fibre-producing tree which grows in South-east Asia and the oil is similar to cottonseed oil. Indonesia is the only country which exports more than negligible quantities.

Tea seed oil is used for edible purposes in Asia and closely resembles olive oil. There are some exports from China, mainly through Hong Kong to the United Kingdom.

The white poppy is grown in India and other Asiatic countries for the production of opium, with seed as a by-product. In Europe, Turkey, Persia and the U.S.S.R., the *black poppy* is grown for both edible and industrial purposes and the United States and Germany import small quantities of the seed.

Niger is a plant indigenous to Ethiopia and other parts of tropical Africa, and is also well known in India. The best qualities of niger seed oil are edible, while inferior grades are used in the soap and paint industries. Production is probably between 100,000 and 150,000 tons a year.

In the United States *corn oil* is an important by-product of corn, used chiefly as a salad and cooking oil. Production has increased considerably in recent years and now amounts to about 100,000 tons a year.

MARGARINE, COMPOUND COOKING FAT AND SOAP

Most vegetable oils are, in some degree, interchangeable and different countries use certain oils more extensively than others, their preferences being usually determined by the types of seed grown domestically or in associated countries and colonial territories. In the United States soya bean oil has now become the most widely consumed vegetable oil as the result of a great expansion in soya bean cultivation and the chief imports are of copra or coconut oil from the Philippines. The United Kingdom has small quantities of domestically grown linseed but imports the bulk of its requirements of vegetable oils from Commonwealth sources.

For *margarine* production, vegetable oils are refined to the highest degree of purity and, to produce the finished article, are combined with skimmed milk and churned. The industry was first established in the Netherlands in the eighteen-seventies and both world wars have greatly stimulated production. In recent years Germany, the United States and the United Kingdom have been the leading manufacturers, each producing not far short of 500,000 tons a year. Consumption has increased in most countries since before the war: in the United States, between 1938 and 1951, *per caput* consumption of margarine increased from 2·9 lb. to 6·6 lb., while consumption of butter fell from 16·4 lb. to 9·7 lb.; in the United Kingdom margarine consumption increased from 8·7 lb. to 18·2 lb., and butter consumption fell from 24·1 lb. to 14·6 lb. All the time that margarine remains much cheaper than butter it looks as if butter-consumption, even in rich countries, will

fail to increase ; as butter substitutes, modern margarines are very good. The United Kingdom is normally the leading exporter of margarine, though the Netherlands, Australia, France, Norway and the United States all share in the trade.

The United States and the United Kingdom are the only considerable producers of compound cooking fat, the former producing 660–760,000 tons a year, the latter 200–230,000 tons. Canada and Germany produce smaller amounts.

In the United States alone about 1·5 million tons of soap are manufactured each year, but animal fats are the chief raw material. United Kingdom production, based in the main on vegetable oils, is over 500,000 tons a year, and France, Germany, the Netherlands, Australia

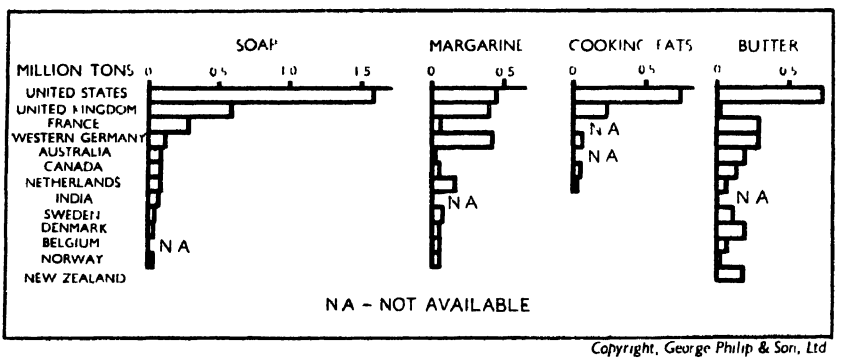


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Fig. 48. Production of soap, margarine, compound cooking-fats and butter in certain countries

and Canada all produce considerable quantities, though production in Germany has fallen sharply since before the war owing to a shortage of oils and fats. Synthetic detergents, in the main a by-product of mineral oil, are becoming increasingly important as competitors with soap.

CONCLUSION

In considering post-war trade in vegetable oils and oil-seeds four factors stand out.

The first of these is the great increase in United States production since 1938, with a consequent reduction in imports. This has meant that, despite a lower total volume of world trade in these commodities, supplies available to Europe and other areas have not fallen.

The second factor is one which is common to many other fields, namely, the continuing currency difficulties of many countries which have led the non-dollar world to restrict its imports of vegetable oils from

the dollar areas even though, as has been the case in some years in the Philippines, these areas have had difficulty in disposing of surpluses.

Thirdly, governments have come to play a much more important part in the regulation of trade than they did in pre-war years and many importing countries are now, wherever possible, ensuring the maintenance of supplies by long-term agreements with producing areas, while producing countries themselves, in some cases, are exercising a control over exports as a matter of national economic policy. This has had the effect of making the supply position in any one year less dependent on current harvests.

Fourthly, the greater utilization of milk for drinking purposes and the general excellence of margarine as a butter substitute, has led to a reduction of butter supplies and an increasing substitution of margarine for animal fats.

PART III – RAW MATERIALS AND POWER

Chapter 11
Raw Materials: A Summary

Unlike the production of some foodstuffs, the production of raw materials has more than kept pace with the growth of population over the past twenty years, but the larger part of this increased production has been utilized in countries already rich, particularly in the United States. By American – or even by Western European – standards world production is still dismally short of what might be considered a reasonable minimum.

We have seen in Chapter 4 that the world produces considerably less food than is desirable for health – perhaps 90 per cent of the requisite energy providers, 70 per cent of the major protein foods, and 50 per cent of the fruit. The needs for raw materials – and the manufactures based upon them – are more difficult to estimate since the need for clothing, fuel, shelter and transport varies from climate to climate. If the United Kingdom – a well-to-do country – is taken as the standard, the world requires something like three times the textiles, steel and fuel which it produces at present; allowing for climatic differences twice the present output of raw materials would be by no means amiss in a world which possessed a tolerable living standard for all.

The raw materials which are the subject of Chapters 12 to 17 can be divided into those which are the fruits of cultivation, and which therefore compete to a greater or less extent with food production, and those which are won from the earth.

The major fruits of cultivation are the industrial fibres which go, in the main, to satisfy man's first great need after food, the need for clothing, and at first sight it seems that, just as nature has provided a basic foodstuff in each main climatic region, so has she provided a textile material. The equatorial forest has its coir, manila and sisal; the monsoon areas their jute; the tropical and subtropical climates – savannah, monsoon and warm temperate regions – their cotton; the cool regions, wool; and, through the marvel of technology, the subarctic forest its rayon.

In a sense this is true. Of course, coir, manila and sisal are not clothing fibres, but then the need for clothing is least in the equatorial forest. Cotton has the widest range and is most suited to warm climates; wool is warmer and hence suitable for the cool climates; and, before rayon, the forest areas had their furs.

In fact, however, both the cool and the equatorial regions are deficient in textile materials and need to import cotton from the warm zones, though the future may witness rayon production from grasses in the tropics, and rayon production is already high in the temperate climates. The future may, indeed, see the different regions of the earth more self-sufficient in textiles than they have been in the recent past, since the textile industry is the simplest industry to establish, and reconstituted and synthetic fibres can be made from a wide variety of vegetable and mineral materials.

At present, half the world's 16 million tons of industrial fibres (exclusive of hides) consists of cotton, and of this 8 million tons of cotton the United States produces nearly one-half. The United States also produces one-third of the world's rayon and imports much of the world's wool – mainly from the British Commonwealth. The other leading textile manufacturers are the U.S.S.R., the countries of Western Europe, and Japan, and the textile exports of all but the U.S.S.R. are an important item in their trade.

Rubber apart, timber products can scarcely be described yet as the fruits of cultivation, though they will have to become so if the world is not to be denuded of its forest wealth. Timber is principally a constructional material, satisfying in part man's need for shelter and furnishing, but it is also important as a fuel and, nowadays, as the raw material for rayon and newsprint. Its worth is more than that of any other raw material, with the possible exception of the fibres, and yet it is most unevenly distributed. It is the softwoods and hardwoods of the cool temperate forests which are mainly used, and with these the U.S.S.R, the United States, Canada, Sweden and Finland are handsomely endowed. The trade is mainly between the last three countries and Western Europe.

Rubber is something of a curiosity. Conjured up by the invention of the pneumatic tyre and the growth of transport, it flowed, between the wars, from Malaya and Indonesia to the United States, the United Kingdom and the other industrialized countries. The Second World War cut off these supplies, and so the United States, Germany and, later on, Canada manufactured rubber from crude petroleum, coal or alcohol. Now both sources satisfy an increasing demand, though among the manufacturers of the synthetic product Germany has closed her war-time factories.

For the minerals there are no synthetic substitutes and so their

chance distribution in the crust of the earth is all-important. On the whole – the possible exceptions are lead and petroleum – there is no dearth of reserves, no prospect of absolute mineral shortage, though the ease with which they are won varies from place to place and particular countries, indeed, whole continents, are deficient in supplies of one or another of the essential minerals and must acquire them by exchange.

Thus iron ore is seemingly concentrated in three or four great natural reserves – in the United States, in Alsace-Lorraine and other parts of Western Europe, and in the U.S.S.R. – and, since coal is not far away, these are the manufacturing regions. Further supplies of iron ore are imported from Sweden, Spain and North Africa, and other ores still from more distant places: copper from Chile, Northern Rhodesia and the Belgian Congo; bauxite from Guiana; manganese from India and South Africa.

It is possible that northern China will become a great centre of industry, and certainly light engineering and textile manufactures will become more widely dispersed about the world as power production grows. Nevertheless, the existing centres of the heavy engineering industries, and those of the future, are likely to remain in the temperate regions where iron ore is found, and their flow of manufactured goods will be exchanged against the products of the hot and warm climates. This does not mean to say, however, that the terms on which they are exchanged will remain the same; in relation to food, manufactures will become more plentiful and will exchange for less than they have done in the past.

So far as power or energy production is concerned, we are on the threshold of far-reaching developments, developments which, while initially concentrating still more power into the hands of those who have large supplies already, must ultimately make power cheaper, more abundant, and more evenly distributed throughout the world. At the moment power is exported mainly in the form of petroleum – if we leave aside the movement of coal between allied European nations – and it is sent from the Caribbean and the Middle East to the United States and Europe. In a generation or two it is conceivable that the United States and Europe will export atomic fuel to the Caribbean and the Middle East.

However, it does not behove the economic geographer to indulge in prophecy: the mind is feeble and the element of guesswork is enormous. The United States is at present the nation most blessed of all on earth with food, raw materials and power, and is likely to remain so. As a closely knit political unit, the U.S.S.R. comes next. Neither the British Commonwealth nor Western Europe is more than a loose federation of nations, but both are rich while they remain united. There

is no reason to suppose that these statements will not remain true for twenty years, though the wealth and power of China is bound to grow.

Far greater quantities of raw materials than of food are moved about the face of the globe. Among the foodstuffs, it is the beverages and some of the oil-seeds which are shipped more or less complete to foreign parts. Among the raw materials, it is a few of the rarer metals and natural rubber. In sheer quantity, wheat is the food which makes most demands on shipping space, though sugar is another foodstuff shipped in large enough quantities for tanker-like vessels to be specially constructed for its transport.

But ten times as much petroleum as wheat is carried from one country to another – nearly 40 per cent of total production accounting, by weight, for 40 per cent of sea-borne trade. Coal exports weigh perhaps 100 million tons, four times those of wheat, though this is only 6 per cent of production and most of it goes to neighbouring countries. Exports of other minerals are difficult to calculate but may amount to 50 million tons. Beside these, the actual quantities of fibres and timber seem small, though the proportion of fibres, at least, is probably as much as one-third of total production.

It is hoped that there is as much logic as possible in the chapters that follow. Textiles and hides come first as having the closest connection with Part II, and also as satisfying the second of man's most urgent economic needs. Timber and rubber follow to complete the products of the vegetable world, and it is noteworthy that there is a chemical link between the regenerated fibres (a timber product) and rubber and synthetic rubbers and fibres which owe their origin to petroleum and coal, both of which have a vegetable origin.* Since this is the case, and since timber is still an important fuel, perhaps the chapter on power should follow these.

No arrangement, however, is completely satisfactory, and the live vegetable kingdom is followed by the mineral, the whole section being concluded with an account of the 'mineral' sources of power which, combined with the raw materials, produce the manufactures and transport equipment which feature so largely in Part IV. These will close the circle of trade and exchange and thus bring this survey to an end.

*There is a theory which suggests that petroleum has a mineral origin but it is not widely held.

Chapter 12

Textiles and Hides

INTRODUCTION

Clothing, like food, is one of the primary needs of man. It is perhaps the first thing which distinguishes him from the other animals and, with food, shelter and fuel, it forms the basis for the construction of any civilization. Although skins and hides were probably the earliest coverings of the body, the spinning and weaving of animal and vegetable fibres into cloth was one of the first arts. The wool trade alone was the foundation of England's commercial prosperity until the eighteenth century, and then it was the inventions in the textile industries which played a vital part in the initial stages of the industrial revolution and gave to Britain an advantage over every other country in the world, an advantage which she continued to enjoy for more than a hundred years.

The textile industries as a whole have maintained the position of major importance which they have held since earliest times, but the relative importance of the various materials used has changed and is still changing. Nevertheless, since the failure in the early eighteenth century of British legislation designed to prevent its competition with wool, cotton has kept its pre-eminent position. Nowadays, the world production of industrial fibres amounts to some 32,000 million pounds and cotton still accounts for just over one-half of this total. Second place – perhaps surprisingly – is taken by jute (a fibre which is not so much used for clothing as for the manufacture of sacks) and jute production forms about 14 per cent of the world total of fibre production. Closely rivalling it in amount nowadays is the artificial fibre rayon, the production of which has increased tremendously since before the war though even in those days it had already ousted wool from its position as the second most important clothing fibre. Nowadays, 12 per cent of the world's fibres consist of rayon and there is a small but increasing production of other synthetic fibres. After these comes wool – 7 per

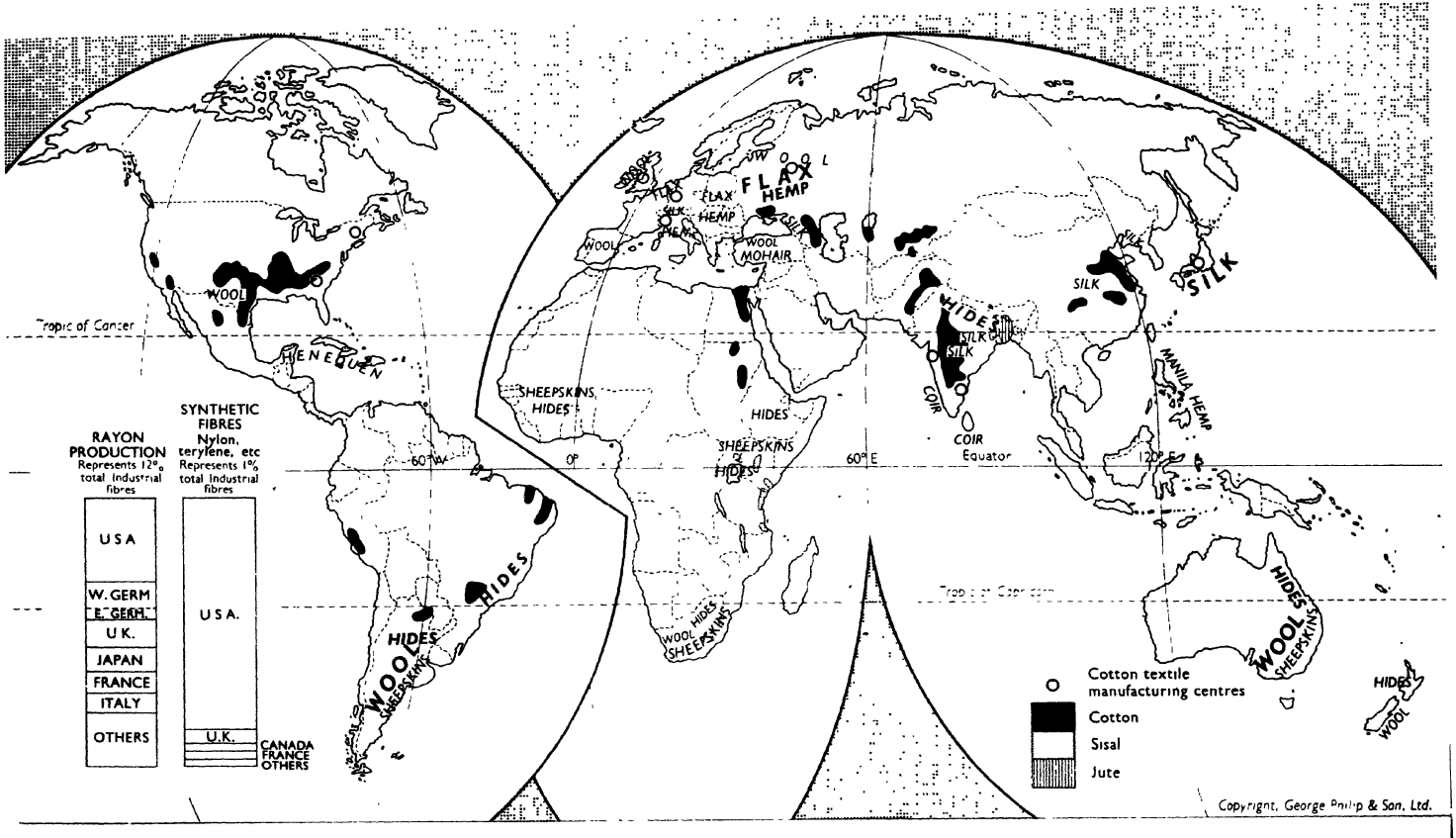

Fig. 49. World production of industrial fibres

cent of the total* – though it must be remembered that a significant part of the wool produced is used in the manufacture of carpets. Of roughly the same importance as wool, by weight, are hemp, a fibre used mainly for ropes and cordage, and flax, which has its main uses in household goods other than clothing. Finally – and a long way behind all these since it accounts for little more than 1 per cent of world production – comes silk.

Into the sophisticated dress of modern man nearly every one of these materials enters. No longer does the inhabitant of Western countries wear a simple woollen smock or robe of silk. His suit is still of wool, perhaps, but it is lined and padded with jute. His shirt is of cotton (or even terylene), his underwear of rayon or some mixture of different fibres. His hat is of felt, his handkerchief of linen, and his tie of silk. Probably his socks have toes and heels reinforced with nylon. And not only his clothes, of course, are of industrial fibres. He sleeps between cotton sheets and woollen blankets; he walks on woollen carpets or linoleum backed with jute; he sits on upholstery of silk or wool, while the cushion covers and curtains may be of rayon and the deck-chair in the garden covered with canvas. New uses for textiles have been found too, in the manufacture of aeroplane fabrics, motor tyres and electrical insulating material and, for many of these new uses, cotton or the synthetic fibres are of the greatest importance. In these circumstances it is not, perhaps, surprising that the demand for textiles is still increasing and that production in recent years has been nearly 30 per cent above pre-war levels, though the high level of demand in the immediate post-war years must be explained in part by demands arising from the outbreak of war in Korea being superimposed upon demands outstanding after the cessation of hostilities in 1945. The production of textiles had fallen during the Second World War and, at the end of that period, the wardrobes of most people were sadly depleted.

The pattern of fibre production has shown some marked changes in the past twenty years. As producers of cotton, Mexico, Turkey and Syria have increased in importance, and cotton production has also been expanded in China, the U.S.S.R., and in such colonial territories as Nigeria, Mozambique and French Equatorial Africa. Brazil and Peru, on the other hand, have tended to lose ground. The production of rayon has increased rapidly and this industry is being developed in many small countries. In the production of wool, Australia, New Zealand and Paraguay have become more important, and the United States and Argentina less important. Indian production of jute is of greater significance than in the past, and the post-war years have

*This is after the grease has been removed. With the grease, wool weighs twice as much.

witnessed a rapid expansion of hemp production in British East Africa and a good recovery in the Philippines. Silk production, on the other hand, is still below pre-war levels, though Japanese output is increasing.

The U.S.S.R., China and Eastern Europe together produce perhaps 20 per cent of the world's fibres but take practically no share in world trade. Exports, generally, are at about pre-war levels, cotton, wool, jute and hemp being by far the most important of the fibres entering into trade, though there is an increasing export of rayon. The United Kingdom, which is almost entirely dependent on oversea supplies, is the principal importer though her current imports are below 1938 levels. The United States, Japan, France, Germany, Italy and Belgium also import large quantities of industrial fibres, and United States imports of wool and hemp are well above pre-war levels.

COTTON

Cotton is the name given to the fibre which surrounds the fruit or 'boll' of a shrub indigenous to both the Old and the New World. It is a perennial plant, but is normally cultivated as an annual. Generally speaking, the longer the fibre, the better the quality of the cotton, the Sea Island varieties – the best of which grow in the British West Indies with a 'staple' 1½ inches or more long – being the finest. Other fine cottons are produced in Egypt and Peru. Medium qualities are produced in the United States, Brazil, Pakistan and Mexico, with a staple a little over 1 inch long. The Indian types are coarser and shorter, though the staple length has increased considerably since the war.

Cotton may be grown between the limits of 30° N. and 30° S., but climatic conditions influence quality considerably and the best types are produced in sub-tropical countries where the growing season is fairly wet and the ripening and picking season warm and dry; such conditions occur in savannah, monsoon and warm temperate oceanic regions. Frost kills the cotton shrub, so that it is impossible to grow it on a commercial scale where there are less than two hundred days free from frost. Where total rainfall exceeds 60 inches, rank vegetation and poor quality cotton is produced, and heavy rains make soil erosion a serious menace in most cotton-growing countries where irrigation is not practised – in the southern states of the United States, for example. Irrigation is necessary in Egypt and India, and the finest qualities of cotton are produced in coastal areas. If the seeds as well as the cotton fibre are removed, as they are in the United States cotton belt, the use of fertilizers or the practice of crop rotation is essential if soil fertility is to be maintained. Thus, mineral salts are used as a fertilizer over wide areas of the United States and the cost of these can be borne since the long-staple cotton grown in these regions commands a relatively high price. Elsewhere, economic production may be dependent on the

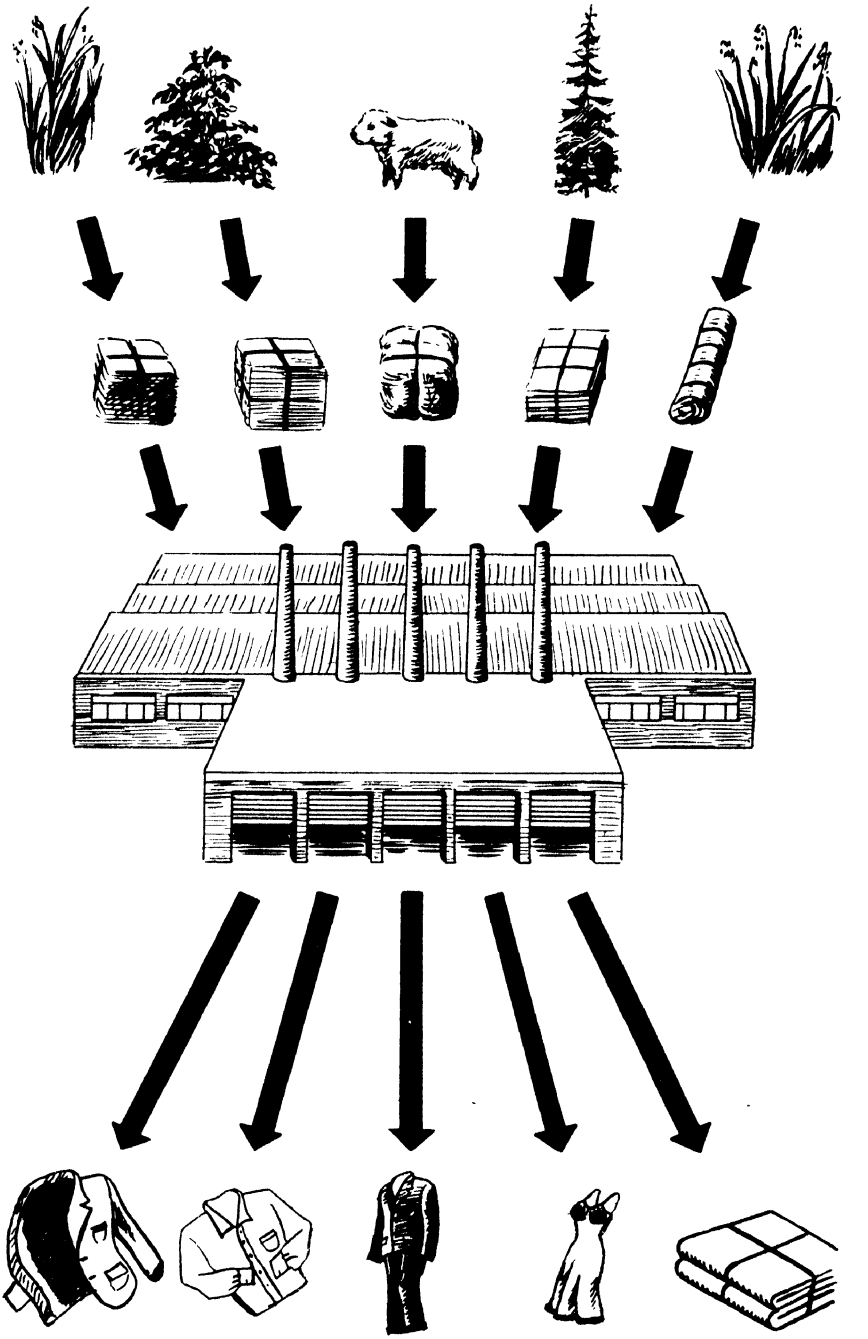

Fig. 50. The way in which textiles enter into clothing and home life

use of virgin soils or, as in Egypt, may be carried on in regions where annual flooding supplies a layer of fertile mud.

Many pests attack the cotton plant, but those which do most damage are the boll weevil, which came originally from Mexico but has spread to the United States, and the pink boll worm, which is found in India, Africa, South America and Mexico. The effects of the spread of the boll weevil in the United States at the end of last century led eventually to the development of new areas of production, especially in the savannah lands and irrigated desert regions of Africa. In the United States itself the boll weevil did more to encourage the adoption of crop rotation and mixed farming than any other factor, and the cotton belt also spread into drier and cooler regions where the climate was not so suitable for the propagation of the insect.

Cheap labour is necessary for cultivation and picking, for picking must at present be done by hand. In Queensland, Australia, where cotton is cultivated by white farmers, the government gives a relatively high bounty and thus makes its cultivation economically possible. On the other hand, the use of machinery – the cotton gin – is essential for separating the lint from the seed and no cotton-producing area can hope to produce cotton on a commercial scale without considerable expenditure on such equipment.

In recent years, world production of cotton has reached, and sometimes exceeded, 16,000 million pounds, but most of the increase in production over that of pre-war years has occurred in the United States, a country which normally grows anything up to 45 per cent of the world's crop. Despite a very much larger crop, however, United States exports have declined from about two-thirds to one-third of output over the past half-century and, in addition to its traditional home in New England, the manufacturing industry has assumed increasing importance in South and North Carolina.

The U.S.S.R. is now the second largest producer of cotton, and grows some 12½ per cent of the world's crop. The output of Russian Turkestan increased rapidly in the years before the war and is now above pre-war levels. Moscow is the chief manufacturing centre.

China, where the quality is poorer, produces 9 per cent of the world output, largely in the Szechwan Province and in the lower Yang-tse-kiang and Si-kiang basins. Output has increased rapidly in recent years but most of the cotton is consumed internally.

Indian cottons, though improving, are also of low quality, but Indian production amounts to 7½ per cent of the world total, the principal areas being on the volcanic soils of the north-west Deccan, with Bombay as the chief manufacturing and exporting centre.

Brazil and Egypt each produces about 5 per cent of world output, and cotton-weaving is the most important manufacturing industry in

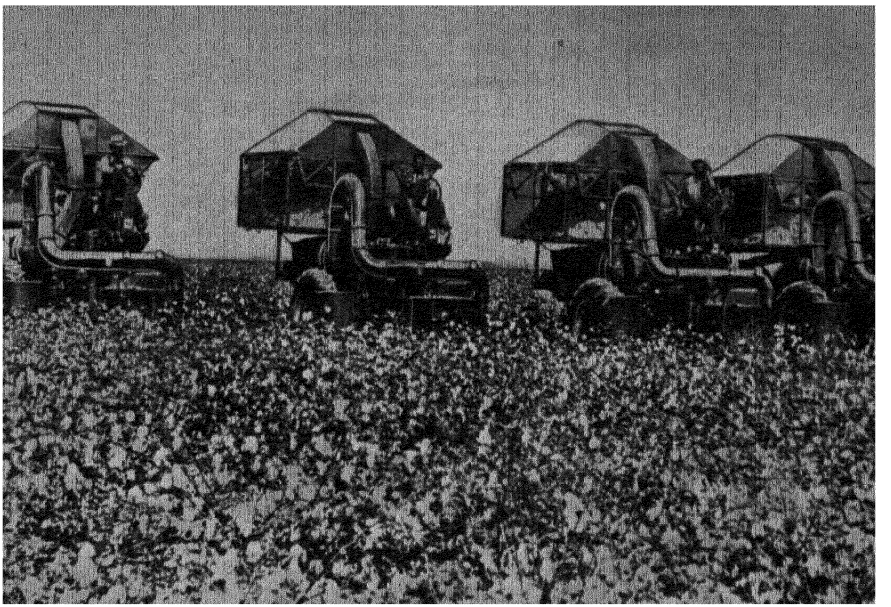

Fig. 51. A cotton-picking machine said to do the work of 40 men

the former country. In Egypt, cotton-growing is carried on chiefly in the Nile delta and, Peru apart, yields are the highest in the world, being considerably higher than those in the United States and more than twice as high as those in Brazil or Pakistan. In Egypt most of the crop is exported and manufacturing is relatively unimportant.

Other important producing countries are Mexico, Pakistan, Turkey and Argentina, and many other territories produce significant quantities, including Peru, Uganda, the Sudan, the Belgian Congo and Syria.

Cotton, as was pointed out in the introduction to this chapter, is easily the most abundant textile material and the cheapest of those suitable for the manufacture of clothing. Unlike wool and silk, it is used for clothing in all climates and hence ranks with coal and wheat as being an almost universally acceptable cargo, since manufacturing is carried on in such widely separated countries as the United States, Japan, China, Western Europe, Italy and India. Moreover, without seeing the cotton, buyers can be sure of quality, fineness and length of fibre, silkiness and resistance (which qualities are denoted by number), as they are in the wheat and coal markets. As quality is fixed but the harvest variable, marketing, though often subject in these days to governmental influence, is carried on at a distance and in advance, there being a highly organized market in cotton 'futures'. Owing to the complicated nature of the business, the buying market for cotton tends to be concentrated in a few important places near the manufacturing

districts, and it is customary for huge stocks of cotton to be carried over from year to year.

Exports of cotton normally amount to about 40 per cent of world production, and were 5,300 million pounds in 1951 compared with a world production in the 1950–1 season of 13,500 million pounds. The principal exporters are the United States (about 50 per cent of total exports), Egypt (10 per cent or more), Pakistan (9 per cent), Mexico (7 per cent), Brazil (6 per cent), the Sudan, Peru, Uganda and Turkey. Mexican exports, in particular, are much higher than they were before the war.

In the past few years United States exports have gone mainly to Japan, India and West European countries. The United Kingdom is the main market for Egypt and Brazil, and Japan the main market for Pakistan. The United Kingdom and Japan are the world's largest importers, taking about 20 per cent and 17 per cent, respectively, of total exports. After them come France, Germany and Italy, then India, Belgium and Canada, while other West European countries take the bulk of the remaining cotton which enters world trade.

The United States is by far the greatest manufacturer of cotton goods and industrial consumption there amounts to about one-quarter of world production. The U.S.S.R., India and Pakistan together, and China come next, industrial consumption in each case being between 12 and 9 per cent of world production. Outside these producer-manufacturer countries come the great industrialized countries – Japan, the United Kingdom, France, Germany and Italy – relying for their raw material on imports. The tendency in these latter countries has been for the volume of cotton manufactures to fall since 1938, while it has increased in the producing countries, including among the latter Argentina, Egypt and Brazil.

WOOL

Sheep were probably domesticated first in Turkestan but, by the Middle Ages, Italy had become the centre of the woollen industry and from there it spread gradually northwards to France and Belgium. At first, the early manufacturing regions depended on local flocks but, by the fourteenth century, supplies were also being drawn from Britain. After Edward III had turned England into a cloth-manufacturing rather than a wool-exporting country, Spain became an important source of supply, importing the merino sheep from Africa before the end of the Moorish occupation. Further supplies were also obtained from Silesia, Saxony and Bohemia but, by the end of the eighteenth century, the outside sources of the supply of wool had dried up because each of the exporting countries had begun to develop local industries.

The growth of industrialization and the rapid increase in population

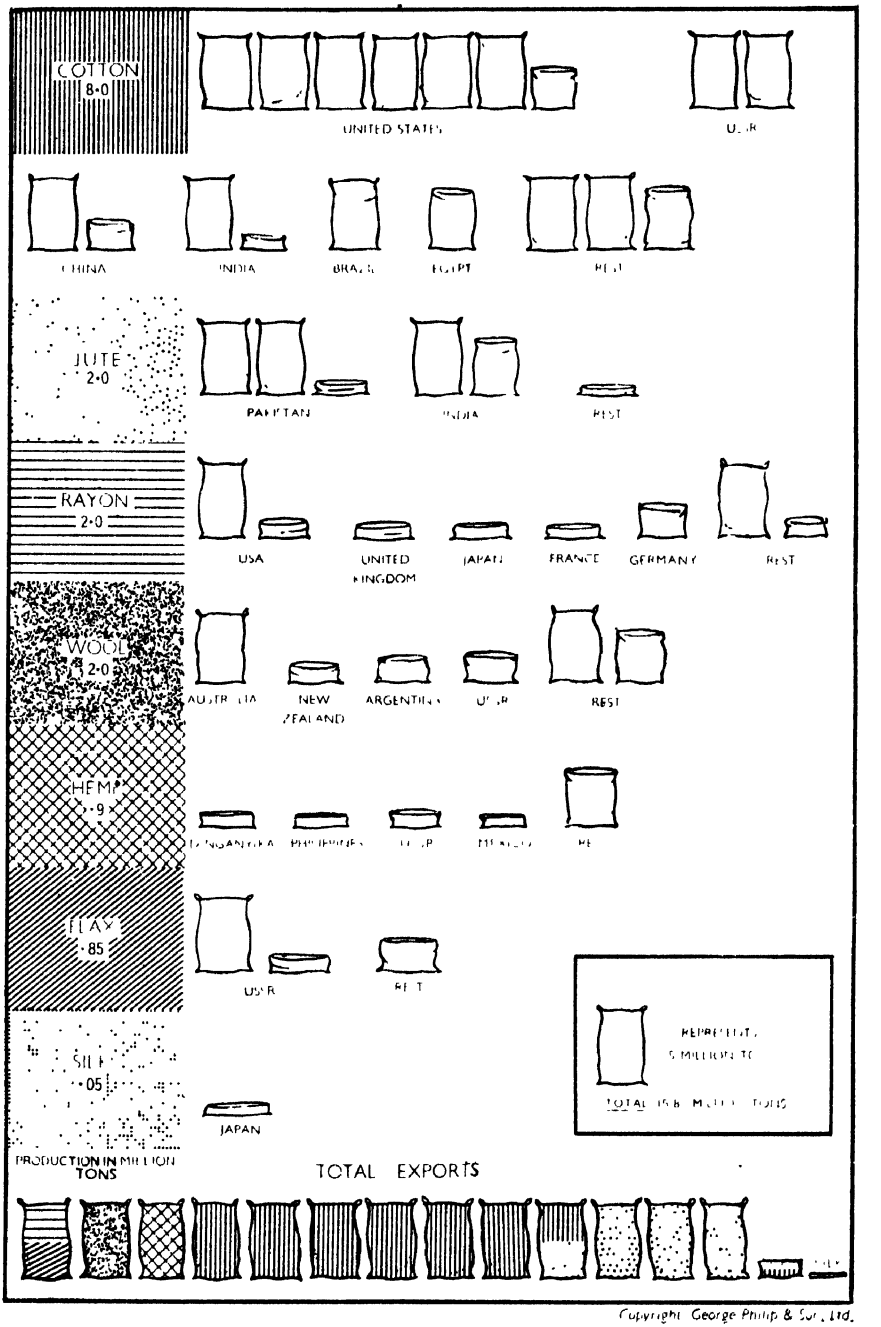

Fig. 52. The production of major fibres

which followed the industrial revolution led to an increased demand for meat and other foods so that, before long, even the newer centres found their local supplies insufficient and the import of wool from distant regions became profitable. Owing to the nature of its agriculture, Britain remained a wool producer and, even at the present time, still possesses larger home supplies than Spain, Italy, Yugoslavia and France, the only other European countries with considerable local supplies. Nevertheless, less than one-sixth of the wool now consumed annually in the United Kingdom is produced at home. Even in the United States, sheep-grazing has been forced westwards until the only region where it is dominant is in the Rocky Mountain States, and the number of sheep has decreased from 63 million in 1900 to 30 million to-day. Thus, nowadays, the chief centres of wool supply are found in the southern hemisphere.

Broadly speaking, there are three main categories of wool: merino, crossbred and carpet. The two former are used for clothing and in merino sheep-farming, which accounts for 33 per cent of world production, wool is the main product. Merino sheep are generally reared on light pastures with light rainfall and are well suited to the steppe conditions of Spain, North Africa, Australia and southern Argentina, though they are sensitive to drought and the production of the finer wools may vary considerably from year to year. Crossbreds produce both wool and mutton and account for 45 per cent of the world production of wool. They are stocked on the heavier pastures with a higher rainfall. Coarse or 'low' wool, widely used for the production of carpets, accounts for 12 per cent of world production and comes from the stronger, more meaty varieties of sheep, the U.S.S.R. being an important producer.

From the producer's point of view the weight of wool is calculated on a greasy basis since this is the way it is sold and carried, in order to avoid the felting of the fibres. The clean scoured weight is often no more than half as much and varies considerably from area to area. On a greasy basis, world production of raw wool is about 4,000 million pounds (2,300 million pounds clean), the principal producers being Australia (27 per cent), Argentina and New Zealand (about 10 per cent each), the United States and South Africa (about 6 per cent each), Uruguay (4–5 per cent), the United Kingdom, Spain and Turkey. Detailed statistics do not exist for the U.S.S.R., China and Eastern Europe but together they probably produce about 14 per cent of the world total. United States production has fallen since pre-war days, but each of the three main producers has increased its output.

Exports of raw wool in the immediate post-war years were high owing to the liquidation of stocks accumulated during the war, but normally they average about one-half of world production. Of this total,

Australia exports 50 per cent, New Zealand 18 per cent, and South Africa and Argentina large quantities. Together these countries account for 85 per cent or more of world exports and Uruguay is the only other country exporting fairly large amounts. It follows that the bulk of the trade is in the hands of the British Commonwealth. Exports of raw wool now account for one-half of the value of all exports from Australia and New Zealand and, although the United Kingdom remains the principal customer, the United States is the second most important market and wool – along with rubber, tin and cocoa – is an important source of dollars for the Commonwealth countries.

The United States and the United Kingdom are the main importers of raw wool and each of these countries retains between 20 and 30 per cent of the wool entering into trade, while the United Kingdom also has an important, though declining, re-export business. France, Japan, Italy, Germany and Belgium all import large quantities, the bulk of the remainder going to other European countries, the U.S.S.R. and Canada. United States imports have increased very considerably since pre-war days and the United States has now become the leading industrial consumer. London remains the chief warehousing centre, being the chief area for clothing manufacture in the United Kingdom, but London's relative importance has been declining for half a century since other countries have tended to import more of their requirements direct and, even in England, those ports nearer the West Riding manufacturing area have tended to handle more of the trade.

An increasing amount of other fibres – principally cotton and rayon – is being used with wool in the wool textile manufacturing areas and the production of wool, although it has not declined, has remained relatively stable while the production of artificial fibres has rapidly increased. Nevertheless, there is so far no substitute for wool in the manufacture of high-class worsted cloths, serges, tweeds, flannels or carpets.

Other animals beside the sheep yield material for woollen manufactures. These include the goat, the alpaca, the vicuna, the llama and the camel. Of these the Angora goat, which yields a long, lustrous hair (mohair) used in the worsted sector of the woollen industry and in the manufacture of plushes, is economically the most important. About 30 million pounds of mohair are produced each year, principally in the United States and Turkey, though Turkish production has fallen in recent years. South Africa shares the United Kingdom market with Turkey. The Cashmere (Kashmir) goat of the Himalaya mountains also yields wool for the famous shawls, while camel's hair, used for painters' brushes, came principally, in pre-war days, from China and the U.S.S.R.

SILK

Silk – the most expensive of all textile materials, if the newest synthetic fibres be excepted – is manufactured from the glossy thread which makes up the cocoons of silk worms, the larvae of certain moths in the chrysalis stage. Mulberry leaves form the natural food of the silkworm, though the leaves of some other plants, including the castor-oil plant, are a good substitute. The mulberry tree and bush grow best in humid tropical or sub-tropical regions, but the silkworm thrives in a drier heat and hence flourishes in areas where the mulberry is irrigated or where the worm is protected from the heaviest rainfall. The best temperature for rearing the worm is between 62°F. and 75°F., and the number of crops varies from one to six according to the climate and soil. The cocoons are killed by baking, and each one yields about 3,000 yards of filament, though only about one-fifth of this consists of silk.

Silk has been valued highly throughout the centuries, but since the middle nineteen-thirties, and particularly since the war, it has been increasingly subject to competition from artificial fibres. Nylon has now almost ousted silk from the hosiery markets and post-war production has been less than one-half of what it was immediately before the war. Even so it is probable that silk will retain its place in the market for textiles of the highest quality, and output is making some recovery from the effects of war, particularly in Japan and the U.S.S.R.

Since the labour supply for the rearing of the silkworm must be both skilled and cheap, production is limited by more than geographical considerations and, of the present world output of about 52 million pounds, Japan produces 55 per cent, China 21 per cent, the U.S.S.R. 7 per cent, and Italy and India perhaps 5 per cent each. Korea and Turkey are the only other countries which produce more than token quantities. The higher wages obtainable in other industries have led to the decline of sericulture in the Rhône valley over the past half-century, and it has failed to develop to any great extent in India partly because of the religious attitude towards the taking of life. Chinese production fell rapidly during the Sino-Japanese War and, although some recovery has been made since, China does not now export large quantities to Western countries.

Exports of raw silk in post-war years have so far varied between 11 and 16 million pounds, as compared with 76 million pounds in 1938. Of the former totals Japan exports about 84 per cent and Italy 12 per cent, with China and France accounting for the bulk of the remainder. The principal importers are the United States (40 per cent), France (16 per cent), the United Kingdom (14 per cent), India (10 per cent), Switzerland and Germany. The United States, France and the United Kingdom are the principal markets for Japanese silk, but Japan remains the principal consumer of raw silk, manufacturing the bulk of her out-

put into textiles. Since silk is a luxury, demand fluctuates considerably with changes in economic prosperity, with consequent effects upon the prosperity of the industry.

REGENERATED AND SYNTHETIC FIBRES

Rayon is the name generally given to those regenerated or artificial fibres which are manufactured from a cellulose base, the cellulose being obtained normally from woodpulp and cotton linters, though in India it is intended to develop bamboo as a source.

Two main processes are used in the manufacture of rayon. In the viscose process, which is the cheapest and the one most commonly used, the cellulose obtained from wood-pulp is chemically treated and dissolved in a caustic soda solution. When it is sufficiently viscous or sticky the solution is extruded through a 'spinneret' containing a large number of holes into an acid bath where it hardens into continuous filaments; these filaments are then twisted together to form yarn. In the acetate process, where the cellulose may be derived from cotton linters or wood-pulp, the raw material is treated with acetic acid, acetic anhydrite and sulphuric acid, and the resulting cellulose triacetate is hydrolized and dissolved in acetone. The resulting viscous solution is then fed through a spinneret into a spinning cabinet where the filaments solidify in a stream of warm air. They are then spun together on to a bobbin to form yarn. It should be noted that in the United States the term 'rayon yarn' does not normally include acetate yarn.

Instead of being reeled as yarn, the filaments can be cut into regular lengths and spun like the natural fibres on spindles. It is then known as 'staple fibre', and has the advantage of being uniform in staple length and fineness so that the proportion of waste is very small. Artificial fibres also have the advantage of being more easily controlled in supply and, although basically agricultural in origin, they do not compete to the same extent with food production. As yet they have been regarded mostly as complementary to natural fibres, being used to a very large extent in mixtures, but the production of all-rayon fabrics is increasing rapidly. Rayon cloth is becoming popular in summer wear, and in industrial uses (for example, in tyres) rayon is tending to displace cotton because of its superior resistance to heat.

Bearing all this in mind, it is not surprising that world rayon production has risen to levels of about 4,000 million pounds, or more than twice the quantity produced in 1938. Of this total, some 2,200 million pounds is rayon filament yarn and the rest staple fibre, nearly three-quarters of the combined amounts being produced by the viscose process. The acetate process is used mainly in the United States and the United Kingdom, and accounts for about one-third of the yarn production in each country.

Of the world total, the United States produces roughly 32 per cent, Western Germany 10 per cent and Eastern Germany a further 4 per cent, Germany being the world's largest producer of staple fibre. Other large producers include the United Kingdom (10 per cent), Japan (9 per cent), France (8 per cent) and Italy (7 per cent), though Austria, the U.S.S.R., the Netherlands, Canada, Czechoslovakia, Brazil and Poland all have considerable industries.

Exports of yarn amount to some 250 million pounds, and Italy, the world's largest exporter, sells abroad nearly half its domestic production. All the other large producers share in the trade and India is currently the largest importer. Exports of staple fibre are about 280 million pounds with Western Germany, Austria and Italy heading the list, though again many countries have some share. The United States, followed by India, is the leading importer.

In addition to rayon many other semi-synthetic or wholly synthetic fibres are now produced. Among the former are the protein fibres ardil and vicara, the one produced from groundnut residue mainly in the United Kingdom, the other produced from corn in the United States. Lanital, another protein fibre, is produced from milk casein in Belgium and Italy. The production of all of these fibres, which have wool-like qualities, is, as yet, quite small.

The wholly synthetic fibres, chiefly derived from by-products of coal and oil, include nylon, dacron, perlon, terylene, orlon and acrilan, and have an extensive and expanding range of uses, though they are three to four times as expensive to produce as cotton. Each tends to have particular qualities for which it has been developed, but their common characteristic is strength and durability. They have been introduced both in mixture fabrics and in pure fabrics for such clothing as shirts, underwear, blouses and gloves, as well as in industrial uses for beltings, awnings and tarpaulins. Nylon and terylene, as is well-known, are crease-resisting and dry quickly since, like other synthetic fibres, they have a low absorbency. Just how far such materials will be adopted for clothing remains to be seen, since low absorbency is not always an advantage, but the fire-resisting fabrics, like dynel, may well have a wide use as curtains and upholstery. One of the present limitations to their use is the difficulty with which they take dyes, but already some success has attended attempts to remedy this.

In the early nineteen-fifties world production of the wholly synthetic and protein fibres just discussed reached some 250 million pounds – or one per cent of the output of all industrial fibres. Of this total the United States provided 80 per cent, with the United Kingdom, Canada, France, Germany and Japan accounting for the bulk of the remainder. In the United States nylon contributed more than half the output, and nylon was practically the only fibre in this group entering into world

trade, with the United States naturally playing the leading role as exporter. The South American countries, led by Brazil, and the richer countries of Europe, excluding the United Kingdom and Germany, were the leading importers.

FLAX

The cultivation of the flax plant for seed has been considered in the last chapter. For seed it is generally grown in tropical climates, but the best fibres are produced in temperate climates. The plant makes heavy demands on the soil, which should be well drained, clean and heavy, and needs considerable attention. The use of mechanical harvesters is being developed but much flax is still pulled by hand and, for these reasons, soil and labour are more important for its cultivation than climate. Flax is thus well-suited to peasant communities and the chief growing areas have always been the U.S.S.R. and the countries of Eastern Europe.

The crop is sown in the spring and harvested about 3½ months later. After harvesting, the flax is softened with water (retted), either naturally or artificially, and then dried and 'scutched', that is, beaten to remove the coarse, woody matter. The yield of scutched flax is between 10 and 20 per cent of the straw weight and production figures are expressed in these terms.

Statistics for post-war production are not so reliable as those for most other fibres because of the difficulty of accurately assessing Russian and Central European output, but current world production has been estimated at about 850,000 tons of scutched flax, or nearly 10 per cent more than in 1938. Of this total, the U.S.S.R., including the three former Baltic provinces, produces no less than 75 per cent and Russian output is expected to increase still further in the next few years. Poland, France, Belgium, the Netherlands, Czechoslovakia, the United Kingdom and Yugoslavia are the other main producers, but none of these produces so much as one-twelfth of Russian production.

France and the Netherlands export about 150,000 tons of unscutched flax straw to Belgium each year. In addition about 100,000 tons of the scutched fibre enter into international trade, Belgium and the Netherlands being the principal suppliers and the United Kingdom and France the largest importers. The U.S.S.R. shipped 20,000 tons abroad in 1938 but no trade statistics have been published since the war, though it is known that no more than 5,000 tons a year have been sent to western countries. The United Kingdom is the world's largest exporter of linen manufactures, with the United States its main customer. Since the war these exports have varied between 40 and 50 million square yards of linen piece goods, of which total the United States has taken 40 per cent or more.

JUTE

Jute is a fibre obtained from a tropical plant which grows from eight to twelve feet high. For economic production a damp, hot atmosphere – from 75° to 80°F. throughout the year – and a large total rainfall are required, though too much rain early in the season results in shorter stalks; it is unique in being the only fibrous crop which will withstand flooding. As it is used principally for cheap sacking, it must be produced more cheaply than any other fibre used in weaving, and world production is centred almost entirely in the Indian sub-continent, and particularly in the Ganges delta where population is dense and the fertility of the soil is renewed by the annual floods. In the Ganges delta jute can be grown on lands unsuitable for other fibres and grain, and conditions there seem to produce a fibre softer and silkier than that which grows in other regions. It is grown mainly by peasant farmers on small holdings.

The method of preparing the fibre is simple. The stems are cut by hand and steeped in water a process similar to the retting of flax – for ten to thirty days. The fibres can then be separated from the tissue and dried and bleached in the sun. The partition of India in August 1947 created difficulties in this industry since it separated the main growing area in Pakistan from the manufacturing centres in and around Calcutta, the chief export port. In consequence both countries are attempting to achieve a greater degree of self-sufficiency, India by extending the area under jute and cultivating the existing area more intensively, Pakistan by erecting modern mills in East Bengal.

Jute occupies a most important position in the world economy because of the great demands for sacking for agricultural and other produce, including sugar, flour, meat, potatoes, coffee and cocoa, bales of wool and cotton, and chemicals. Some thirty per cent of the cloth produced, however, is used for other purposes, including the foundation of linoleum, roofing felts and carpets, the lining and padding of clothes, and in the furniture and shoe industries. In the years immediately prior to 1952, the high price of jute which then prevailed led to an increase in the bulk handling of agricultural produce and the wider use of such packaging substitutes as paper sacks, coarse cotton bags and the fibre kenaf. Relative prices in the future are likely to determine how far these new packaging or handling methods replace jute sacking, though it is clear that the bulk handling of sugar, which was stimulated by the high price of jute, has come to stay. The demand for jute for other purposes has been well maintained.

The crop yield is extremely dependent on the weather, though normally it fluctuates round about 2 million tons or a little less. Of this total Pakistan produces about 56 per cent, India 42 per cent, and Brazil and Formosa the remaining 2 per cent. Pakistan exports the

great bulk of its fibre (1 million tons or so a year), over 40 per cent of it to India, 10 per cent or more to the United Kingdom, 10 per cent to France, and smaller amounts to Germany, Belgium, Italy, the United States, Japan and the Netherlands. India now exports negligible quantities of raw jute, but exports 800,000 tons or more of jute manufactures, mainly in the form of sacking (burlap) to the United States. At the present time, raw jute accounts for over 50 per cent of the value of all Pakistani exports, and jute manufactures for nearly 40 per cent of the value of exports from India. In Britain most of the raw jute is manufactured into sacking, etc., in Dundee and, together with other European countries, the United Kingdom exports small quantities of jute manufactures.

HEMP

A number of fibres are known as 'hemp', all of them to some extent interchangeable, but each of them having particular uses. The main uses are for ropes, cordage, string, twine and binder-twine.

True hemp, which is eminently suitable for soft twines and cords, grows under similar conditions to flax and is principally produced in the U.S.S.R., Italy, other European countries, Japan and Korea. The Italian variety can be used in some instances as a substitute for flax. *Sunn* or *Indian hemp* is also a soft fibre produced only in India where it can be used as a substitute for jute.

The chief types of hard fibres, which are produced from the leaf rather than the stem tissues, are *manila* and *sisal*. The former, which is grown mainly in the Philippine Islands and to a lesser extent in Sumatra and North Borneo, is used chiefly in the manufacture of marine cordage. The latter, which is produced in East and West Africa, the Bahamas and Central America (where it is known as henequén), is used for binder-twine in harvesting and for other twines and cords. Other varieties include *Mauritius hemp*, akin to sisal and grown in Mauritius, New Zealand hemp or *phormium*, grown in New Zealand and St. Helena, and *maguey*, obtained from the Philippines.

World production of hemp and hemp-like fibres amounts to about 900,000 tons, of which 36 per cent is soft or true hemp. In recent years the production of hard hemps, particularly sisal, has tended to increase in relation to soft hemps and there has been a marked expansion in Tanganyika and Kenya. Exports amount to about 550,000 tons, the principal exporters being Tanganyika (25 per cent, all sisal), the Philippines (22 per cent, all manila), Brazil (sisal), Mexico (henequén), Kenya (sisal), Italy (true hemp), Haiti (sisal) and Angola (sisal). The United States and the United Kingdom are the principal importers, though most of the industrialized countries of Europe and Japan take fair quantities.

COIR

Coir, as was seen in the last chapter, is the fibrous mass round the shell of the coconut which is retted in brackish water for about 18 months before the fibre is extracted by crushing. Mat fibre, the finest and longest variety, is used in the manufacture of ropes, cord and matting; bristle fibre, which is coarser and thicker, is used for brushes and brooms; curl, toe or mattress fibre, the shortest variety, is used for mattresses or as a substitute for horsehair in stuffing upholstery. Despite the very large quantities of coconuts grown elsewhere, India and Ceylon are the only large producers of coir.

In India commercial production is centred mainly along the Malabar coast, the best qualities coming from Cochin. Exports take the form of coir yarn and, to a less extent, such manufactures as mats and matting. Total exports amount to about 70,000 tons a year and are sent to the United Kingdom, the Netherlands, the United States, Germany and other European countries.

Singhalese exports, mainly in the form of fibre, amount to about 60,000 tons a year, nearly 50 per cent of which goes to the United Kingdom, and the rest to Australia, South Africa and the other highly industrialized countries of the world.

HIDES AND LEATHER

Although it is not the first part of his apparel to which he gives attention, and needs are different in different climates, as man moves up on the income scale he eventually covers his feet. The hides and skins with which he does this are obtained from many different animals

Fig. 53. Animal skins being cured in Libya

and are put to many other uses. Consequently, comprehensive statistics are impossible to come by, but of the hides and skins from which leather is produced the most important are the hides of cattle (including calfskins), buffalo and horse, and the skins of sheep, lamb, goat, kid and pig. Minor varieties include the skins of deer, antelope, kangaroo, dog, alligator, ostrich, reptiles of many classes, walrus and seal. In addition, there are the animals which provide fur – fox, ermine, mink and beaver.

The great bulk – probably more than 80 per cent – of cattle-hides are used for footwear, though the hides from ox and steer may be used for belting and calfskins for bags, bookbinding and textile machinery purposes. Sheepskins and lambskins are used primarily for the lining of footwear, fancy leather articles, glove leather and bookbinding, while goatskins and kidskins are used mainly for upper leather and gloves. From the scientific point of view leather is a fibre and the industry is concerned with the conversion of protein fibres (collagen) into leather fibres, a conversion necessary because collagen fibres are attacked by micro-organisms and swell in acid and alkaline solutions, and one which is accomplished by tanning.

It is believed that the value of the annual world consumption of hides and skins exceeds that of any other raw material except timber and cotton. Since they are, for the most part, a by-product of the meat industry – except in Africa and Asia where many millions of cattle not used for meat die each year – most European and American countries have fairly substantial home supplies of hides and skins, but the meat exporters also have a surplus of hides. Of recent years, Brazil has exported annually nearly 400,000 tons of dried or salted cattle hides, Argentina over 110,000 tons, Uruguay 17,000 tons. In addition East and West African countries are substantial exporters, and other supplies come from India, South Africa, Abyssinia, Australia, New Zealand and Far Eastern countries. During the war, however, there was a considerable development of the tanning industry in some of these countries and exports of hides fell.

New Zealand, Australia, Argentina, Uruguay, South Africa, East and West Africa and the Middle East countries are the main sources of supply of the sheepskins which enter into trade, while the United States imports goatskins mainly from the east, particularly from India.

United States home production of cattle-hides and sheepskin is in excess of 300,000 tons and imports are normally about 100,000 tons, though there is a considerable re-export trade. United Kingdom home production is about 80,000 tons and imports normally exceed this quantity. Germany, Italy, Japan and the Netherlands, and to a lesser extent Belgium and France, are also leading importers.

CONCLUSION

Although the wholly synthetic fibres like nylon and terylene attract a good deal of attention nowadays, it must not be thought that they are likely to assume anything like the importance of such traditional natural fibres as wool and cotton, or of the regenerated fibre rayon. The United Kingdom, for example, one of the world's most important manufacturers of textile goods of all kinds, consumes cotton and clean wool at the rate of 1,000 million pounds and 500 million pounds a year respectively, but the annual production of nylon is not likely, in the near future, to exceed 30 million pounds a year, and current plans for terylene visualize an annual output of no more than 12 million pounds. The synthetic fibres have limited uses, and are much more expensive to produce than either rayon or cotton.

In the United States cotton accounts for nearly 70 per cent of fibre consumption, rayon for 18 per cent, wool for about 7 per cent, and the newer chemical fibres like nylon, dacron, orlon, dynel and vicara for no more than 5 per cent. As prices of the synthetics come down to more competitive levels they will, no doubt, be used more and more in mixtures, in combination with cotton and wool.

Chapter 13
Timber and Pulp

FOREST REGIONS

Two great classes of trees provide timber: the conifers, including pines, spruces and larches, yield 'softwoods'; the dicotyledons or broad-leaved trees, including the oak, ash, beech, teak, mahogany, lignum vitae and ebony, provide 'hardwoods'. The distinction implied by the names has general validity since most of the hardwood group are physically hard, but they also include such broadleaved species as balsa and poplar which are physically soft.

For thousands of years men have been burning and felling the forest areas of the world to clear them for purposes of grazing and cultivation. In China, the Near East, the Mediterranean lands and parts of Western Europe, such forest clearance took place so long ago that little record of it remains, but in North America and New Zealand ruthless exploitation has destroyed much of the forest area in quite recent times, and it is no more than half a century ago since men in Europe and America began to give serious thought to the problem of conserving and regenerating some of the destroyed forest.

In equatorial lands the problem of conservation is less acute since commercial exploitation has not been on the same grand scale and the forest re-establishes itself more quickly, but the tropical hardwoods provide a relatively small (though increasing) part of world needs.

Despite the destruction of centuries, however, existing forest areas still cover some 10,000 million acres of the world's surface – or more than the total of all arable and pasture land put together – though much of these areas is at present inaccessible. The chief regions are the cool temperate forests of the northern hemisphere or 'Taiga', the areas of mountain forest, and the tropical forests.

The *cool temperate forests* form a belt which stretches from Scandinavia to Sakhalin in the Old World and from British Columbia to the mouth of the St. Lawrence in the New, and they constitute the principal reserves of the soft timber used in construction work and in the furniture

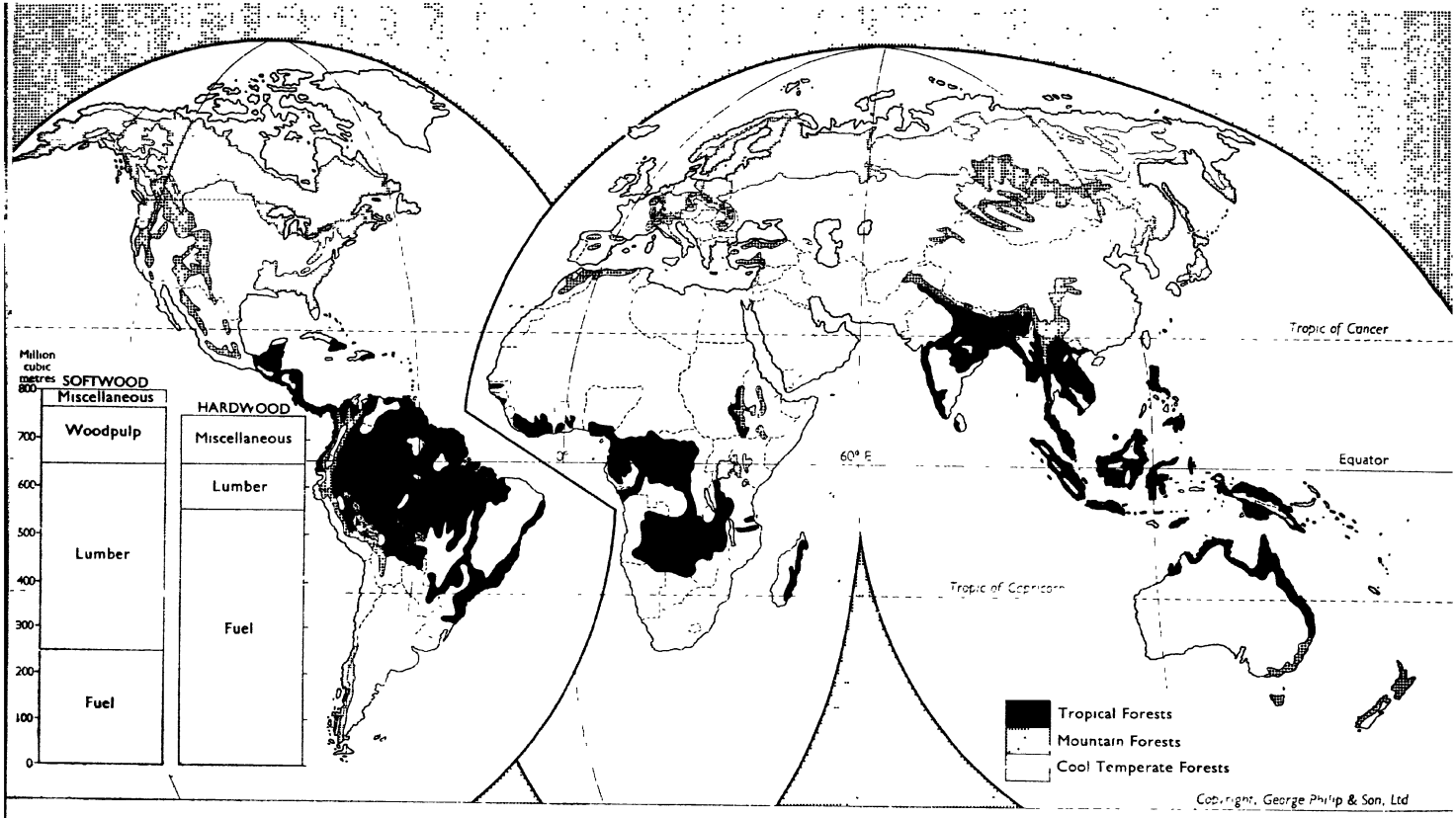

Fig. 54. The world's forests

and paper industries. Most of these forests consist of slow-growing timber, the Swedish forest, for example, taking from 75 to 150 years to mature.

The *mountain forests* cover the slopes of highland regions in most parts of the world, and the chief of these are the Rocky mountain system, the Andes, the Atlas mountains, Alps, Pyrenees, Caucasus and Himalayas, the mountains of Turkestan, the Altai mountains, Tian Shan, the mountains of western and south-western China, the ancient highlands of the Ardennes, Vosges, Black Forest and Czechoslovakia, and the ranges of eastern Australia and New Zealand. Here, the kind of timber varies with altitude and it is possible for the foot of a mountainous area to possess tropical hardwoods while the upper slopes are clothed with conifers.

Tropical forests are found mainly in the equatorial lowlands and on the wetter coasts of monsoon countries. Here the trees are, generally speaking, shallow-rooted, creeper-covered and very tall but vary from the grass-like bamboo jungles of the Orient to the selvas of the Amazon. Most of the tropical timber does not grow in pure stands, like that of the temperate forests, but is found in the form of isolated trees. In consequence, exploitation is expensive and such timber as enters into world trade is of high value. Many new varieties of tropical timber have been used in Europe since the war.

THE TEMPERATE FORESTS

By far the greater part of the timber used at the present day is derived from the great temperate forests of Euro-Asia and North

Fig. 55. Toppling the upper section of a Douglas fir in British Columbia

OAK ASH BEECH MAHOGANY TEAK MAPLE LARCH

Fig. 56. Some

America, forests which cover perhaps 4,500 million acres, though not all of this is capable of being used commercially. One-half of this area is found in the U.S.S.R. and the Russian forests constitute the world's principal timber reserves. So far, no more than a fraction of the annual growth is cut and the Russian climate produces a close-grained white-wood which is especially suitable for building and joinery.

Canada possesses some 800 million acres of forest though no more than one-third of this area is at present being used productively. The chief lumbering region is in British Columbia, where the milder climate and greater rainfall have produced trees of immense size. It was in 1824 that David Douglas, a Scottish botanist, first drew attention to the magnificent timber (the Douglas fir) which grows along this Pacific Coast and which now bears his name. This tree, which is also known as the Columbian or Oregon pine, often stands 300 feet high. The red cedar, sitka (or silver) spruce and the western hemlock are also found in British Columbia, the latter being used, among other things, for rayon production. In eastern Canada, the Canadian spruce, the white (or yellow) pine, the yellow birch and the maple are of great commercial importance, and the Lake region is the chief source of wood-pulp.

In the United States the timber reserves are estimated to cover some 600 million acres, two-thirds of which is fairly easy of access, but the annual cut of timber is considerably in excess of natural growth and in the past 300 years half the forest has been destroyed. The forest which remains consists of a number of distinct areas: (a) the lakes and north-east, where only 30 per cent of the original forest remains; (b) the South Appalachians and Gulf Coast, a principal lumbering area where 50 per cent of the timber remains; (c) the central forests, where only 20 per cent remains; (d) the Rocky mountains, where 75 per cent remains and forms a reserve for the future; (e) the Pacific region, where 80 per cent remains but where lumbering has expanded rapidly, particularly in Washington and Oregon; and (f) Alaska, where 80 per cent of the timber is uncut and forms a reserve of pulp wood. The American furniture industry is particularly fortunate in having

WHITE PINE DOUGLAS FIR HEMLOCK CEDAR BIRCH SPRUCE FIR WALNUT

forest trees

a big hardwood forest area at hand which yields a wide range of species, including alder, ash, basswood, beech, birch, chestnut, cottonwood, elm, hickory, maple, poplar, red gum, red oak, spa gum, tupelo, white oak and walnut.

The rest of the world's temperate forests are widely distributed. Argentina has 120 million acres, Sweden, Finland and Japan each have between 50 and 60 million acres, and there are considerable areas in other European countries and New Zealand.

Generally speaking, the only use which can be made of the land which the coniferous forests cover is as timber country, either soil or climate or both being unfavourable for agriculture. Snow in most areas gives easy transport in winter, and spring floods enable logs to be carried to navigable rivers. Glaciation has rejuvenated the drainage system and water-power can be developed for sawmills and pulp mills, while felling in some areas forms a winter occupation for farmers from neighbouring agricultural regions. On the other hand, the rate of growth is extremely slow and it takes a long time for timber that has been felled to be replaced. The regeneration of soft timber forests may take anything from 50 to 200 years and the more severe the winter, the slower the growth.

The rate of growth of the mixed forests of Central Europe and of the southern United States is much greater than that of the northern pine forests, but the absence of a heavy snowfall makes the cost of transport to navigable waterways much greater.

TROPICAL FORESTS

Tropical forests are coming increasingly into use. Brazil, with 1,000 million acres of forest area, possesses over one-third of the world's reserves though less than one-half of this area is at present accessible. East, West and Central Africa taken together has a forest area even larger than that of Brazil, while Indonesia and neighbouring countries possess the bulk of the remaining tropical timber. The rate of growth of tropical forests is at least twice as great as that of temperate forests.

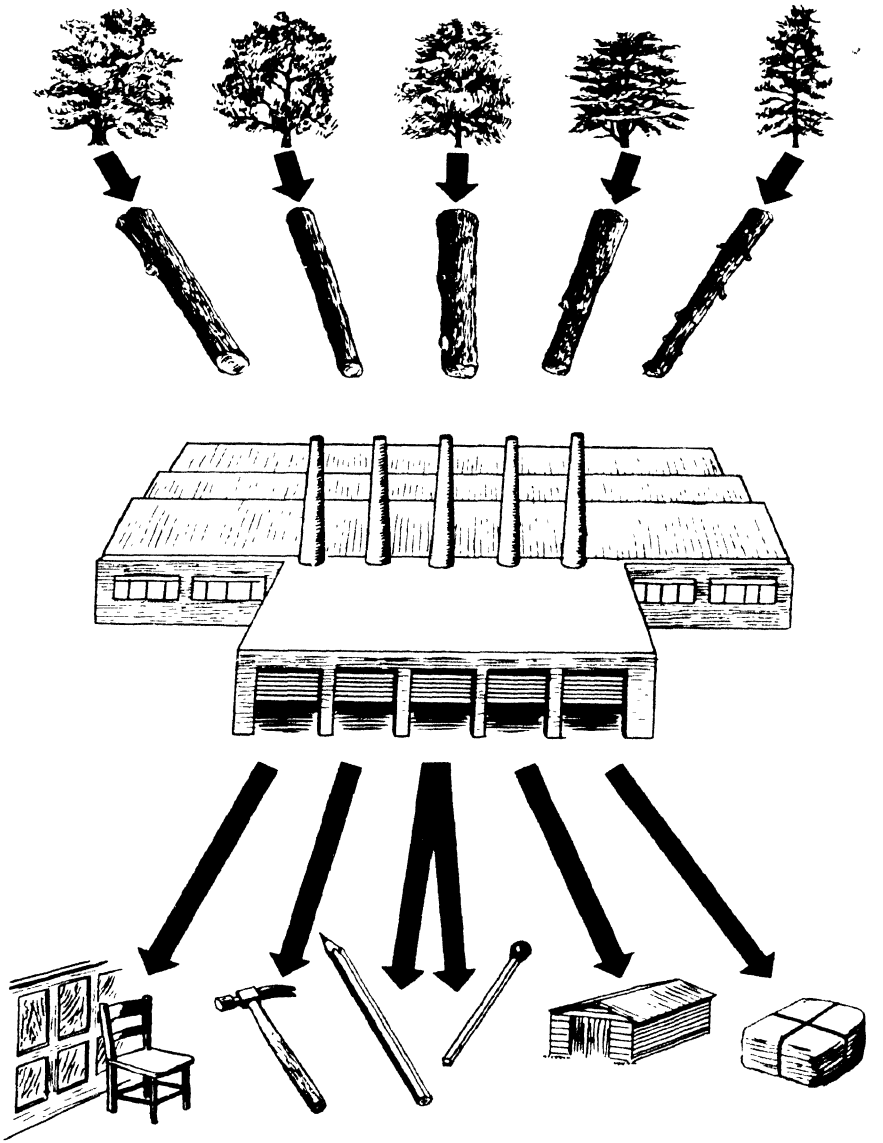

Fig. 57. The way timber enters into home life

PRODUCTION AND TRADE

In recent years the world production of roundwood – that is, the solid volume of wood felled, excluding the bark but before conversion into lumber, veneer or other products – has been estimated at about 1,600 million cubic metres – its value being some $20,000 million, or twice the value of the world output of crude steel or petroleum. This total is almost equally divided between hardwood and softwood species, but while only one-quarter of the softwood is used for fuel, as much as two-thirds of the hardwood is used in this way. It is often forgotten that, even in the modern world, wood remains a fuel of considerable importance and, all told, no more than 33 per cent of the timber cut is turned into lumber, though a further 8 per cent is used for the wood-pulp, and 9 per cent more for miscellaneous industrial products.

Unfortunately, Russian production is not known precisely, and such estimates as are available are not subdivided into hard- and softwood categories. Recent plans have called for an annual production of 600 million cubic metres, or nearly 38 per cent of the world total. Whether these plans are fulfilled or not, there is no doubt that the U.S.S.R. is the world's most important producer of timber.

The rest of the world produces about 430 and 410 million cubic metres of softwoods and hardwoods respectively. To the softwood production, the United States contributes about 46 per cent, Canada 20 per cent, Sweden 7 per cent, and Finland 6 per cent. The United States also contributes 20 per cent of the hardwood production, Japan, France, Australia and Italy being the other principal producers of temperate hardwoods, and Tanganyika, India and Uganda the principal producers of tropical timber. The total production of tropical hardwoods, however, does not exceed 120 million cubic metres and most of this is used for fuel.

World production of all types of timber now exceeds the pre-war figures, and the output of plywood and wood-pulp has increased very considerably. Thus, world production of *lumber* in recent years has been about 225 million cubic metres (48 million standards) a year, or 16 per cent more than pre-war. Of this total at least 80 per cent is softwood lumber, most of it being produced in North America, Europe and the U.S.S.R. Exports, at 11 per cent of production, are also above pre-war figures, and Canada exports 40 per cent of the total. Most of the rest is accounted for by Sweden, Finland, Austria, France, Yugoslavia and the United States.

Plywood production, at some 4 million cubic metres roundwood equivalent, is twice the pre-war output, with the United States producing over 50 per cent, and Western Germany the leading European manufacturer. Exports, however, come principally from Finland and go to the United Kingdom.

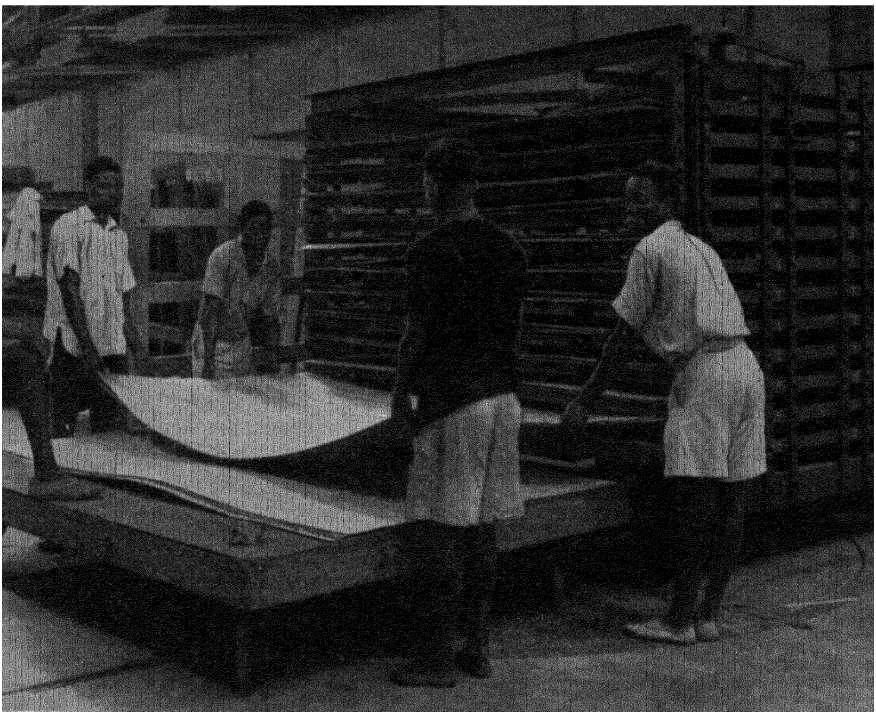

Fig. 58. The making of plywood from tropical timber at Sapele, Nigeria

Railway *sleepers* are often included among the figures for lumber production: production amounts to at least 5 million cubic metres, with France as the principal exporter and the United Kingdom the leading importer.

In addition to these, some 16 million cubic metres of roundwood are devoted to *pitprop* production, Finland, Sweden and Canada being important exporters and the United Kingdom again the largest importer.

Finally, there is the production of wood-pulp and newsprint. At nearly 33 million metric tons (100 million cubic metres, roundwood equivalent) *wood-pulp* production is more than 50 per cent above the pre-war level. It is produced almost entirely from softwoods and the United States contributes 40 per cent (much more both relatively and absolutely than in 1937), Canada over 20 per cent, Sweden 10 per cent, and Finland 6 per cent. Finland, Sweden and Canada together export 85 per cent of the 6 million tons entering international trade, while the United States and the United Kingdom take 66 per cent of the imports. The United States consumes no less than 50 per cent of all the wood-pulp produced in the world excluding the U.S.S.R.; of the remainder Europe takes a further 25 per cent, and Canada 20 per cent, leaving 5 per cent for some three and a half continents.

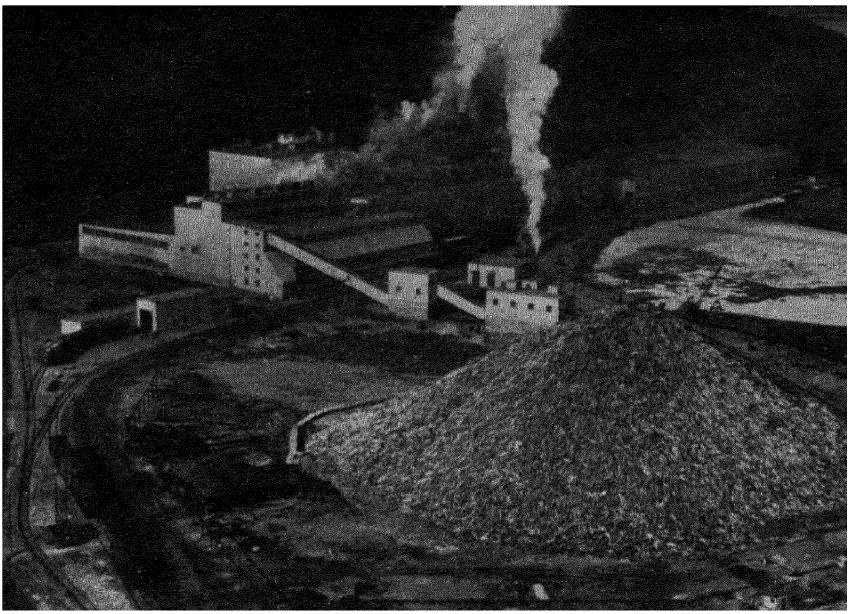

Fig. 59. A pulp and paper mill at Marathon, Ontario

World production of *newsprint* (excluding Russian production) is not less than 9 million tons, and Canada accounts for over 50 per cent of this total – nearly twice as much as the total European production. No less than 5·5 million tons enters into world trade, but the great bulk of this represents Canadian exports to the United States.

Before the war, *per capita* consumption of newsprint was highest in the United Kingdom: that is to say, the British read more newspapers and magazines than the people of any other nation. This is no longer the case and – as anyone who has compared an American Sunday newspaper with that of any other nation will easily believe – *per capita* consumption in the United States is now far higher than it is anywhere else. Canada, Australia, Sweden and New Zealand come next, with British *per capita* consumption little more than one-third of that in the United States. The most important reason for this is the drastic reduction in the size of British newspapers since the nineteen-thirties. On the other hand, the United Kingdom still publishes more book titles than any other nation, though the average edition is quite small.

To sum up the world trading position in all timber products: world exports amount to rather more than 100 million cubic metres in equivalent volumes of roundwood, or about 12 per cent of total output (20 per cent of the wood used wholly for industrial purposes) produced

in countries exclusive of the U.S.S.R., China and one or two less important areas. Total exports, despite increases in production, are no higher than those in pre-war years. Canada, Sweden, Finland and Austria together account for nearly 80 per cent of world exports of forest products, and Finland exports an equivalent of 56 per cent of its total roundwood output, Sweden 51 per cent and Canada 42 per cent. The main importing areas are the United States and the countries of Western Europe. Recent imports into the United States, the major importing country, have been equivalent to about 42 per cent of all reported world imports, and those of the United Kingdom to about 19 per cent.

THE USES OF TIMBER

Since the industrial revolution coal, petroleum and hydro-electric power have replaced timber as the main fuels, and iron, steel, concrete and other materials have largely replaced it in ship construction and found uses in other building work. Even so, timber is still a fuel of importance, and as a constructional material retains several desirable properties. It is strong in proportion to its weight, a good shock absorber, unaffected by normal temperature changes, and - as those who live in timber-built houses are aware – an excellent insulator against heat or cold. It is also easy to work, and can be finished in a great variety of attractive ways. The disadvantages of timber, on the other hand, are that it is inflammable, subject to insect and fungus attack, and limited in size. Although strong in proportion to its weight, it also varies in strength and cannot be relied on in quite the same way as the mineral building materials. Indeed, since the different timbers vary so much in their qualities, it follows that each of them has more or less specialized uses, and timber is not capable of the same degree of standardization as other materials.

In north temperate regions, softwoods are still very widely used for building and general constructional work. In Europe, the Scots pine (also known as red or yellow deal) and spruce (white deal) are the foremost timbers for these purposes; in North America they are the Douglas fir and western hemlock, as well as certain pines and spruces. The Scots pine is also used for telegraph poles and sleepers, while spruce – in addition to its uses for wood-pulp manufacture – is important for packing-cases. Softer timbers still, like the Canadian yellow pine, are made into matches or used for pattern-making in engineering and for cabinet work.

In the United States, particularly, it is the hard and smooth-grained woods of the deciduous forests which serve the furniture industry, though much furniture is made from hardwoods elsewhere. Oak enters into furniture and panelling, as well as being used for the con-

struction of casks and barrels, while oak bark is used in the leather industry for tanning. Larch, which is tough and durable, makes good fencing, pitprops, breakwaters, boats and carts, and the tropical hardwood, greenheart, which is resistant to marine boring animals like shipworm, is still useful in marine constructional work. Ash, which is flexible, is particularly valuable for the bodies of carriages and cars, and for oars and tool handles. Oak, birch and maple are laid down as flooring, the latter being unequalled for skating-rinks and dance-floors, while jarrah, a kind of eucalyptus indigenous to western Australia, has a special value for wood-block flooring and road-blocks since it wears well under heavy traffic. Pencils are usually made from juniper wood which cuts easily obliquely across the grain.

Pine, Douglas fir, birch, alder and certain tropical hardwoods are among the timbers used for plywood, which consists of thin slices (veneers) cut from logs and glued together under pressure. By alternation of the grain, boards of great strength may be obtained, and plywood has now become a familiar material for interior use and is being used more and more for army huts, the hull coverings of boats and other outside purposes.

Of course, just as technological discovery has brought new rivals for timber, so it has brought new uses for timber itself. The demand for pitprops and sleepers has grown with mining and railway development, but more important nowadays is the production of wood-pulp for rayon and paper manufacture. Rayon has been dealt with in Chapter 12, and here it remains for a word to be said about paper.

Nearly nine-tenths of the world's paper supply is obtained from wood-pulp, the chief sources of supply being Canada, the United States and the Scandinavian countries, where there are abundant supplies of spruce, water power, clean water and cheap transport. The pulp lumber camp is no longer a moveable centre as it was in the past, since large capital expenditure on plant is involved, and it is usual in Sweden, and in the newer works in Canada, for the pulp mills to become the centre of a permanent township. Mechanical pulp, produced by grinding wet wood against a grindstone, accounts for nearly 40 per cent of production and is used largely for cheap paper and newsprint. Chemical pulp, which is produced by boiling wood chips with various alkaline or acid reagents, is used for better class papers, though the finest quality paper is made from cotton or linen rags and esparto grass. Many textile materials can be used for paper and it is possible that, in the future, bamboo may become an increasingly important raw material.

The main uses of timber having been outlined, it should be remembered that alcohol, tar, creosote, turpentine, charcoal, wood naphtha, disinfectants, resins, various dyes and cork are all timber products, even

though timber is not the sole source of the supply of most of them. Research still proceeds and new uses for timber are still being discovered, just as on the other side – in the field of plastics, for example – new rivals continue to make their appearance to replace timber in some of its traditional uses. It is quite certain, however, that the world's wealth of forest will always be one of nature's most valuable gifts to man.

Chapter 14
Rubber

INTRODUCTION

The use of natural rubber for waterproofing purposes was known to the Indians of South and Central America at an early date but, until the nineteenth century, it was used by Europeans only as an eraser. In 1824, Macintosh used it for waterproofing, but not very successfully because rubber tended to melt in hot weather and crack in cold. In 1839 Goodyear discovered the process of vulcanization – in which sulphur is heated with the raw material – and thus prevented cracking, and a demand for rubber gradually developed. Large-scale development, however, did not come until the pneumatic tyre was invented and applied to bicycles and cars at the end of the century, but with the growth of the automobile industry and the increasing need for insulating material for electric cables and wires the demand for rubber has grown enormously and is still increasing. In the world as a whole there are over 70 million motor-vehicles, exclusive of motor-cycles, in use already, and the demand for new cars and commercial vehicles exceeds 8 million each year. In addition, rubber is used for footwear, machinery belting, proofed fabric, and many other industrial and consumer goods.

By 1938 world production of natural rubber amounted to about 1 million tons a year. At that time synthetic rubber was scarcely known, though both Germany and the United States were experimenting with its production. The war itself, of course, gave an immense stimulus to the synthetic rubber industry, since the natural rubber plantations were largely in the hands of the Japanese, and, by 1944, the production of the synthetic material was as great as the production of natural rubber had been six years earlier.

The post-war situation is complicated. World demand for rubber for ordinary industrial and consumer uses continues to increase and the output of natural rubber has not only been restored to pre-war proportions but, in recent years, has exceeded them by 50 per cent.

At the same time, there has been an immense accumulation of stocks, partly as military reserves, and the United States has felt it wise to keep up at least some production of synthetic rubber even though natural rubber can compete with it in price. As with some other commodities, there are real possibilities of over-production.

Since 1934 there have been attempts to regulate the production

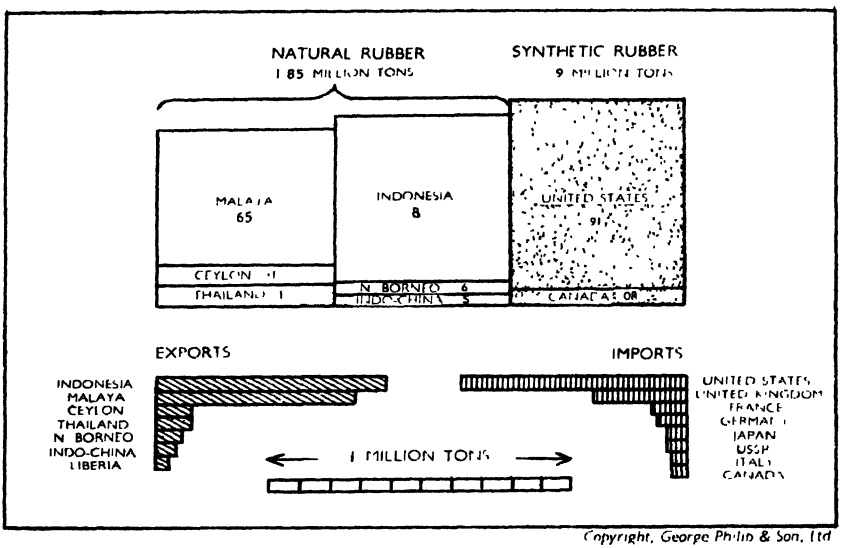

Fig. 60. Annual production of rubber

and export of rubber. In 1944 a new Rubber Study Group was established which included representatives of the major producing and consuming countries though, until 1952, it restricted its discussions to marketing problems. In that year, however, it set up a committee to consider the possibility of preventing burdensome surpluses or serious shortages, mainly by multilateral contract agreements and a buffer-stock scheme. What success will attend these attempts at international co-operation remains to be seen.

NATURAL RUBBER

The geographical requirements for the growth of rubber are constant heat at a temperature of about 80°F. and a total annual rainfall exceeding 60 inches. It follows that rubber is chiefly produced in equatorial lowland regions where the soil is well-drained. Until 1905 the equatorial

Fig. 61. A latex-collecting station on a Malayan rubber plantation

forests of Brazil and Africa, where rubber trees grow wild, were the chief centres of production, the latex being gathered by native collectors. In 1876, however, Sir Henry Wickham shipped seeds to Kew and, from the plants successfully cultivated there, the vast cultivated plantations of Malaya and Indonesia and the smaller but still extensive plantations of Ceylon, Siam, North Borneo and other Far Eastern countries have developed. Despite valiant efforts by the United States Government and the Ford Motor Company to develop plantations in South America during the war, these new areas have long superseded the lands of origin. The chief reason for this is that the Far East has an abundant supply of cheap, skilled Indian labour and no comparable labour supply is available in the immense rubber-bearing forests of Brazil, though rubber tree diseases prevalent in South America are also responsible in part. It is usual for the common food crops – upland rice, banana, corn and cassava – and sometimes coffee to be planted between the rubber trees and this helps to prevent erosion of the soil.

The rubber or 'latex' itself is a sticky, milky fluid which exudes when the tree is wounded or 'tapped', though it takes from five to seven years for new trees to yield. In practice a sloping channel is cut round the trunk and the latex drips into a collecting cup which is emptied daily and carried to the estate factory tanks. There it is coagulated by formic acid (a process rather similar to the curdling of milk) and either rolled and dried or rolled and smoked. In this state

it is usually exported since vulcanization is essentially a job for heavy machinery.

Mature trees benefited from their enforced 'resting' during the war and previously immature trees came into full production so that it was not long before output was restored to pre-war dimensions and, indeed, with record demands in the middle nineteen-fifties, world output reached 1·9 million tons (dry weight). To this total Malaya contributed 32 per cent, Indonesia 43 per cent (up to 1950 Indonesian production was lower than that of Malaya), Ceylon and Siam between 5 and 6 per cent each, and Indo China and North Borneo about 3 per cent each. Smaller amounts came from India, Nigeria and Brunei in the British Commonwealth, and Brazil, Burma, the Belgian Congo and Liberia elsewhere. Except in so far as they are affected by stocks and, in the case of Malaya, by the extensive trade in re-processing and re-exporting crude rubber imported from Indonesia, exports follow the same pattern and, indeed, the amounts involved differ little from production figures.

The dominating position of the United States as the world's largest user of rubber is indicated by the fact that she normally takes about half the world's exports, some 700,000 tons or more a year. The United States is the principal customer for rubber from Malaya, Indonesia and Ceylon. The United Kingdom takes a further 20 per cent of world exports, principally from Malaya, and France, Germany, the U.S.S.R., Japan, Italy, Canada, Australia, and – to a lesser extent – South Africa, Belgium, Czechoslovakia and Sweden, are all important consumers. Rubber shipments are vital to the economies of all the leading producers, and in Malaya and Indonesia account for more than one-half of the value of all exports.

SYNTHETIC RUBBER

The main sources of the raw materials for synthetic rubber are crude petroleum, acetylene (obtained from coal and limestone), and to some extent industrial alcohol which is produced from grain. The nature of the different synthetic rubbers varies considerably and each has distinctive properties and uses. GR – S or Buna S was the main rubber used for tyres and most other goods during the war and it is distinctly tougher and harder than natural rubber – more difficult to work, but superior in its wearing qualities. Butyl is much softer and stickier but gives excellent service in tyre inner tubes. Neoprene and perbunan are not general purpose rubbers and are manufactured in much smaller quantities; their importance lies in their exceptional resistance to oil and solvents, which makes them applicable in fields where other rubbers would become swollen and weakened.

The United States, Canada and Germany are the only nations at

present manufacturing synthetic rubber. United States production, which rose to a wartime peak of 820,000 tons in 1945 fell to 394,000 tons in 1949, but rose again to 845,000 tons in the exceptional conditions of 1951. Canada did not begin production until 1943 and production increased in each subsequent year up to a total of 62,000 tons in 1951. Germany's peak production of 116,000 tons was reached in 1943 but no synthetic rubber was produced in 1949 or 1950. In 1951 there was a small output of 1,000 tons.

CONSUMPTION

Some two-thirds of the total consumption of all rubber is accounted for by the manufacture of tyres and tubes. Other commercial uses include cables, belting, proofing, footwear, surgical equipment, sports goods and, more recently, upholstery. The United States, the United Kingdom, France and the U.S.S.R. have all doubled their consumption of rubber since before the war and, in addition to natural and synthetic rubber, large quantities of reclaimed rubber are used each year in manufactures. An expansion of industrial activity in British Commonwealth countries has been reflected in higher consumption figures in Australia, Canada, India and South Africa, but the United States and the United Kingdom remain the leading rubber manufacturers and each has an important export trade, particularly in rubber tyres. American exports, however, have declined through the formation of American-owned factories in several large marketing regions, including Great Britain.

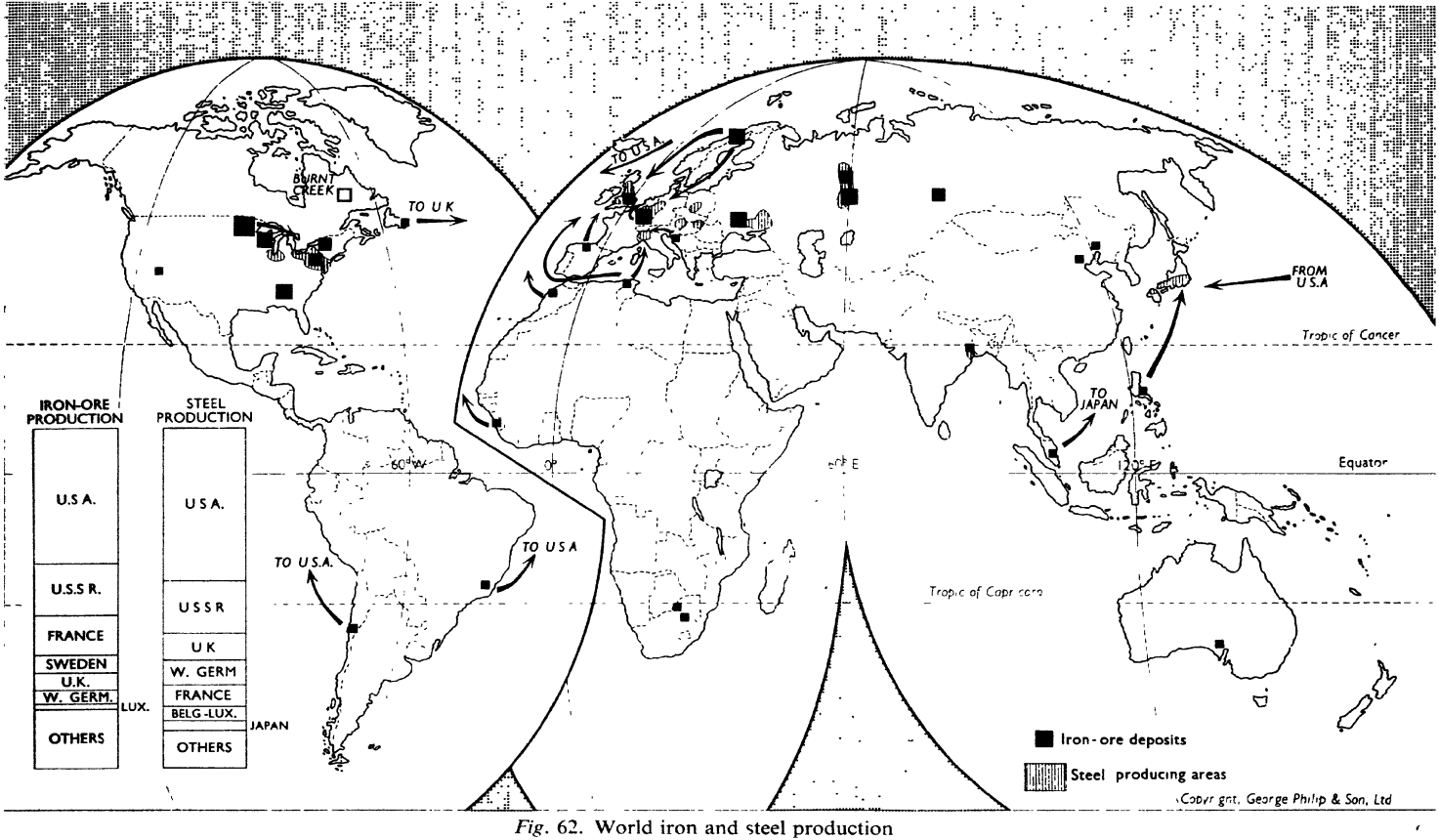

Fig. 62. World iron and steel production

Chapter 15
Iron and Steel

IRON ORE

Historically, the iron age is the successor of the bronze and stone ages, but it was not until after the industrial revolution that iron and steel became the backbone of civilised society and the chief raw materials for the great engineering, transport and other capital goods industries.

Our knowledge of the world's iron ore resources is far from complete, but it has been estimated that iron ore reserves amount to at least 150,000 million tons, of which no more than 300 million tons is mined each year at present, so there is no immediate prospect of a world shortage. The distribution of these resources, however, is most uneven. Of the known reserves, the Americas possess two-thirds – mainly in the United States, Canada and Brazil – and Europe, including European Russia, possesses much of the remainder. Although little is known about iron ore reserves in Asian Russia and China, there seems little doubt that the vast areas of Asia, Africa and Australia are but poorly provided with this vital metal.

For economic production, iron ore should be easy of access and contain at least 25 per cent of iron. The richest ores, like the magnetite of Sweden and the red hematite of the United States and Spain, contain up to 70 per cent.

By far the greatest iron ore producing region in the world is the district lying to the west of Lake Superior, which yields over 80 per cent of United States ore production and nearly 25 per cent of the world's supply. Here, for the most part, the ore can be quarried and is easy to win (with one-and-a-half times the labour force, the European Coal and Steel Community mines half as much) but, since there are no supplies of coking coal close by, most of the ore is carried to Lake Superior by rail and then by water to the bituminous coalfields which lie to the south of the lakes – a distance of anything up to 1,000 miles. Transport costs are a large part of total costs in such circumstances as these and,

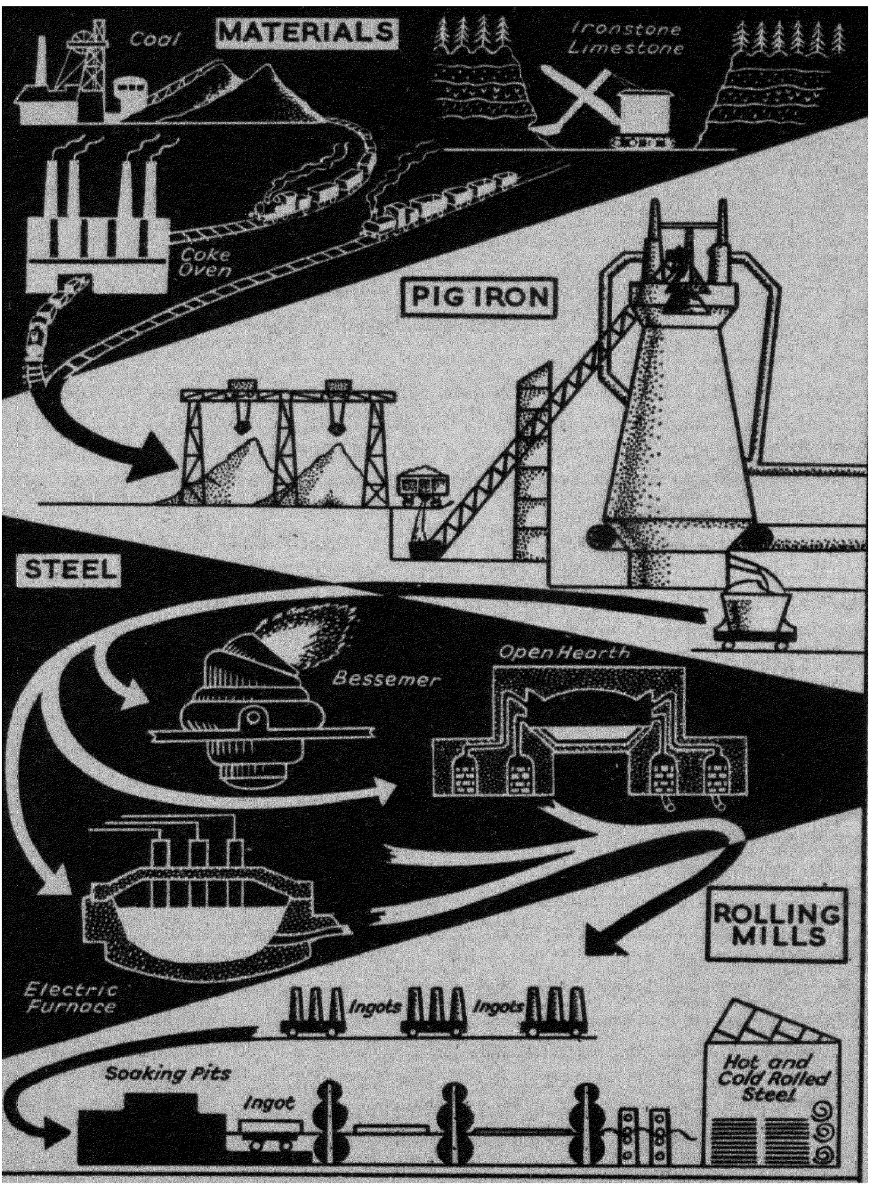

Fig. 63. The manufacture of steel

since the Lake traffic is ice-bound in winter, large stocks must be built up.

Elsewhere in the United States, the iron and steel industry is of lesser importance. Both coal and iron ore are mined close together in Alabama and a localised industry exists there; on the west coast an industry based largely on scrap-iron expanded rapidly during the war; and on the east coast there are a few works which depend, in the main, on ore imported from Chile, Sweden, Brazil and North Africa.

The second most important ore-producing area is based upon the limonite deposits of Alsace-Lorraine which account for most of the French production, though the iron content is considerably lower than that of the American hematite deposits. The Alsace-Lorraine steel industry is, in part, dependent upon imports of coke from the German Ruhr, and the Ruhr is, in part, dependent for its low-grade ores upon Alsace-Lorraine. The Belgian industry also utilises large quantities of Lorraine ores, and Luxemburg – which has an impressive iron and steel industry for its size – is becoming more and more dependent on both Lorraine ores and German coke. It is little wonder then that Alsace-Lorraine has long been disputed territory and in the nineteen-thirties, when Lorraine ores were unavailable, Germany made desperate attempts to develop very low-grade domestic deposits near Hanover. After the loss of Lorraine in 1918, indeed, the Rhine industry became very largely dependent on imported Swedish ores. However, with the establishment in 1952 of the European Coal and Steel Community – which has established a common market for coal and steel in Belgium, France, Western Germany, Italy, Luxemburg and the Netherlands – there is evidence of a rapidly growing trade between the six countries and a big expansion in capacity.

In the U.S.S.R. there are very rich deposits of martite (a form of hematite) in the southern Ukraine and iron-mining first developed round Krivoy Rog and Zaporozhye, but from 1932 onwards the emphasis began to shift to Magnitogorsk in the Urals and Kuznetzk in Central Siberia. The Ukraine industry, in particular, suffered very severely during the war, but Russian production is expanding rapidly again now and the U.S.S.R. is third in importance as an ore-producing region, after the United States and the European Community countries.

Sweden comes next and possesses deposits of high-grade ore, particularly in the north (Kiruna and Gällivara) but also in the centre (Grängesberg). The absence of local coking coal, however, has resulted in the export of most of the ore mined, though hydro-electric power is being increasingly used and the manufacture of 'sponge-iron', for which a blast-furnace is not necessary, is developing. The Swedes are famous for certain special grades of steel (steel for ball-bearings,

for example) and the government has recently sponsored a big expansion of steel-making in the north at Lulea.

In the United Kingdom production is widely scattered and the older centres now depend largely on imported ores since local deposits have been worked out. Half the ore used is imported, mainly from Sweden, Spain, North and West Africa and Newfoundland.

Both Japan and Italy are ill-provided with iron ore. Japan now imports ore from the Philippines, the United States and Malaya, as well as large quantities of scrap from the United States. Italy imports ore from Algeria, Sweden and Yugoslavia, and scrap from France, Germany and the United Kingdom.

PRODUCTION AND TRADE

World iron ore production has increased rapidly in recent years and is now not far short of 300 million tons a year, as compared with 210 million tons in the pre-war peak year of 1937 and 166 million tons in 1938. To this total the United States contributes some 40 per cent, the U.S.S.R. 15 per cent, France 12 per cent, Sweden and the United Kingdom 5 per cent each, Western Germany 4½ per cent, and Luxemburg 2 per cent. Countries producing round about 1 per cent each include India, Chile, China, Algeria, Brazil, Canada and Spain.

Belgium-Luxemburg, the United Kingdom, Western Germany, the United States and Japan are by far the leading importers, Belgium-Luxemburg alone importing about 11 million tons a year, mainly from France but including large quantities from Sweden. Sweden, Spain and North Africa provide the bulk of British imports, and Sweden is still the main source of imports into Germany. Since 1948 the Saar has been incorporated economically into France so that the movement of iron ore from France to the Saar does not now appear in international trade statistics; before incorporation, however, about 10 million tons of ore entered into trade in this way. It follows that much of the trade in iron ore is between the countries of the European Coal and Steel Community.

The United States normally exports about 4 million tons of ore, but imports some 10 million tons, mainly from Chile, Sweden, Canada and Brazil. Japanese imports currently amount to about 3 million tons a year.

Sweden, with exports amounting to 13·5 million tons, is the world's leading exporter, followed by France, Algeria, Morocco and Spain, and, in South America, by Chile and Brazil.

MANUFACTURE

Iron ore has frequently to be carried long distances even in countries with high domestic production, since many deposits are remote from

suitable deposits of coking coal. It is cheaper to carry the ore to the coal than the coal to the ore but, even so, transport costs often exceed the costs of mining.

The ore is usually smelted in a blast furnace, where it is mixed with coke and, if need be, lime or limestone as a flux. From the furnace the molten iron is run off and either taken in a large ladle direct to a steel works or cast, often mechanically, into bars or 'pigs' (hence the term pig-iron) weighing about 100 lb. which are subsequently re-melted. The slag – the alumina, lime, silica and other impurities which float on top of the molten iron – is a by-product which can be used for road metal or cement.

Steel is made by re-melting pig-iron and, by oxidation in conjunction with appropriate fluxes and by dilution with scrap, removing such unwanted elements as carbon, manganese, silicon and phosphorus which form a separate slag. To do this a number of different processes can be used. In the *Bessemer* process from 10 to 60 tons of pig-iron are poured in at the top of a pear-shaped vessel and air or oxygen is blown through the bottom. This oxidises all the unwanted elements and a little of the iron, so that ferro-manganese and spiegeleisen are added after the blow to deoxidise the steel and provide the required amount of carbon and the small quantity of manganese which is needed in all steel. In the *open-hearth* process, which has increased in relative importance, the iron is heated with scrap, oxides and other materials in a rectangular reverberatory furnace which is charged from the side and holds up to 400 tons of metal. The advantage of the reverberatory furnace is that it can work very varied proportions of pig-iron and scrap whereas the Bessemer process can use little scrap and demands iron of a narrower composition. Labour and capital costs are all much higher but the open-hearth process gives greater control over quality, and it is cheaper to make steel from steel-scrap if this is available. *Electric* furnaces are used for making steel of exceptional purity, the principal type being the arc furnace. In some countries where water-power is plentiful, notably Sweden and Italy, arc furnaces are also used for smelting iron; coke is then required solely for reduction purposes and not as a source of heat. To make high-grade steel cheaply from low-grade iron, the steel is sometimes made in the Bessemer converter but finished in one of the other furnaces. This process is known as 'duplexing' and it has been effectively developed in Germany.

Slag is poured or skimmed off the molten steel which is itself 'tapped' or poured into a firebrick-lined ladle and then 'teemed' through the bottom of the ladle into a series of cast-iron moulds. The moulds are square at the top if the steel is for bars, rails or girders and oblong if it is for plates or sheets.

'Hot-worked' products comprise those which are hot-rolled or

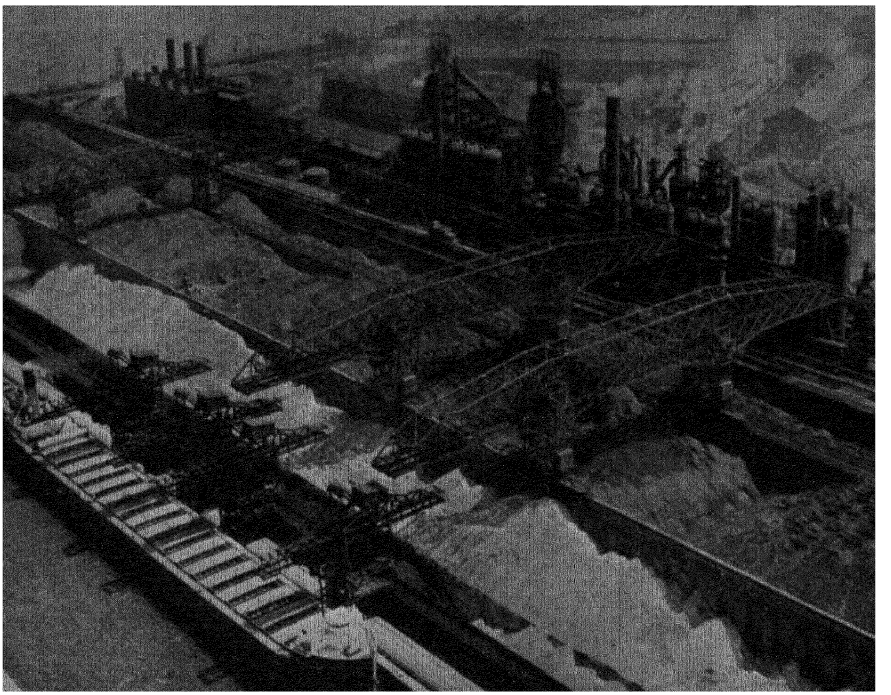

Fig. 64. Iron ore being unloaded on Lake Michigan

shaped while the ingot is still white hot. They may be finished products, semi-finished products which are sold for further processing, finished steel castings or steel forgings – all of them carried a stage further than the crude steel in its ingot form.

The term 'flat products' is used to denote steel plates, sheets, sheets coated with tin such as are used in the canning industry, bars, and strips for tubes. All these are being made more and more by the process known as continuous casting, a mass production method which was first adapted to steelmaking in the United States. In continuous casting the liquid steel is water-cooled and solidifies quickly, with the result that the casting is of a fine, uniform structure with a satisfactory surface. The erection of continuous wide-strip mills is the most important new development in steel manufacture in recent years, and these mills are steadily superseding the old-fashioned types which produce an inferior product and have high labour costs. The continuous wide-strip mill produces sheets and plates which are particularly useful in the manufacture of certain durable consumers' goods, the demand for which increases as standards of living rise. The economies which result have an important effect on the price of cars, containers and kitchen equipment.

Other recent developments of importance in the steel industry are the growth of cold-rolling of sheet and strip (i.e. the metal is rolled

without being heated), and the growth of electrolytic tinning in place of the older method of dipping sheets or wire in molten zinc or tin.

These and other advances have been marked by a progressive increase in size, complexity and the cost of plant. There are considerable economies in large-scale production, and steel manufacture everywhere tends to be in the hands of very few firms. In the United States, the United States Steel Corporation alone makes over a quarter of the whole output of the industry, or more than 10 per cent of the world's production of crude steel, while the Bethlehem Steel Corporation, the second largest firm, makes about as much as the whole British industry.

STEEL PRODUCTION AND CONSUMPTION

Nowadays, the world is using considerably more steel than it did before the war, though one of the chief reasons for this is that the major countries are devoting a larger part of their resources to the production of armaments than they have ever done before in peace-time. Another contributory factor, however, is an increasing demand in the richer countries for such consumer goods as cars, electric washers, refrigerators, and other domestic equipment.

Since the world is currently producing considerably more steel than pig-iron, it follows that there is a growing demand for scrap steel. Thus the annual world production of crude steel is about 220 million long tons, whereas pig-iron amounts to no more than 150 million long tons.

Total steel production is no less than four times what it was in 1932 and over 50 per cent more than it was in the pre-war peak year of 1937. Of the total, the United States' share has risen from 38 per cent to 45 per cent in fifteen years, and that of the U.S.S.R. from 13 per cent to 15 per cent. The other leading producers are the United Kingdom (7½ per cent), Western Germany (7 per cent), France and the Saar (6 per cent), Belgium-Luxemburg (4 per cent), Japan (3 per cent), Czechoslovakia, Canada, Italy and Poland, each of them producing round about 1½ per cent of the world total. If the European Coal and Steel Community countries are taken together, their current output of 42–45 million tons of steel is rather more than half that of the United States, and about equal to Russian and British output taken together.

In relation to their populations, Sweden, Australia and Austria also have considerable steel industries, while among many of the smaller producers – notably in South Africa, Brazil and the Netherlands, but also in India – progress has been rapid since the early war years.

In some countries, crude steel consumption has increased remarkably since 1938. In Canada it has increased by 200 per cent, in the United

States by 130 per cent, in Australia by 98 per cent, in the U.S.S.R. by 120 per cent, and in Sweden, Belgium, Luxemburg and the United Kingdom by rather smaller amounts. Steel consumption is also far above pre-war levels in many of the less-developed countries, notably in the Belgian Congo, British East Africa, French West Africa, Syria, the Lebanon, Mexico, Brazil and Cuba. There is, however, an immense gap between consumption in the highly industrialised countries and in the under-developed countries. In the United States, for example, consumption per head of the population is over 600 kilogrammes a year, in Canada and Sweden it is between 300 and 400 kilogrammes a year, and in most West European countries, Australia, New Zealand and South Africa, between 100 and 300 kilogrammes a year. In Mexico and Brazil, on the other hand, it is no more than 20–40 kilogrammes, and in the Philippines, East and West Africa and India less than 7½ kilogrammes.

No world analysis of the uses to which steel is put is available, but just before the war, in the United Kingdom, 20 per cent was used in building and constructional engineering, 15 per cent in mechanical engineering, 10 per cent in shipbuilding, 7 per cent for railways, 7 per cent for motor cars and bicycles, and the remaining 41 per cent in the production of a great variety of goods, including containers, nuts and bolts, tools, carriages and wagons, and electrical goods, as well as in agriculture and the gas and aircraft industries. This is probably representative for any highly industrialised country, the tendency being for the consumption of flat products to increase.

TRADE

Steel, of course, enters into the export trade of the main producing countries in many forms, as machinery of all kinds, as railway and motor vehicles, as ships and aircraft, as well as in other finished and semi-finished forms, so that it is difficult, briefly, to give any clear picture of the trade across international frontiers in steel products. A number of countries, notably the United Kingdom and Western Germany, import large quantities of semi-finished materials, often to use them and to export similar products in a more highly finished and valuable form. United Kingdom imports in a recent year, for example, included 2·5 million tons of iron and steel in the shape of pig-iron, ferro-alloys, ingots, sheets, girders, bars, etc., their total value amounting to £117 million. In the same year, United Kingdom exports of similar articles amounted to only 2 million tons by weight but £131 million by value. Germany imported 1 million tons of such commodities worth 600 million marks and exported rather more than 2 million tons worth 1,700 million marks.

If attention is confined to exports of ingots, semi-finished and finished

steel exclusive of steel products combined with other materials,* Belgium and Luxemburg together are the leading exporters and export nearly 5 million tons of these goods, principally to the Netherlands, the United States, Sweden, Switzerland, the United Kingdom and Argentina. France and the Saar come next with exports of nearly 4 million tons, going principally to the United States, Italy, Argentina, Morocco and Switzerland. The United States itself exports close on 3 million tons, largely to Canada, Mexico, Venezuela and Brazil, while Western Germany exports some 2 million tons, principally to the Netherlands, the U.S.S.R. and Switzerland. United Kingdom exports are about the same as those of Western Germany but go principally to other Commonwealth countries – Canada, Australia and South Africa – and the United States. Japanese exports are half as big and go mainly to Australia, Argentina and the United States. Austria and the Netherlands are the only other countries with exports of any size, and these do not normally exceed 200,000 tons.

It will be seen from these figures that no more than 10 per cent of world steel production enters into world trade and over one-half of this traffic is between the rich, industrialised countries, much of it between the principal exporters themselves.

*I.e. including bars and rods; shapes and sections; strip; plates, sheets (tinned and untinned), wrought tubes, pipes and fittings; rails, sleepers, fishplates and soleplates; railway wheels and axles; and single wire.

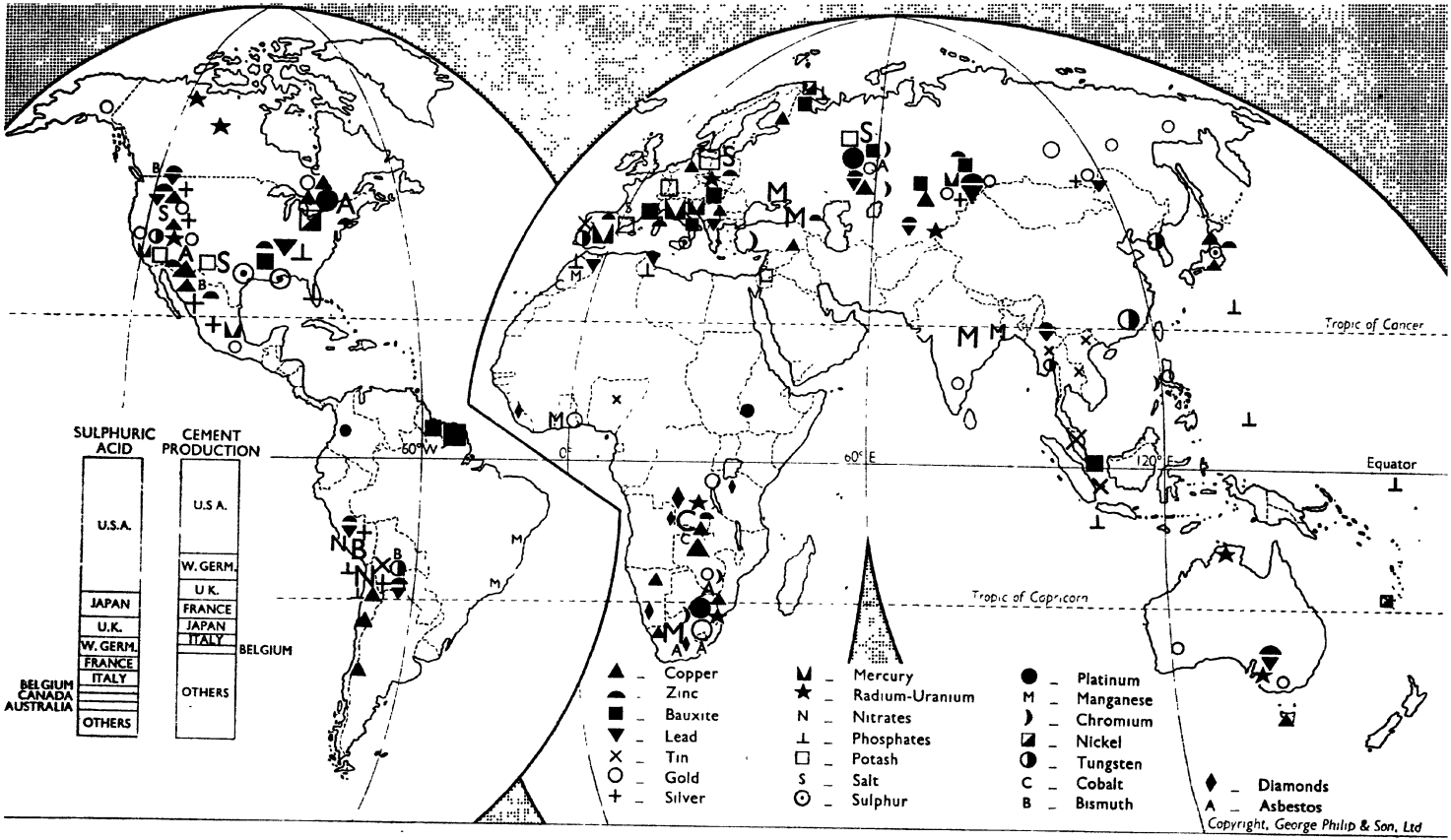

Fig. 65. World production of non-ferrous minerals

Chapter 16

Other Minerals and Chemicals

INTRODUCTION

Chapter 15 has dealt with iron and steel and Chapter 17 deals with coal and petroleum. Sandwiched between them, this chapter attempts to deal with all the other minerals of considerable economic importance. It is least satisfactory in its treatment of the common building materials since few of these enter extensively into international trade and production statistics are hard to come by, but from what we know of cement production it is clear that enormous quantities of clay and limestone are used each year.

Building materials apart, the quantities of these other minerals and chemicals mined or produced nowhere approaches the quantities of coal, petroleum or even iron ore. World production of iron ore amounts to about 290 million tons a year; but cement production is only 140 million tons, salt production about 50 million tons, and bauxite production only 10 million tons, though more bauxite is mined, weight for weight, than any metallic ore apart from iron.

It has not seemed very useful to distinguish between those minerals which are won from the earth and those which are products of the chemical industry since, in a sense, most minerals are both. Metallic ores have to be smelted and nowadays some proportion of the major metals is recovered from scrap-metal which has already served a purpose once. Cement is manufactured, asbestos is much processed, and fertilisers – already produced in greater quantities than the principal metals other than iron and steel – are part manufactured and part mined.

After building materials and salt, the most important of the various mineral products – by weight – are the artificial fertilisers (phosphates, nitrates and potash), bauxite, manganese ore, sulphur, copper, zinc and lead ores. Together they are a cargo of considerable importance to world shipping and a number of ships are built to carry them in bulk.

THE PRINCIPAL METALS

1 – *Copper*

The value of copper as an industrial metal lies chiefly in its power to conduct electricity and in its ductility, strength, and resistance to many forms of corrosion. It is an ideal material for use in water heaters, radiators, milk coolers and refrigerators as well as for the production

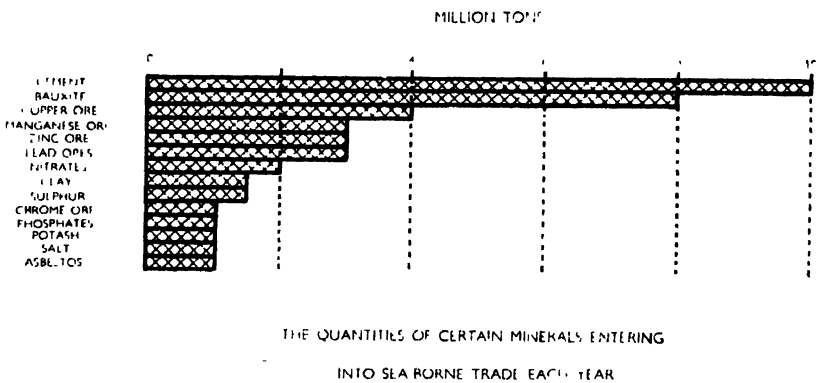

Fig. 66. Some minerals entering into sea-borne trade

of wire. In the United Kingdom about one-half of the copper imported is used in the electrical industry; much of the rest is employed in ship-building, and the remainder enters into the manufacture of a great variety of goods including the two copper alloys, brass and bronze, brass being used for instrument and machine parts and bronze for springs and castings.

World production of smelted copper is not far short of 3 million tons a year, one-tenth of this total being recovered from scrap. This is considerably more copper than was produced before the war and output has risen in many countries including, among the principal producers, the United States, Northern Rhodesia and the Belgian Congo.

Of the total the United States produces about 30 per cent, Chile (which possesses the largest copper mine in the world at Chuquicamata) 15 per cent, Northern Rhodesia 10 per cent, and the Belgian Congo, Canada, and the U.S.S.R. about 7 per cent each. Copper ores, however, are widely distributed and Western Germany, Mexico, Japan, South Africa, Yugoslavia, Finland, Turkey and Australia are all producers of some significance.

Chile, Northern Rhodesia and the Belgian Congo are normally the leading exporters and export all or nearly all their ore production.

Canada also exports large quantities, and South Africa, Mexico, Yugoslavia, Japan, Turkey, Peru, and a number of other countries, smaller amounts.

The United Kingdom, Belgium, France, the United States (despite her huge domestic production) and Western Germany are the principal importers, though Belgium, the United States, Western Germany and, to a less extent, the United Kingdom are also considerable exporters or re-exporters.

2 – *Zinc*

Zinc, which ranks with copper and manganese as one of the three most widely used non-ferrous metals, is mainly used with copper in the manufacture of brass. Of almost equal importance, however, is its use as a protective coating for iron and steel since, when exposed to air it corrodes only one-tenth as fast as iron. Hence zinc is to be found protecting roofing and hardware, and the two main uses together probably account for two-thirds of the zinc consumed in industry. Other zinc alloys find a use as die castings, which are employed in the manufacture of ammunition components as well as in the manufacture of a wide range of common articles, and the metal is also important for the production of batteries and in the printing industry. If zinc vapour is burned it produces zinc oxide and this compound has a number of industrial uses. In paints it has a toughening effect upon the film; in the rubber industry it is used in the vulcanisation process; and in pharmacy it is used in a number of different medicaments and other preparations.

Zinc ores of commercial importance occur principally in the United States, Mexico and Canada, in Central Europe and the U.S.S.R., and in Australia, but smelting is often carried out in places far removed from the mines and the United Kingdom, for example, refines Australian ores.

World production of smelted zinc amounts to nearly 2·5 million tons a year, of which the United States produces rather less than 40 per cent, and Canada, Mexico, the U.S.S.R., and Australia 8–10 per cent each. Poland, Western Germany, Italy, Belgium, France, Japan, the United Kingdom and Norway all produce considerable quantities of the smelted metal, while, in addition to those countries already mentioned, zinc ores are mined in the Belgian Congo, Bolivia, Northern Rhodesia, Spain, Yugoslavia and Peru.

The world's leading exporters of zinc are Canada, Mexico and Belgium (each of which export about 150,000 tons a year), while Spain, Australia, the United States, Norway and Northern Rhodesia export smaller quantities. The United Kingdom and France are the leading importers.

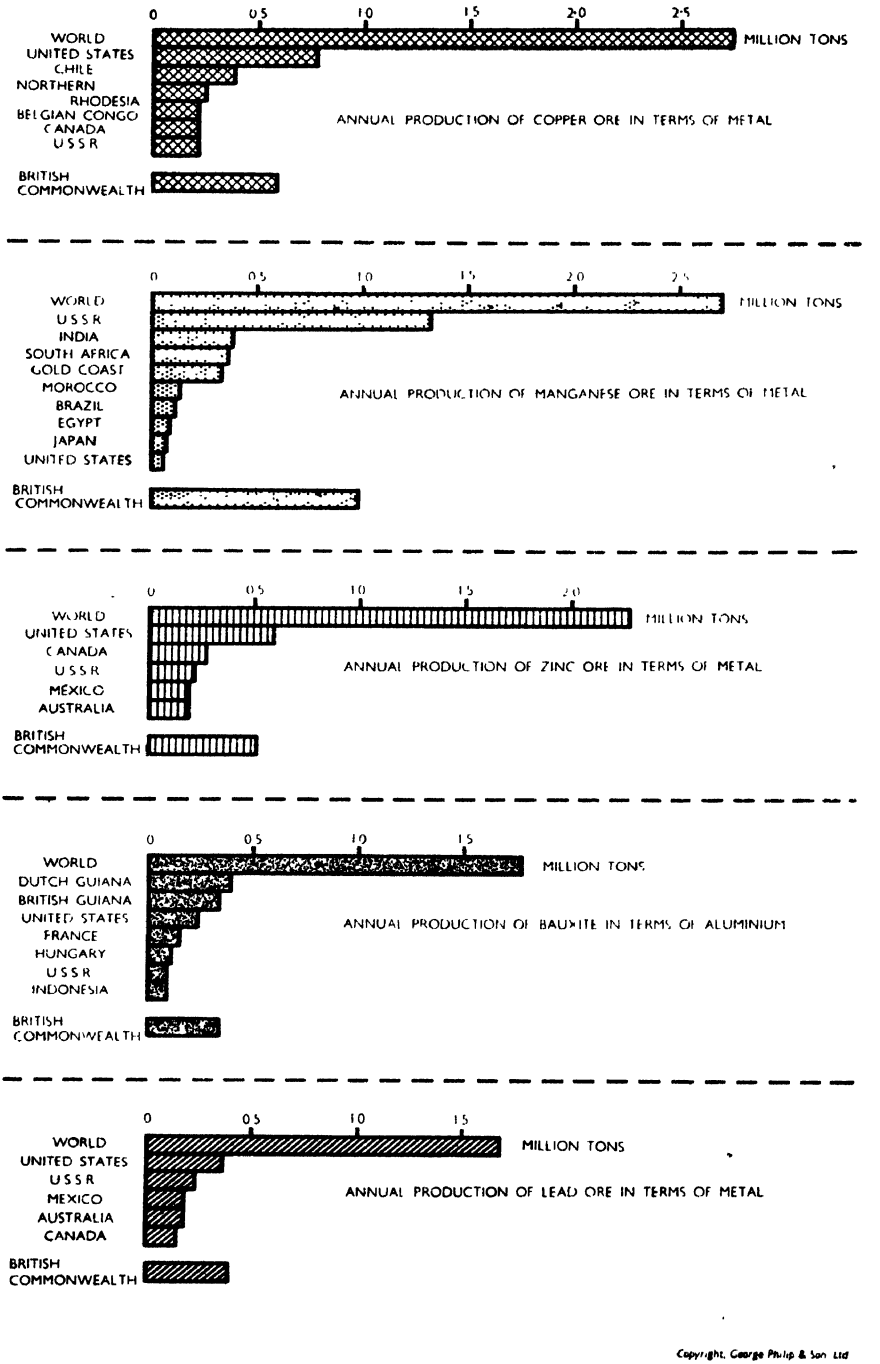

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Fig. 67. Production of the principal non-ferrous metals

3 – *Aluminium*

Since it occurs in all clays, aluminium is the most abundant of all the metals found in nature but, at present, bauxite is the only mineral from which it is obtained on a large scale. Refining is both difficult and expensive and, since aluminium is produced by electric furnaces, cheap power is the first requirement and the ore is carried to the power source. Use of the metal both in the pure form and in alloys, has increased enormously in recent years since, for a given volume, it weighs no more than one-third of the other common metals but nevertheless resists corrosion, is a good conductor and has high reflectivity. For these reasons it is widely used in the aircraft industry, for the production of vehicles and light vessels, in the food industries for such things as dairy utensils and brewery equipment, for the production of certain types of machinery, in the electrical industry, and in structural and building work.

Annual world production – now over 2·5 million tons – is four times what it was before the war. The principal producers of the smelted metal are the United States (not far short of 50 per cent), Canada (nearly 25 per cent), France and Western Germany (5 per cent each), Italy, Norway, Japan, Austria, the United Kingdom, Switzerland, and the U.S.S.R. Dutch and British Guiana together supply nearly one-half of the world's supply of bauxite, the other main sources being the United States, France, Hungary, Indonesia and the U.S.S.R.

4 – *Lead*

Lead is the softest of the common metals and is highly malleable. It can be rolled into sheets, squirted into pipes, and even cut with a knife. Its main uses, therefore, are in cable, sheet and pipe manufacture, though it is also used for batteries, in ammunition, and as an alloy for type-metal. The lead oxides are used in paint and flint glass manufacture and for pottery glazes, while in the form of lead tetraethyl it is a component of 'anti-knock' petrol.

The most important source of lead is the mineral *galena* which often contains silver as well and is sometimes found associated with zinc ores. The fields in south-east Missouri and in the tri-state (south-west Missouri, Kansas and Oklahoma) are among the most productive. Broken Hill in New South Wales, Sullivan Mine in British Columbia, and Bawdwin Mine in Burma are other important mining centres, and lead lodes have been worked in several places in the United Kingdom. British ore production, however, has fallen rapidly in recent years and, the world over, the great ore bodies are becoming exhausted without deposits of comparable size having been discovered to take their place. The result has been a world shortage of lead and, in recent years, other metals have been much used in plumbing as lead substitutes. It may be

that in future such plastics as *polythene* will replace lead in some of its uses; polythene, in addition to being resistant to corrosion, does not split when the water in the pipes expands on freezing.

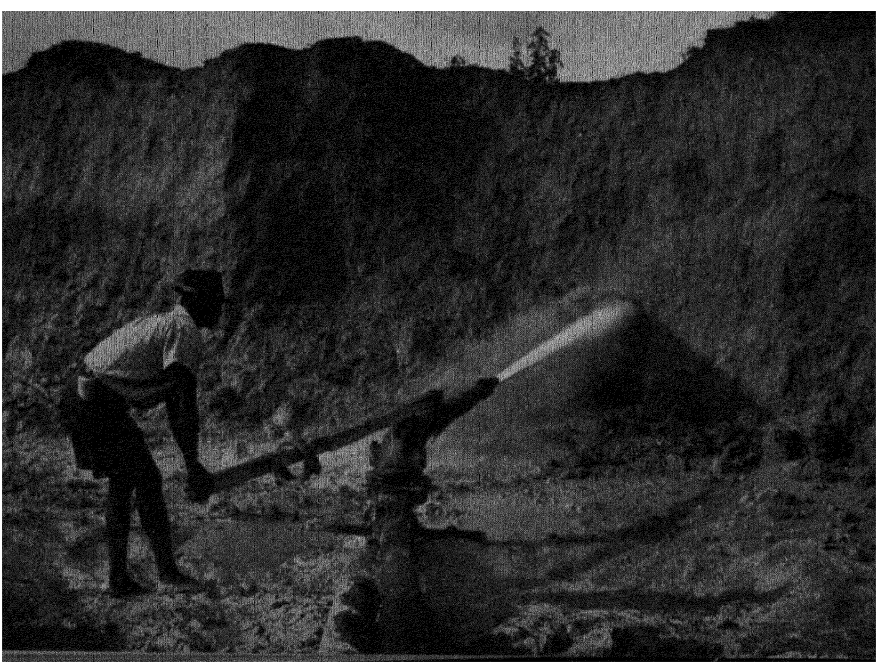
At the moment, world production of the smelted metal amounts to about 1·7 million tons a year. Of this total, the United States produces nearly 30 per cent, the U.S.S.R. and Mexico half as much each, Australia and Canada round about 10 per cent each, and Western Germany 5 per cent. Australia, Mexico and Peru are the world's leading exporters, though ore is also exported by Yugoslavia, Bolivia, Morocco and Tunisia. The United Kingdom, Western Germany, Belgium, France and Italy are the principal importers.

5 – *Tin*

Tin is resistant to attack by most organic acids if the acids are dilute, especially in the absence of air. The metal is therefore very useful as a coating material in the canning industry. In the electrical industry some copper wire is tinned to prevent any reaction between the copper and the sulphur in the rubber insulation, but tin is being superseded in this use by the substitution of plastic insulating materials for rubber. Solid tin is used for pipes which carry beer or condense water and, as foil, it is used for wrapping food and tobacco. As an alloy, it enters into gun-metal, bell metal and type metal, while the oxide is used to render glass opaque and to give body to white vitreous enamels and glazes.

World production amounts to about 200,000 tons of metal a year,

Fig. 68. Tin being 'washed-out' of a deposit at Kalima, Belgian Congo



of which Malaya produces some 25 per cent, Indonesia and Bolivia a further 15 per cent each, the Belgian Congo 6 per cent, and Siam, Nigeria, Portugal and Burma smaller quantities. It is noteworthy that practically no tin is found in the United States or Canada, and very little in Europe.

The chief importers are the United Kingdom, the United States, the Netherlands and Belgium.

THE PRECIOUS METALS

1 – *Gold*

Gold is proverbially the most coveted of all metals and, although it has its uses as jewellery, in dentistry and as gold-leaf, it commands its high price principally because it is universally accepted as a *store* of value: people and governments are always willing to accept it in exchange for other goods. Both in circulation as coinage and out of circulation as a 'backing' to paper currency it has had a profound effect upon world history, and the prosperity of whole eras has depended in part upon its chance discovery.

World production of gold in one recent year was estimated at 25 million fine ounces, of which South Africa produced nearly 50 per cent. The other big producers are Canada (15 per cent), the U.S.S.R. (12 per cent), the United States and Alaska (6 per cent), and Australia (4 per cent). Both geologically and geographically the ore is widely dispersed and it is also worked in the Gold Coast, the Belgian Congo, Southern Rhodesia and, to a lesser extent, in Brazil, Chile, Colombia, Mexico, India, Japan, New Guinea, the Philippines, Rumania and Sweden, but there are wide fluctuations in production as the value of gold varies in relation to that of other goods.

Gold movements are seldom reported in trade statistics but the United States stands ready to purchase any quantity at a fixed price and for more than thirty years much of the rest of the world's imports from the United States have been financed, directly or indirectly, in this way.

2 – *Silver*

Silver is used mainly in alloy form as token currency or 'small change', though it also has important uses in industry as an electrical contact material, for lining chemical plant, and for producing mirrors. World production varies considerably from year to year but is now about 210 million ounces Troy of which nearly 80 per cent is produced in the Americas, mainly in Mexico (35 per cent) and the eight 'silver states', Montana, Idaho, Colorado, Utah, Nevada, California, Arizona and New Mexico (which together produce about 20 per cent of world

output). The third largest producer – accounting for over 10 per cent of the world total – is the U.S.S.R.

Most silver nowadays is produced as a by-product in the extraction of lead and copper and, to a lesser extent, of zinc, gold, tin and nickel. The United States is the principal importer, and silver has always played a most important role in American domestic politics.

3 - *Platinum*

The platinum group of metals, which includes ruthenium, rhodium, palladium, osmium, iridium and platinum, has important uses in the chemical, textile, electrical, glass, jewellery and dentistry industries.

In one recent year Canada produced 130,000 ounces, South Africa 55,000 ounces, Colombia 39,000 ounces and the United States 25,000 ounces. Many of the original alluvial deposits have been worked to exhaustion and the principal remaining ones, in order of importance, are located in the Urals, Colombia and Abyssinia. Currently, the copper-nickel ores found in the Sudbury district of Ontario, Canada, and at Rustenberg in South Africa are among the world's most important sources of platinum.

OTHER METALS

Among the remaining metals of industrial importance pride of place must undoubtedly go to *manganese*. The annual production of ore amounts to 6 million tons and the production of metal rivals that of copper.

Like many of the metals dealt with in this section, manganese is mainly used as an alloy with iron, and the two iron-manganese alloys, spiegeleisen and ferromanganese, take the major part of the manganese produced. As an oxide, however, it is also used in dry cells and batteries and, as a constituent of various compounds, it is used in a number of other industries.

The U.S.S.R. produces half the world's output and the British Commonwealth produces most of the remainder, principally in India, South Africa and the Gold Coast. Brazil and French Morocco contribute smaller amounts and production in the latter country has increased considerably in recent years.

Chromium is also used as an alloy with iron and for the production of chromium plate, while chromic salts are used in the dyeing and leather industries. About 2 million tons of ore are mined each year – yielding, perhaps, half as much metal – and to this total the U.S.S.R., South Africa and Turkey each contributes 20–25 per cent, and Southern Rhodesia and the Philippines each 12–15 per cent.

The other metals are mined in small quantities. Eighty-five per cent

of the world's *nickel*, for example, comes from the Sudbury district of Ontario but total production is not normally much above 130,000 tons of metal. New Caledonia and the deposits at Petsamo, now worked by the Russians, are the other chief sources of supply, and the metal is used as an alloying addition in steel and other metals, for coinage and, increasingly, in electro-plating.

Tungsten is yet another metal used in conjunction with steel to produce tool steels, but the pure metal is important for filaments in electric lamps and has other uses in the electrical industry. It is also used in the production of paints, dyes and printing inks. China was the main source of supply between the wars and in 1938 produced 12,400 tons. Burma, Portugal, the United States and Bolivia are other producers, and the United Kingdom is a leading importer.

Like tungsten, *cobalt* enters into the composition of many alloys useful for the production of high-speed tools and heat-resisting steels. It is also used in plating in conjunction with nickel, the oxides are employed in pottery and glass manufacture, and the sulphate is a pasture dressing used for the cure of a number of deficiency diseases among sheep. The Belgian Congo produces about 4 million pounds a year, Northern Rhodesia 2 million pounds, French Morocco 500,000 pounds and Canada very much smaller quantities.

About 34,000 tons of *antimony* are used a year, chiefly to impart hardness to lead alloys, the main sources of supply being Mexico, Bolivia, the United States and South Africa, though China was an important exporter between the wars.

Bismuth comes mainly from Peru but also from Canada, Mexico and Bolivia, and is used in small quantities for solders, cosmetics and dental amalgams.

The world production of *mercury* is about 12 million pounds, and the leading sources of supply are the United States, Spain, Italy, Mexico and the U.S.S.R. Apart from its use in barometers and kindred instruments, it is also used in the production of some pharmaceutical goods, mirrors and mercury vapour lamps.

Radium-uranium ores (mainly pitchblende) have, of course, assumed a new significance since the release of atomic energy and a feverish search for new sources of supply is taking place. Great Bear Lake in Canada's North-West Territories and the Belgian Congo were the chief producers until recently, but South Africa now leads the field and important new discoveries have been made at Rum Jungle in Australia's Northern Territory, at Myponga in South Australia, and near Lake Athabasca in Saskatchewan, Canada. There is also considerable domestic production in the United States, mainly on the Colorado Plateau, while, among communist countries, it is known that important deposits occur in Czechoslovakia.

FERTILISERS

To produce the greater crop yields necessary to feed the world's growing population farmers are using more commercial fertilisers than ever before, and total consumption has practically doubled in the last twenty years. In the main, these fertilisers are now produced by the world's chemical industries and are usually classified into three principal groups – nitrates, phosphates and potash.

Nitrates occur in nature mainly as sodium nitrate (or Chile saltpetre) or as a potassium salt (nitre or saltpetre). The latter occurs as an incrustation upon the soil in such hot countries as India and Persia but, commercially, it is the enormous shallow deposits of Chile saltpetre occurring in the almost rainless deserts of Peru, Bolivia and Chile which are of most importance, and Chile still exports more than 1·5 million tons of sodium nitrate each year. The bulk of the world's nitrogenous fertilisers, however, are prepared by industrial methods, the most important being the manufacture of synthetic ammonia for which the basic raw materials are air and water, nitrogen being obtained from the former and hydrogen from the latter. Cheap fuel, abundant water, good transport facilities and a temperate climate are all factors which determine production and synthetic ammonia industries are found mainly in the United States, Germany, the United Kingdom, Norway and other industrialised countries. Of the 5–6 million tons of nitrogenous fertilisers consumed in the world each year (outside the U.S.S.R.), the United States consumes at least 30 per cent, Japan 10 per cent, Germany about 9 per cent, France 7 per cent, and the United Kingdom, the Netherlands, Italy and Egypt perhaps 4 per cent each. India, Peru, Canada and Cuba all consume smaller amounts, and Norway and Germany are the leading exporters of the manufactured product.

The nitrates are particularly valuable as top dressings to stimulate flagging plants in the early part of the season. *Phosphates*, on the other hand, stimulate root development and hasten ripening. Even greater quantities of phosphates, mainly in the form of superphosphates, are used than of the nitrogenous fertilisers, and world consumption has recently been close on 6 million tons a year. The chief raw materials are deposits of phosphate rocks, though the droppings of sea-birds (guano) are accumulated in workable deposits on the almost rainless islands off the west coasts of South America, South Africa and west Australia, and basic slag (a by-product of the steel industry) and bone-meal also provide phosphates. The largest producer and consumer is the United States which uses 33 per cent or more of the world total. The other main consumers are Germany, France and Australia (consuming about 7 per cent of world production each), Italy, the United Kingdom and Japan (about 5 per cent each), the Netherlands and

Canada (nearly 2 per cent each), with Cuba, Peru, Egypt, India and Mexico using smaller amounts.

The major sources of *potash* – which is essential to leaf development – are the large subterranean deposits of soluble potash materials which exist in Germany, France, the United States, the U.S.S.R., Spain and Poland, and these countries are the chief producers. Brines and lake deposits in the United States and Palestine also contribute significantly

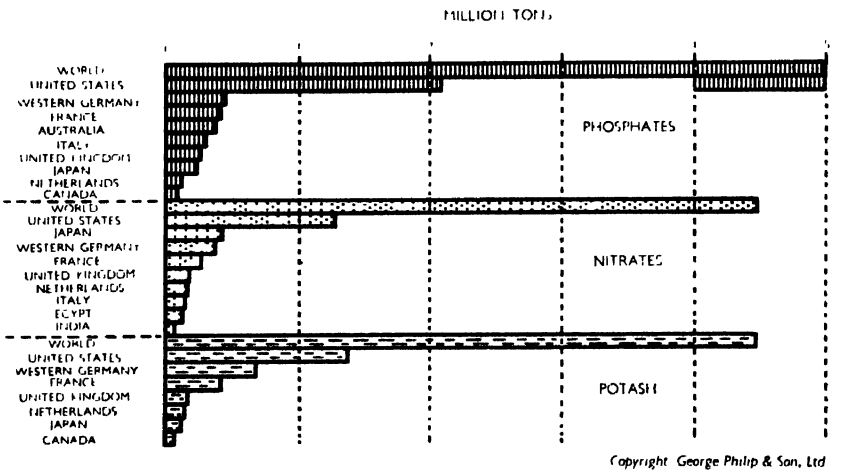


Fig. 69. Consumption of fertilizers (excluding U.S.S.R.)

to output, and potassium salts are produced as a by-product of the sodium nitrate industry in Chile. In the United Kingdom a valuable potash deposit has been discovered in Yorkshire. Of the 4–4·5 million tons used in the world each year (outside the U.S.S.R.), the United States again consumes about 33 per cent, Germany 16 per cent, France 10 per cent, the United Kingdom and the Netherlands about 4 per cent each, and Japan nearly 3 per cent. Before the war, the U.S.S.R. produced and consumed about 230,000 tons a year and production has probably increased since.

To sum up this section, the United States at present consumes about one-third of all commercial fertilisers and imports more than she exports. Australia, Italy, the United Kingdom and Japan are all large importers, while Norway and Chile are the major exporters and Germany and France, despite a large home consumption, have an export surplus. United States consumption has risen more rapidly than it has elsewhere, but the use of fertilisers has also expanded very considerably in recent years in such countries as India, Ceylon and Egypt, though the total amounts used in these countries is still small. It may be confidently

predicted that the use of commercial fertilisers will grow rapidly in the future.

OTHER MINERALS

There are many other mineral products of the earth, all of them treated industrially in some degree, which enter into commerce.

The *clays*, of course, are the traditional raw material for bricks and hence of the greatest importance in the building industry, but they have many other industrial applications, the most important being in pottery and porcelain manufacture and in fulling cloth. Kaolins or china-clays are also used in large quantities in paper manufacture, while bentonite and fuller's earth are used for refining edible oils and hydrocarbon oils. These and other clays are used in small quantities for pharmaceutical products and cosmetic preparations. Statistics for clay production or exports are not easily come by, but the United Kingdom normally exports about 700,000 tons.

A better guide to building expansion since the war are the figures of *cement* production. Cement is basically a combination of chalk and clay, but modern cement manufacture is highly organised and accuracy and constancy of composition are essential if quality is to be maintained. World production including the U.S.S.R. but excluding China is now more than 188 million tons, or over twice what was produced in 1938. Of this huge total, the United States produces 30 per cent, the U.S.S.R. 10 per cent, Western Germany about 9 per cent, the United Kingdom 7½ per cent, France nearly 6 per cent, Japan 5 per cent, and Italy 4 per cent. The United Kingdom, Western Germany and Belgium export about 2 million tons each, and the United States, France and Japan about 1 million tons each. These same nations are likewise the principal exporters of bricks and tiles – Japan and the United States exporting some 700,000 tons each, and Germany and the United Kingdom about 250,000 tons each.

As in the chemical and some other industries, many of the smaller producers of cement are making rapid advances in production. Venezuela and Puerto Rico, for example, produce 13–14 times as much cement as they did before the war, and the Belgian Congo, Guatemala, Ecuador and Mozambique 5–8 times as much.

Salt has long been an important article of commerce. The sea provides inexhaustible reserves but there are also immense deposits of rock salt in many parts of Europe, North America, the U.S.S.R. and India. Near Cracow the mines have been worked for 700 years, and the important beds at Stassfurt in Germany yield potash as well. In the United Kingdom the Cheshire salt field alone contains reserves sufficient to last for centuries.

Despite its universal use as a condiment, far greater quantities

of salt are used in industry, in the preservation of foods and hides and, above all, in the chemical industry which, since salt is the main source of sodium and chlorine, is the largest single consumer. World production probably exceeds 50 million tons a year, five-sixths of it deriving from rock salt. Of the total, the United States produces about 33 per cent, and the United Kingdom, Germany, France and India are other large producers. The United Kingdom, one of the principal exporters, exports more than 250,000 tons a year.

Sulphur, of which large quantities are used in the vulcanisation of rubber and as fungicides, is also extensively used in the chemical and paper industries. The United States – producing some 80 per cent of the world total – mines over 5 million tons of crude sulphur a year. Sicily and Japan are the only other producers whose output exceeds 200,000 tons. United Kingdom imports are normally about 400,000 tons a year.

Though salt and sulphur statistics are incomplete, we can gain some idea of recent expansion in the chemical industry as a whole from those which relate to *sulphuric acid*. Excluding the U.S.S.R. and Czechoslovakia, world output of sulphuric acid has increased from 15 million tons to about 30 million tons in the past fifteen years. Of the present total no less than 45 per cent is produced in the United States, the next largest producers being Japan, Western Germany, the United Kingdom, France and Italy. Chemicals play a considerable part in the exports of all these countries. Including among them dyes, medicinal products, perfumery, cosmetics, fertilisers, explosives and plastics, United States chemical exports are worth over $800 million a year, British exports more than $500 million, German exports nearly $400 million, French exports $300 million, and Italian exports nearly $100 million. There is a tendency, however, for home production to rise rapidly in some of the less developed countries.

Two other minerals are worthy of mention even in so short a survey as this.

The first is the *diamond* which, by some whim of nature's, is found almost exclusively in Africa – in the Union of South Africa, South-West Africa, Sierra Leone, the Belgian Congo, the Gold Coast, Angola, and, most recently, Tanganyika. South Africa produces over 2 million carats a year (mainly gem stones), the Gold Coast about 2 million carats (mainly industrial), and the Belgian Congo 11 million carats (over 95 per cent industrial).

The chief countries for diamond cutting are Belgium, the United States, Palestine, Brazil and the Netherlands. Most of South Africa's output goes, in fact, to New York. The diamond is by far the world's most important precious stone, and has valuable industrial uses in addition to its use as jewellery. About two-thirds by weight and

one-quarter by value of the total annual output of some 18 million carats is used for industrial purposes, mainly for drilling and cutting tools.

The other mineral which cannot be overlooked is *asbestos*, one of the most interesting minerals of all. To obtain a ton of fibres it is necessary to blast, mine, convey and put through the mills from 50 to 100 tons of rock. Since they are non-inflammable, resistant to heat and chemical action, and can be woven, the fibres are extensively used for heat insulation either in the production of asbestos-cement sheets, pipes and wall-boards or in the form of tape, cloth, brake-linings and packings. With the exception of the U.S.S.R. – for which country up-to-date figures are not available – all the important asbestos-producing countries are in the British Commonwealth. World production outside the U.S.S.R. is rather more than 1 million tons a year, of which Canada produces at least 70 per cent, Southern Rhodesia and South Africa nearly 10 per cent each, and Swaziland and the United States something under 5 per cent each. The important producers export most of their output.

CONCLUSION

This chapter has ranged over a good deal of ground, from the production of a great variety of raw materials to the production of a great variety of finished goods.

So far as the crude minerals are concerned it is apparent that their distribution over the earth's surface is most uneven. Canada alone produces over 80 per cent of the world's nickel, 70 per cent of its asbestos, and nearly one-half of its platinum. Most of the world's diamonds come from Africa. Over one-half of the world's silver is mined in the United States and Mexico, over one-half of the world's manganese in the U.S.S.R., and over one-half of the world's cobalt in the Belgian Congo. Nearly one-half of the world's bauxite comes from British and Dutch Guiana, nearly one-half of the world's tin from Malaya and Indonesia, and nearly one-half of the world's gold from South Africa. Even though copper, zinc and lead ores are more widespread, whole continents as well as countries are deficient in them.

It follows that self-sufficiency in these minerals is not a realisable aim and trade will continue in them just as it will in the agricultural products of different climates, the main factors of an unpredictable nature being the discovery of hitherto unknown deposits and the new importance of known deposits where technological advance vests them with a different significance.

On the other hand, the relatively undeveloped countries may be expected to develop their own manufactures as capital is accumulated, and among these manufactures will be the smelting of metallic ores and the processing of other minerals. Trade in such finished or semi-

finished products as cement, bricks and artificial fertilisers will depend primarily on the absolute increase in world demand for such products as incomes rise, and on the residual cost differences which remain between different manufacturing areas after allowing for transport costs and governmental barriers to trade.

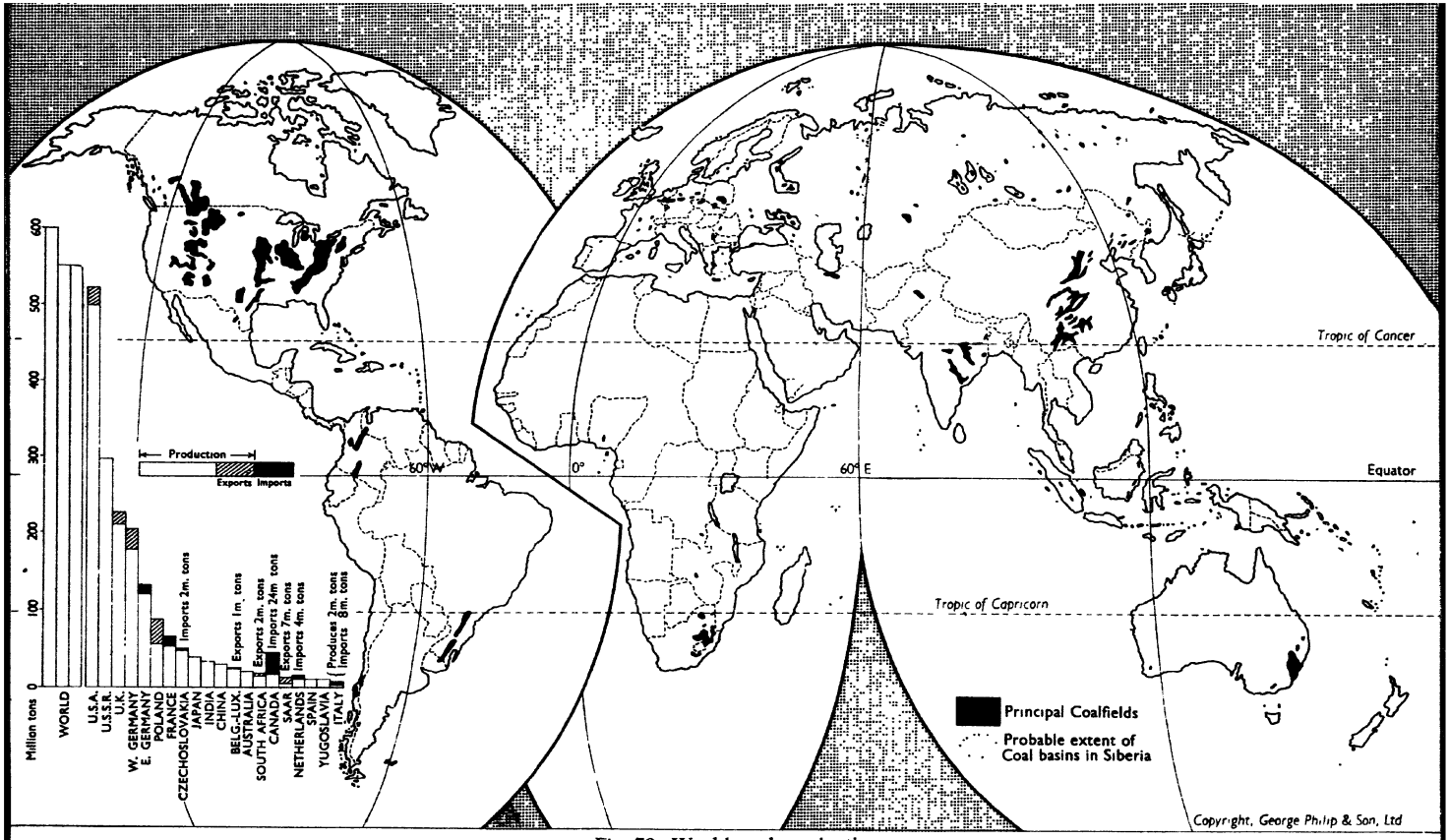


Fig. 70. World coal production

Fig. 71. Water, wind and animal power

Chapter 17
Power

INTRODUCTION

Primitive man had only the power of his muscles. Later on, to aid him in his work, he used the power of other animals, the power latent in timber, and the power of wind and moving water. These sufficed until a timber famine in England drove him to fossilized timber and, very shortly after that, the industrial revolution ushered in two centuries of the supremacy of coal, two centuries in which industry moved to the coalfields. The past fifty years, however, have witnessed change again: coal has been losing ground steadily to the rapidly expanding petroleum and hydro-electric energy-producing industries, and still more sources of power are in the offing. With each new application of materials and resources to power production there has come some re-shaping of the pattern of production, some widening of industrial areas; and, since all sources of power are substitutes one for another, every addition to the chief sorts of power available for human use tends to make more uniform the distribution of power and industry on the earth.

In these modern times the pace is rapid and, in less than fifteen years, the world's consumption of energy has increased by more than 50 per cent. Canada uses 80 per cent more energy than in pre-war

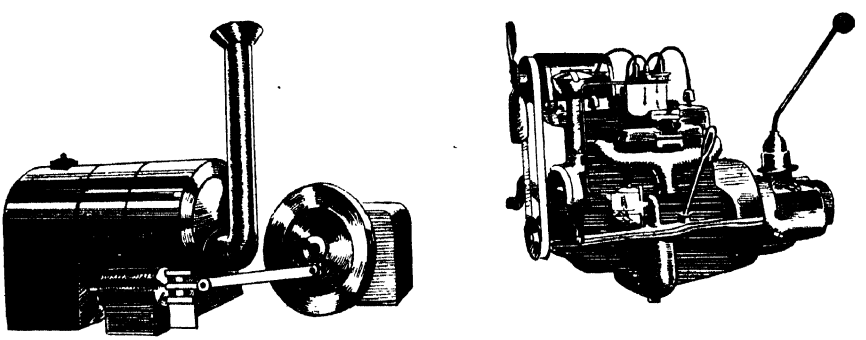


Fig. 72. Steam engine and high-octane oil engine

days, Australia over 70 per cent more, the United States over 60 per cent more, and even India and Pakistan over 50 per cent more. In South America consumption had doubled in this same period; in industrialised Europe the increases, though less spectacular, are none the less considerable. Such figures are a measure of industrial expansion and, combined with the figures of energy consumption per head, as in Fig. 74, they are as good a guide as any to the existing industrialisation and the current rate of expansion in those countries for which the information is available.

The figures in Fig. 74 exclude the use of wood fuel but, even so, the differences in the degree to which mechanical power is brought to the aid of man in different countries is striking, and the fact that *per capita* energy consumption in the United States is five times that of the world average is some indication of the world's poverty, and potential power requirements if living standards are to be raised. At present the world's annual consumption of energy in all forms is equivalent to nearly 4,000 million tons of coal a year. If present trends continue, more than twice as much will be required in fifty years' time.

COAL

Despite the internal combustion engine and the jet, despite the oil-fired ship and the atomic-powered submarine, coal remains the most important single source of mechanical power used by man, and probably supplies about 40 per cent of the world's fuels as measured in terms of energy. It is not, however, a simple, homogeneous substance. The hard, bright anthracites, the bituminous coals, the lustreless cannel coals, and the soft brown coals or lignite are all different one from another both in their value as fuel and in the uses to which they can be put. Some are particularly useful for the manufacture of gas; some yield the best metallurgical coke; some are most suitable for household use; and some are well-adapted for the bunkering of steamships. Nor should the by-products of coke manufacture be forgotten, for coal produces many chemical raw materials – tars and oils, dyes, flavours and perfumes, explosives, saccharine and ammonia, and breeze for the manufacture of building blocks – as well as power and

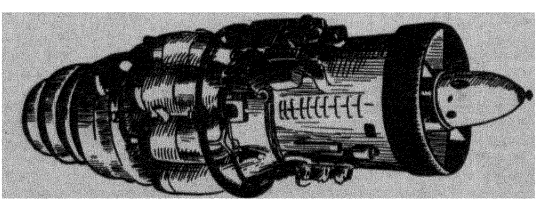


Fig. 73. Low-octane oil engine

	1951	1937	*Percentage increase* 1937–51
World	1·43	1·15	25
Saar	8·16	n.a.	—
United States	8·02	5·89	36
Alaska	7·07	6·73	5
Canada	6·96	4·91	42
United Kingdom	4·65	4·28	9
Norway	4·59	3·44	33
Belgium-Luxemburg	4·16	4·02	4
Sweden	3·52	2·50	41
Australia	3·21	2·27	42
Germany	2·78	3·02*	—
Switzerland	2·51	1·81	38
Iceland	2·37	1·85	28
France	2·34	2·12	10
New Zealand	2·34	1·94	20
Denmark	2·08	1·71	22
Netherlands	2·06	1·79	15
Union of South Africa	1·95	1·32	48
Chile	0·92	0·67	35
Japan	0·87	0·93	–6
Argentina	0·87	0·65	34
Venezuela	0·85	0·30	184
Italy	0·81	0·66	23
Mexico	0·66	0·44	50
Malaya	0·47	0·37	27
Yugoslavia	0·40	0·18	122
Colombia	0·29	0·14	107
Brazil	0·24	0·13	84
Costa Rica	0·23	0·17	35
Algeria	0·18	0·14	22
India	0·10	0·09†	—
Philippines	0·10	0·05	100
Belgian Congo	0·09	0·03	200
Indonesia	0·06	0·05	20
Burma	0·02	0·05	–60
Thailand	0·02	0·01	100
Haiti	0·02	0·01	100

n.a. not available * including Saar † including Pakistan

Fig. 74. Energy consumption per head
(*In coal equivalents – metric tons*)

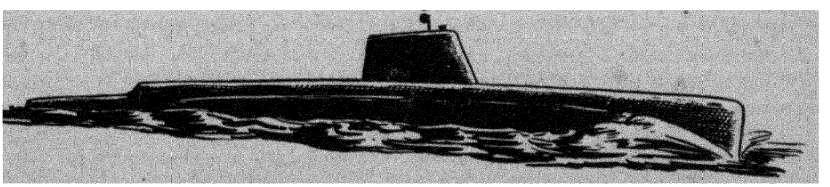


Fig. 75. An atomic-power submarine

heat. The principal uses are perhaps indicated by figures applicable to the United Kingdom: 20 per cent in industry, 20 per cent in the domestic hearth, 10 per cent or more for the production of electricity, gas and coke, and 7½ per cent on the railways.

Coal, of course, is the fossilized remains of primeval plant life. It follows that it is found only in sedimentary rocks and, even then, can be worked – at present – only where the seams are two or more feet thick and not more than four thousand feet or so below the ground. Even without such complications it would be difficult to estimate world reserves and many different estimates have been given. More than once anguished cries of despair have been heard at the rate at which mankind is utilising its exhaustible sources of power but, in fact, there seems little doubt that, at the present rate of consumption, world coal reserves would last for at least 3,000 years, even though the reserves are not all equally accessible and some, in particular areas, will be exhausted much sooner than this.*

Of the hard coal reserves at least 40 per cent are thought to be in the United States, which is by far the richest power region in the world, but Asiatic Russia probably possesses a further 25 per cent, and, after the United States, the U.S.S.R., Germany and Great Britain are favoured above all other nations with coal supplies. Canada, China and Australia, as well as some other European nations, are also fortunate in that their coal reserves are far from exhausted, but the tropical and sub-tropical parts of the world are almost entirely devoid of coal deposits of economic value.

In the United States, the two principal coal-producing regions are the Appalachian and the Mississippi valley coalfields. The former extends from the northern boundaries of Pennsylvania to central Alabama and supplies 70 per cent of the bituminous coal and nearly all the anthracite used in the country. In these eastern fields there are no mines with deep shafts since the massive deposits are only thinly covered and easily reached by shallow borings. The thick, uniform seams facilitate the use of machinery, so that the quantity raised per head is by far the highest in the world – to raise four-fifths as much coal the European Community† employs three times as many men.

The Russian output of coal is rising rapidly and there are enormous reserves in Siberia. Before the German occupation, the Donets basin supplied 60 per cent of total production but, although production in

*Another recent 'survey' of world energy resources states that the reserve estimates of recoverable coal, gas and oil are sufficient for about 400 years at present rates of consumption, but for less than 80 years at the likely level of consumption in the year 2000! Such is the divergence of opinion between experts in a field which the layman might be forgiven for supposing more open to reasonable forecasting than most.

†Belgium, France, Germany, Italy, Luxemburg and the Netherlands.

this region recovered quickly after the war, the recently developed Kuznetsk basin and Karaganda fields have become more and more important. The local Ural fields and the Moscow-Tula brown coal deposits are also highly productive and particularly useful for the railways and power-stations.

In the United Kingdom, the coalfields are distributed geographically in three principal areas. The southern area includes the relatively small fields in the Forest of Dean, Somerset and Kent and the very important South Wales coalfield, the north-western end of which is the chief British source of anthracite. The central area covers Yorkshire, Lancashire, the midlands and parts of North Wales, while the northern area includes Durham, Northumberland and the lowlands of Scotland. Although certain types of coal, such as high-quality coking coal, will be exhausted long before then, British workable reserves, at the present rate of production, will last at least another 200 years. Nevertheless, output has fallen from a peak of 287 million long tons in 1913 to about 225 million long tons at the present time, partly through an accumulation of manpower difficulties, and coal now contributes far less to British exports than it did prior to the First World War.

In continental Europe the principal coalfields are found in Germany, Poland, France and Belgium. In Germany, the best bituminous coals come from the Ruhr. The other coalfields are in the Saar basin, now economically a part of France, and in the Silesian basin which underlies the boundaries of Germany, Poland and Czechoslovakia. The chief coalfields of France and Belgium are in the Valenciennes-Namur basin, where the seams are generally thin and very numerous. Small quantities of coal are also mined in the Aachen-Limburg area of Holland.

Most of the coal in the Indian sub-continent comes from the coalfields of Bihar, Orissa and Bengal, though coal is also found in Hyderabad, Central India, Assam, Baluchistan, the Punjab and Rajputana. In the Far East the coalfields remain largely undeveloped though there are large reserves in China, Manchuria and Korea. In Japan, where there are fairly large deposits of low-rank bituminous coals, mining is carried on in the islands of Kyushu, Hokkaido and Honshu, though production is normally short of the country's requirements.

South of the equator the largest coal deposits in inhabited areas are those in New South Wales, which provide about 80 per cent of Australia's requirements, though there are thick deposits of lignite in Victoria. Small amounts of coal are also obtained in Queensland, Tasmania and New Zealand. The chief South African coalfields are in the Transvaal and Natal and they are of particular importance to the gold-mining industry since the shafts of some of the gold-mines pass through the coal deposits which are, in consequence, easily worked. In Southern Rhodesia there is an important coalfield awaiting

development, and large coalfields are known in Antarctica though they are too remote to be of economic importance. In South America, coal is only worked in the southern half of Chile and in Southern Brazil, but there are considerable reserves in Colombia, Ecuador and Peru.

TRADE IN COAL

There have been very considerable fluctuations in the coal trade since the war but it would appear that about 7½ per cent of world production crosses national frontiers, most of it between various European countries and from the United States to Canada and Europe. Since the war the United States has been by far the largest exporter and Canada the largest importer; for example, in a recent year the former exported nearly 50 million tons and the latter imported over 20 million tons.

In Europe, Germany has rapidly regained a leading position as a coal exporter and recently German exports of coal and coke have amounted to 25 million tons, of which rather more than one-half has been coal. However, since Germany imports an equivalent quantity (some 13 million tons) of coal, the United Kingdom, with exports including bunker coal amounting to about 16 million tons, remains the chief exporter on balance, even though these quantities are less than half those of 1938.* Up-to-date figures for Poland are not available but Polish exports in 1946 amounted to another 15 million tons.

On balance, France is an importer of some consequence, importing 15 million tons or more of coal and coke, two-thirds of which is coal, and exporting about 6 million tons of coal. Italy imports nearly 10 million tons of coal, coke and briquettes, Sweden 8 million tons, Denmark more than 6 million tons, Eire nearly 2 million tons, and Norway over 1 million tons. Belgium imports 5–6 million tons but, on the other hand, exports 3–4 million tons, while the Netherlands imports 6 million tons and exports 1–2 million tons.

Outside Europe and the United States, India and the Union of South Africa are the only exporters of any consequence – India exporting 2–3 million tons and South Africa 1 million tons – though before the war Manchuria had an export surplus. Japan now imports between 3 and 4 million tons a year – roughly as much as before the war – and Argentina about 2 million tons.

PETROLEUM

Although bitumen, produced by the weathering action of sun and wind from crude oil which had seeped through fissures to the earth's surface, was known and used in ancient times, the modern petroleum

* British exports of coal in 1954 were only 13·8 million tons and 3 million tons were imported. Britain's position as an exporter is likely to deteriorate still further.

industry dates only from 1859, when 'Colonel' Drake drilled the first successful well for the specific purpose of finding it. Since then, over a million wells have been drilled in the United States alone.

Nowadays it is generally held that petroleum is organic in origin; that is, it began anywhere up to 400 million years ago as dead fragments of plant and animal life – mainly plankton – in the mud and silt of ancient seas and lagoons. These organisms were sealed in the mud before they decomposed and as the pressure of water and its own weight turned the mud into shale, the source material of oil was finally imprisoned. There it remained until mountain-forming movements subjected the strata to enormous pressure and converted them into harder forms. The oil was then gradually squeezed out into coarser, porous rocks and slowly rose, assisted by the pressure of underground waters, until it was trapped beneath a layer of impervious rock, permeating the softer sandstone or limestone like water in a sponge.

This is the story as it is usually told, but oil is not necessarily found in mountainous country and some of the largest fields, including those of East Texas and the coast of the Gulf of Mexico, the Albertan fields of Canada, Arabia and Eastern Venezuela, are far from any high mountains. Among important fields which do lie relatively near to various prominent mountain systems, however, are those along the Rockies and the Andes, those near the Alps, Caucasus and Urals, and those in Persia along the Zagros ranges. Although oil is produced commercially in well over forty different countries, the world's major proven oil reserves are centred around five main regions: North America (predominantly the United States), the Caribbean, the Middle East, the U.S.S.R., and Indonesia and British Borneo. Nevertheless, the search for oil goes on and the recent discoveries in Alberta, Australia and Saudi Arabia, indicate that much may yet be found.

The latest figures indicate that world production of petroleum is approaching – and may soon exceed – 700 million tons a year, its total value being little short of that of coal and about equal to that of crude steel. Since 1938 production has much more than doubled.

The United States is by far the biggest producer and accounts for some 50 per cent of the world total. Venezuela comes next with 15 per cent, followed by the U.S.S.R. (including Sakhalin) with 8 per cent, Saudi Arabia and Kuwait with 6 per cent each, Iraq (4 per cent), Mexico (2 per cent), and Indonesia and Canada (1·3 per cent each). Smaller producers still include Colombia, British Borneo, Rumania, Argentina, Qatar, Persia, Trinidad, Austria, Egypt, Peru, Western Germany and Bahrein and in that order of importance, all of them producing 1 million metric tons a year or more. Of all these, neither Kuwait nor Qatar produced any oil before the war, and pre-war production in Saudi Arabia, Canada and British Borneo was

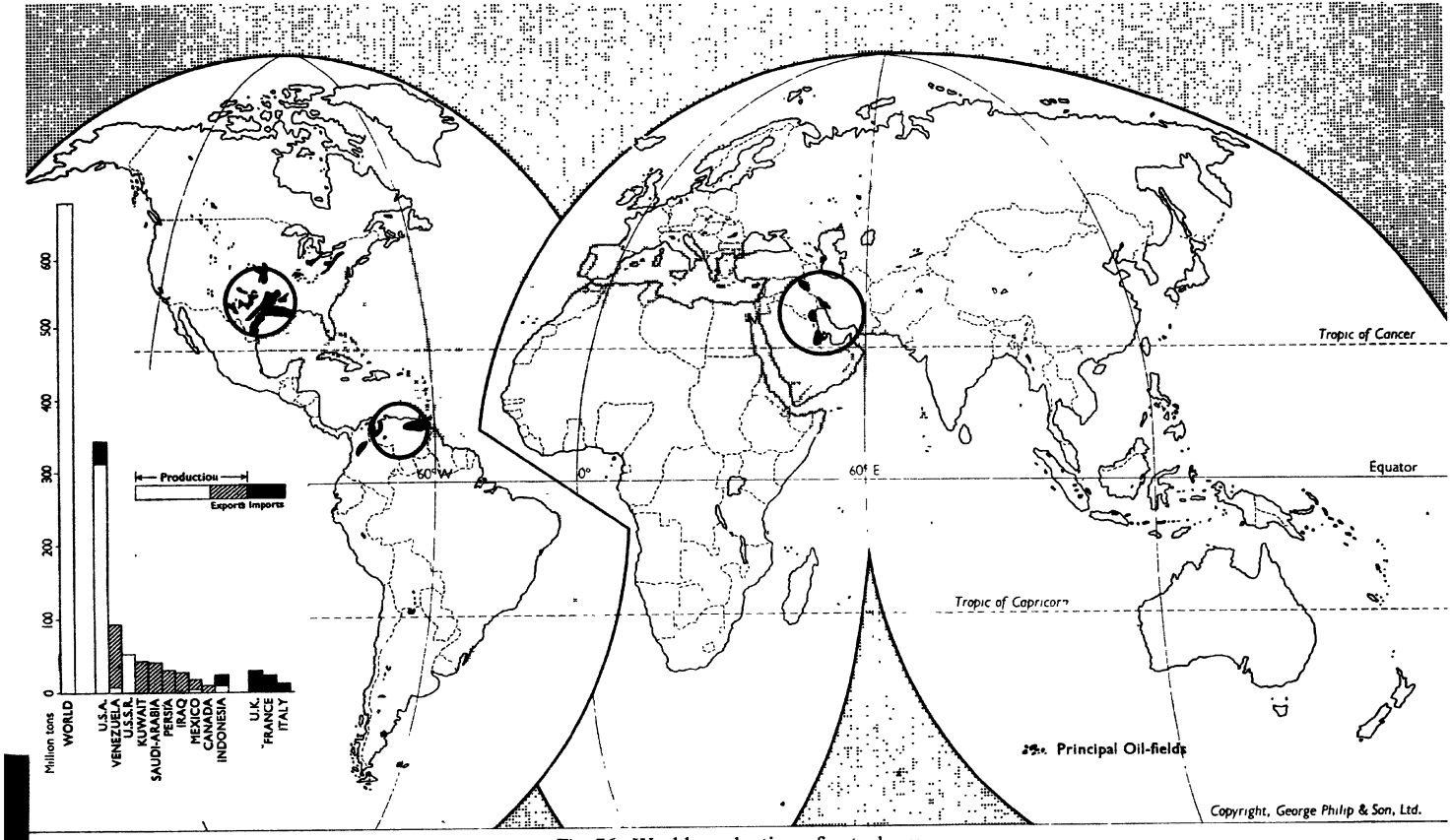


Fig. 76. World production of petroleum

very small. On the other hand, until 1951 Persia was the fourth largest producer in the world and will again become an important producer as the recent political difficulties are fully resolved. Increases in Saudi Arabian, Kuwaiti and Iraqi production more than made up for the loss of Persian supplies in the years immediately after the break in Anglo-Persian relations and there was no deflection in the steady upward trend of world consumption.

Petroleum more than any other mineral is a wasting asset and it is possible that the world's oil reserves may be exhausted in the lifetime of many who read this book. Estimated proven reserves (the resources of tested or producing fields) are put – conservatively it is true – at about 18,000 million metric tons, or no more than 26 years' supply at current rates of consumption – and consumption is still increasing rapidly. Of these over 50 per cent are in the Middle East and 25 per cent in the United States, though United States reserves are being consumed faster.

The picture, however, will almost certainly prove to be less gloomy than this, for the possible reserves – including those not yet discovered – are cautiously estimated at three times as much. Again, the estimates do not include the immense reserves of natural gas in the world, gas which is closely allied in chemical composition to crude petroleum and can either be used as fuel in its natural state or be converted into petrol and other liquid products. It has been estimated that the reserves of natural gas in the United States alone roughly equal, in terms of potential supply of liquid petroleum products, the country's crude oil reserves. Oil may also be obtained from coal and, as has been seen, coal reserves are much more extensive. Finally, oil-bearing shales and oil saturated sands are further possible sources of supply. Even so, great changes in the economic position of some oil-producing countries may be expected as time goes by. Oil has brought a new prosperity to many countries of the Middle East, countries to-day in the stage of 'flush' production; recent discoveries of oil in New Guinea hold out the same hope for parts of the East Indies. It is to be hoped that statesmen will make the best use of these new-found riches, the Aladdin's lamp which nature has put into their hands.

THE USES OF PETROLEUM

Crude oils vary widely in appearance and may range from light, almost colourless, volatile liquids which are rich in petrol to sluggish black oils full of asphalt and so heavy that they cannot even be pumped out of the earth; generally, however, they look rather like thin treacle.

In this form petroleum is seldom used, but goes to the refinery for distillation and, if need be, for 'cracking', a complicated process which breaks heavy oils down into lighter oils. The most important

refinery product, of course, is the petrol which supplies fuel to the world's seventy million motor vehicles and a growing number of aircraft, and petrol alone accounts for 40 per cent of the total consumption of petroleum products. Heavier oils are also produced: kerosene or paraffin for tractors, jet aircraft and domestic heating; gas oil to enrich poor quality coal gas; diesel oil for heavy road vehicles, locomotives, motor ships, and stationary engines such as dynamos for the generation of electricity; lubricating oils and greases for every type of machinery, for use in processing textiles and leather, and for 'quenching' high-grade steels; and fuel oils for burning in the furnaces of steamships and in industrial furnaces. Finally, bitumen is used as a road surfacing material, in roofing felt, damp courses, battery seals, insulating materials and paints.

Apart from all these, petroleum provides over a thousand other products which enter into our daily lives: the highly purified white oils used as the basis for nasal sprays, disinfectants and many other pharmaceutical products, and for food preservation; petroleum waxes used in food packaging, for the manufacture of candles and in polishes of all kinds; white spirit, which is used in paints and dry cleaning; and various bases for insecticides. In some parts of the world the natural petroleum gases are piped to cities for industrial and domestic use, and both natural and 'cracked' gases yield ethylene (used as an anaesthetic and to stimulate plant growth), glycol (the anti-freeze mixture), ethyl alcohol, acetone (used in the manufacture of rayon, etc.), butylene and many other hydrocarbon products. Chemicals derived from petroleum form the basis of very many synthetic rubbers and plastics, carbon black, and a variety of drugs, e.g. the barbiturates, and other petroleum products form the base of soaps and the increasingly important other detergents for household, laundry and industrial use. In fact, petroleum and its derivatives enter into the manufacture and processing of thousands of articles, ranging from boot polish to chewing gum, and from artificial flowers to high explosives. In the United States, in a period of only two decades, from 1925 to 1945, the supply of petroleum chemicals grew from an insignificant proportion to almost a third of the total production of all chemicals whose structure is based on carbon, the total quantity produced in the latter year being no less than 7·6 million tons.

Since crude oil yields so many different products, involving very large capital costs and expensive research and organisation, and since the geographical distribution of oil-bearing areas is often remote from the industrial countries where oil is most used, the oil industry has to be organized on a large scale, and there are in the industry a number of very large companies whose names are household words and whose operations are almost world-wide. They undertake the

Fig. 77. Grangemouth refinery, Scotland

whole range of operations, from oil exploration to the delivery of the finished products to consumers, and between these two there are often difficult financial negotiations, international in character and of considerable political significance. A few examples will indicate the scale of capital outlays needed for technical installations and research: a 27,000 ton tanker costs £1·25 million or more; the pipeline from the Saudi Arabian fields to the Mediterranean, completed in 1950, cost £80 million; a modern refinery costs from £10 to £35 million; and one company in Venezuela spent £12 million on exploration and development between 1920 and 1930 before it marketed any oil from that area.

TRADE

The international history of oil is fraught with sharp struggles between powerful economic and political groups for the possession and exploitation of the world's oilfields outside the United States, struggles which since the war have become less those between different companies and more those between the companies on the one side and nationalistically-minded governments in the producing countries on the other. Of total world reserves United States interests control some 56 per cent, 34 per cent in the United States itself and 22 per cent elsewhere. British and Dutch interests control a further 25 per cent, almost entirely outside the home countries, while the Russians control 14 per cent, almost entirely on domestic ground. The French and the Mexicans are the only other nations with extensive oil interests, the French controlling 2·2 per cent of world reserves, mainly overseas, and the Mexicans controlling 1·5 per cent, entirely at home. The two

leading groups are Royal-Dutch-Shell (under British and Dutch control) and Standard Oil (American), though Standard Oil nowadays is, at most, a loose federation of many American companies, the chief of these being the Standard Oil Company of California, the Standard Oil Company of New Jersey, and the Socony-Vacuum group. With the British Petroleum Company (controlled by the British government) and the Texas Corporation (American), these groups cover about 80 per cent of the world's oil supply. Outside them, the biggest group is the Soviet State Oil Trust. The financial organization described above must be borne in mind when oil movements across frontiers are considered below.

Crude oil when produced is stored in tanks near the wells and from these it is pumped through a pipeline to the refinery or to a loading terminal for transport by sea, rail or road. After refining, the liquid products are stored again in tanks, the solid products being stored in barrels or bags. In transporting large quantities of oil overland during a period of years, the pipeline is usually the most economical method of land transport and immense lengths of pipeline have been constructed in the Middle East, the United States, and elsewhere. For comparable distances, however, the cheapest method of carrying oil is by tanker and the tanker fleets of the world now form a large proportion of all merchant shipping – in fact petroleum is now by far the most valuable of all sea-borne cargoes. Where political conditions make it practicable, the tendency is to establish more and more refineries on or near the oilfields to save transport costs, but immense quantities of crude oil are still refined at terminal ports in Europe.

The rapid growth in the use of oil in the United States in recent years has resulted in consumption steadily increasing relative to domestic production, with an inevitable decline in exports. In 1939 the United States was second to the Caribbean area (mainly Venezuela) as an oil exporter, with the Middle East third. Since the war the importance of the Middle East has greatly increased and exports from the Caribbean have also been expanded. The United States, however, though still exporting large quantities of petrol and other light oils and special products, herself imports large quantities of crude and heavy oils, mainly from the Caribbean area, and during recent years has, on balance, been a net importer of oil – to the extent of some 25–35 million tons, an amount exceeding the total annual consumption of oil in the United Kingdom.

Latin American production now amounts to about 120 million tons a year, nearly 80 per cent of it produced in Venezuela. Venezuela, Colombia and Trinidad – together producing over 100 million tons a year – export the great bulk of this output in crude form. Mexican

exports are also appreciable though home demands are increasing, but, outside Peru, most other Latin American producers, including Argentina and Brazil, do not produce enough for home requirements. Each of the latter imports 5–6 million tons a year.

In the Middle East production is currently about as high as that in Latin America, the petroleum coming mainly from Saudi Arabia, Kuwait, Iraq and Persia and being exported almost entirely in crude form, mainly to Europe, but also to the Far East.

In comparison with these amounts, Far Eastern production itself – about 15 million tons – is small and the great bulk of it comes at present from Indonesia and British Borneo.

About one-third of the world's oil enters into international trade, the chief importers being the United Kingdom, France, the United States and Canada. The United Kingdom now manufactures about 25 million tons of petroleum products and consumes 18 million tons, so that her petroleum exports now rival in value the much-reduced foreign sales of coal. France imports 22 million tons of crude oil or semi-refined oil and also exports about 7 million tons of crude and 1 million tons of refined oil, as well as 5 million tons of refined products; and Italy imports over 10 million tons of crude oil and exports 3 million tons of refined products. The only other country with an important re-export trade is Belgium, which imports nearly 2·5 million tons each of crude and refined oil, but exports 2 million tons of refined products.

Canada, despite a rapidly increasing domestic production, remains a large importer, importing some 13 million tons of crude oil and 5 million tons of refined products. Germany, Sweden and Norway in Europe, and Japan, India and Australia in the East, are the other main importers, the quantities involved varying from 2 to 5 million tons.

The U.S.S.R., once a great oil exporter, to-day uses more oil than any other country except the United States and there is no great margin for export. Production has risen from 31 million tons in 1939 to some 60 million tons at the present time, the most important regions being the Caucasian and Volga-Ural-Emba fields west of the Urals. The second area is being rapidly developed, but consumption continues to rise rapidly and in many post-war years oil has been obtained from Rumania and other satellite countries. Just recently, however, there has been a noticeable increase in offers of oil by the U.S.S.R. when negotiating trade agreements with the Western world.

HYDRO-ELECTRIC POWER

Water has been used for centuries as a direct source of power for turning water-wheels, but its indirect use for the production of electricity is a development of the twentieth century and one still

in its infancy. Even so, it is already more important than steam in some industries, especially where very high temperatures have to be produced, as in the smelting of aluminium ores, the manufacture of carbide, and the fixation of atmospheric nitrogen, or where grinding has to be carried on cheaply as in the manufacture of wood-pulp. Water power has the advantage over coal and petroleum of being inexhaustible, but the installation of generating capacity and the transmission and distribution of electricity are a very expensive business even in terms of national finance.

For purposes of analysis three kinds of hydro-electric power may be distinguished though the third is, as yet, in no more than the experimental stage and the first is overwhelmingly the most important. They are: (i) power derived from waterfalls and streams with a very rapid flow, (ii) power derived from rivers with a large volume of water but gentle gradients, and (iii) power derived from the movement of tidal waters. Generally speaking, the power developed depends on the volume of water and the height of the fall and, ideally, the volume of water should be fairly constant throughout the year. There are grave disadvantages in regions such as the Apennines where there are great variations in seasonal rainfall and as much use as possible is made of natural or artificial lakes to regulate the flow. Permanent snow on mountain-tops tends to give rivers a regular regime.

The chief types of water-power region are as follows: (a) The *fold mountain regions*, including the Alps, Pyrenees, Cordillera, Caucasus and Himalayas, and the mountains of central Asia, Japan, New Zealand and Papua; these regions normally have one or two high water periods – two if there are snows to melt in late spring and early summer. (b) *Tropical and equatorial regions* where long summer rains make it possible to use rivers like the Zambesi for the production of hydro-electric power; of these river systems the Congo has special advantages and is one of the greatest potential power regions in the world, since it gathers water from both sides of the equator and also has falls resulting from faulted structure; the gradient of the Amazon is gentle and the possibilities not so great. (c) The *glaciated highland regions*, many of which have peculiar advantages: the height of the dissected tableland causes heavy precipitation and glaciation has left behind a rejuvenated drainage with many lakes and waterfalls. Both Scandinavia and the Canadian-New England highland regions have benefited enormously from the development of hydro-electric industries.

The development of hydro-electric power depends, of course, on the other natural resources of the region, communications with the outside world, and the available labour supply. By the bounty of nature, water power is most abundant where few or no coal and oil resources exist. Where it is plentiful but the population is small

and markets distant, power is only developed for timber and for electro-metallurgical and electro-chemical industries which require a small, skilled labour supply and cheap electricity; this has happened in Norway, the French Alps and the Scottish Highlands. Where labour and hydro-electric power are plentiful the power is used in general manufactures, as in Japan, northern Italy and the New England States. Where power is cheap but not too plentiful in regions of dense population, the current can be used most profitably for lighting and traction. The present limit to which electricity can be economically transmitted is about 300 miles.

It has been estimated that no more than one-tenth of the world's potential hydro-electric power has been developed and most of this development has taken place since 1914, some of it under the stimulus of war when normal imported coal supplies were cut off. The total reported installed capacities of generators in large hydro-electric plants amounts at present to 70 million kilowatts, of which 50 per cent are in North America and 40 per cent in Europe. More detailed figures are available for electrical energy production but these include electricity obtained from coal.

ELECTRICITY PRODUCTION

At present, world production of electrical energy is estimated to be rather more than 1 billion (1 million million) kilowatt hours a year, or nearly two and a half times as much as in 1937, but of this total probably 60 per cent is produced in fuel-operated plants and only 40 per cent in hydro-electric plants. The United States produces some 40 per cent of the whole, the U.S.S.R. 10 per cent, the United Kingdom 6 per cent (mainly from coal), Canada 5½ per cent, Western Germany 5 per cent, Japan 4½ per cent, France 3½ per cent and Italy nearly 3 per cent. Producing between 1 and 2 per cent each, and in order of importance, are Sweden, Norway, Switzerland, the Union of South Africa, Australia, and possibly Czechoslovakia. Although most of the large producers have increased production to two or three times what it was in pre-war years, even greater proportionate increases have been registered by some smaller producers, including Brazil, Chile and Mexico in Latin America, Algeria and French Morocco in North Africa, and Ceylon, Indo China, Malaya and the Philippines in the Far East.

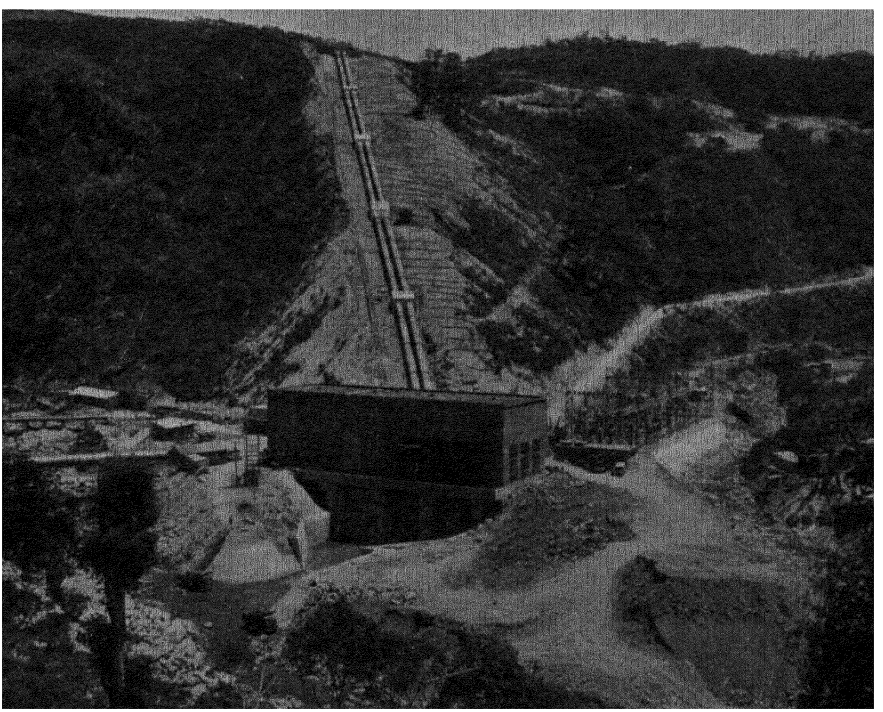
The way in which finance is provided and the industry controlled varies from country to country. In the United Kingdom, electricity manufacture and supply has been nationalized and in a number of other countries there is some degree of governmental control. In the United States and some European countries, however, electricity supply is mainly in the hands of private enterprise and finance is

provided by power finance companies specially created to deal with the high initial capital cost and the comparatively low rate of turnover.

As has been indicated above, the United States has a hydro-electric power installation greater than that of any other country, and the four great rivers Columbia, Colorado, Tennessee and St. Lawrence together contribute more than a third of the developed power. At Niagara Falls, in order to preserve their scenic beauty, the Canadian and American governments have agreed to use no more than 27 per cent of the total flow, but on the international section of the river between Prescott and Cornwall another 2 million horse-power will become available when the deep waterway scheme is carried out. The eight tributary stream dams of the Tennessee Valley Authority, Grand Coulée dam and Boulder dam all contribute significantly to total production, and there is considerable development in New England, the Southern Appalachians, and the snow-fed streams of the high sierra in California, Washington and Oregon. In addition, particularly in the interior lowlands, an increasing proportion of coal output is used in electric-generating stations.

In Canada, the Laurentian shield is particularly rich in water power, especially where the rivers cut through the southern rim to reach the St. Lawrence on the Ottawa, Gatineau, St. Maurice and Saguenay rivers, on the St. Lawrence itself, and where the rivers pass through the shield to Hudson Bay, though these latter regions are at present

Fig. 78. Part of the Snowy Mountains hydro-electric scheme



too distant from markets to make them of great economic importance. In the Western Cordillera only a fraction of the available power has yet been developed, chiefly on the Kootenay and at Ocean Falls, north of Vancouver on the coast range.

After the United States, the U.S.S.R. produces more electricity than any other country though many of the power-stations are fuelled with coal, peat and oil. However, these are supplemented by great hydro-electric plants at Dnieproges, Svir near Leningrad, Rionges in the Caucasus, Chirchik in Central Asia, and elsewhere. Great potentialities still exist, particularly from the Volga, and in the Urals, Kola and Eastern Siberia.

In comparison with other European powers, the United Kingdom is deficient in potential hydro-electric power and most of the electricity generated is based on coal, though there are hydro-electric power stations in the Highlands of Scotland, in the neighbourhood of Snowdon, on the upper Clyde and the river Galloway, and at Worcester, Chester and York. In France three new dams – at Genissiat, Donzère-Mondragon and Ottmarsheim – have recently been put into operation, and in Italy, where water power is the one resource with which the country is relatively well-endowed, considerable progress has been made since the war. Norway, however, is the west European country most blessed with potential resources and electricity is already much used there for almost every industrial and domestic purpose; waterfalls are well-distributed throughout the country and, being mostly near ice-free fjords, are easily developed. Hydro-electric power is also the great industrial resource of Switzerland, and there are a large number of power-stations in the Alps and the Jura.

In the Far East, Japan has the most developed hydro-electric system and her undoubted wealth in this field does something to offset her poverty in coal and oil; if other fuels producing electricity are eliminated, Japan probably stands third, after the United States and Canada, among countries making the fullest use of their hydro-electric resources. Since India is also deficient in coal, particularly good coking coal, great importance is attached there to the development of hydro-electricity, though this is not helped by the great seasonal variations in the flow of water in the often snow-fed northern rivers, the liability to earthquakes, and the easy gradient of the peninsular rivers. So far the most notable developments have been on the Western Ghats behind Bombay and around the Nilgiris in the south, but a number of other large schemes are in hand. In China water power resources still await development though there are plans to dam the Yangtse above Ichang, and many of the West China rivers flow in deep gorges and the coastal rivers have steep headwater gradients where great amounts of water could be impounded. Extensions and new

developments are also taking place in Australia and New Zealand, and both countries have considerable potential supplies.

It is not to be expected that much electricity enters into international trade but there have been small exports from Canada to the United States, from Austria to Italy, and from Sweden to Denmark. Yugoslavia is another country which plans to export electricity to her neighbours.

ATOMIC POWER

World industrial development depends on power but, if we take into account all possible sources, there appears to be no reason to suppose that the supply of power will ever be a factor limiting that development. Men will always, of course, choose the cheapest sources and, at present, these are coal, petroleum, natural gas, hydro-electricity, peat and wood. In the future it is conceivable that alcohol obtained from sugar or other plant-life may become important, or that solar energy (already being harnessed in a modest way to give power to an electric battery), tidal power or wind will supply significant quantities of mechanical energy. The most likely development, however, is the increasing utilisation of atomic energy for electricity production. At present the capital costs are extremely high and a sober British government pronouncement states: 'Even if the experimental work at present in hand shows that industrial power could be generated successfully and economically, the great magnitude of the investment required must mean that it will be decades before a large proportion of the country's electricity can be generated by nuclear reactors.' But, 'however crude and primitive our first nuclear power reactors may appear to future generations, we can look forward with confidence to the time when industrial power from the atom will be a major factor in the world's economy. Exploitation of nuclear energy may come to be regarded as the most important step taken by man in the mastery of nature since the discovery of fire.'*

In the United Kingdom an Atomic Energy Corporation has been established and it is expected that atomic power-stations capable of generating electricity for industry, which by conventional methods would need 20 million tons of coal a year, will be in operation in1965. In the United States, the chairman of the American Atomic Energy Commission has suggested that, in the next five years they will be 'working towards the realisation of economically feasible atomic power,' though not enjoying its fruits,† but already a group of private industrialists in the United States has offered to construct atomic

*Cmd. 8986/53. It should perhaps be pointed out that not much 'discovery' was involved in finding fire since nature supplies it ready made.

†*U.S.A. in Review*, Vol. IV, No. 17.

energy plants without government help, with the object of selling electric power to consumers and atomic fuel to the government, and one important newspaper believes that atomic power will be lighting cities within ten years.

Atomic fuels, of which considerable quantities are already in production, are virtually weightless and can be taken anywhere in the world,

Fig. 79. A plutonium factory in Cumberland

to the source of raw materials, to deserts, to mountains and to islands. Some believe that they will reduce the rate at which the world is using up its natural resources, and atomic energy plants may well assume importance in regions where other power resources are few or non-existent. More fanciful perhaps are the views of Dr. Philip N. Powers, director of the Monsanto Chemical Company's atomic electric project, who has said: 'Years from now we may have distilling and pumping stations powered by atomic energy that evaporate the salt out of sea-

water and pump it wherever you want to use it.' Arid regions such as the Sahara desert, he believes, might be irrigated and more land made fertile to grow food. Power might even be brought to such deserted regions as Central Australia, where vast resources lie dormant for want of power to develop them.* Others might point out that all this depends, in part, on whether atomic energy is put to less peaceful uses in the meantime.

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PART IV - MANUFACTURES, TRANSPORT AND TRADE

Chapter 18
Manufactured Goods

INDUSTRIAL PRODUCTION

It has become apparent from the examination of raw materials and power production in Part III that the world's mining and manufacturing industries are now producing considerably more than they did before the war. In fact industrial production in the middle nineteen-fifties was more than twice that of 1929, more than three times that in the slump year of 1932, and about 75 per cent more than that in the pre-war peak year of 1937.

In the nineteen-thirties the rise in world industrial activity was mainly attributable to Europe and the U.S.S.R., since industrial output in the United States increased by very little in this decade.

In the nineteen-forties, however, under the stimulus of war, United States output rose by some 70 per cent and was the major factor in the increase in world industrial production during the war itself and in the immediate post-war years – a decade in which European production fell by some 10 per cent. The rapid recovery of Europe and the U.S.S.R. from the effects of the war dates from about 1948, and in the six years which followed Russian industrial production increased by 150 per cent, European production by 60 per cent, while the United States enjoyed a further rise of 20 per cent.

In the past thirty years United States industrial output has trebled, while Russian output – though still far less in gross amount – has increased more than ten times. By comparison the rest of the world's performance has been poor, since it has increased by only 90 per cent. It must be remembered, however, that thirty years ago the industrialized countries of Western Europe were more 'mature' than the two giant economies to east and west, and as rapid a rate of progress was not to be expected. In its rate of progress since 1937 Europe has even lagged behind the rest of the world exclusive of the United States and the

U.S.S.R. Nevertheless, the European output of industrial goods still exceeds that of the rest of the world outside the United States.

There is plenty of scope in the world at large for still further spectacular increases in industrial production, in the Old World and the New, but particularly perhaps in the U.S.S.R. and China.

	1929	1932	1937	1947	1950	1954
World	50	32	56	68	84	100
World (excluding U.S.A.)	58	43	69	60	84	108
Europe	57	43	74	59	85	109
United States	44	23	46	75	84	93
United Kingdom	—	—	76	76	94	107
U.S.S.R.	6	12	27	--	68	114
Japan	—	—	80	29	55	108
Germany	—	—	64	--	72	112

Fig. 80. Index numbers of industrial production (1953 = 100)*

MANUFACTURES

Manufacturing means the processing of raw materials and, sometimes, foodstuffs – the business of *adding value to* these commodities by changing their form. Many of the commodities dealt with in previous chapters – steel, hydro-electric power, petroleum, cement, rayon, paper, artificial fertilisers, synthetic rubber, sulphuric acid, wine, and so on – are already partly or wholly manufactured. Others, including timber, mineral ores, textiles, leather, tobacco, and canned and processed foods, are destined to become manufactures after they have been 'worked up'. It follows that, by implication, the main manufactured goods and the countries which make them have already been indicated. The production of machinery and transport equipment is based upon steel and power; the production of clothing and other apparel is based on the industrial fibres and power; the wide range of chemical products, from perfumery to paint, is based on crude minerals and power; paper and rayon production is largely based on timber and power; and building of all kinds is based on steel, timber, bricks and cement. These are the main manufactured goods and it is unnecessary to examine in any detail the thousands of different manufactured articles which actually enter into commerce. A few key figures – steel production, power production, cotton consumption, etc. – are sufficient to indicate the great manufacturing nations or regions.

If we examine crude steel production alone, we find that, just recently, the United States has been producing over 90 million tons

**Statistical Yearbook*, 1955, United Nations Department of Economic and Social Affairs, New York.

a year out of a world total of rather more than 220 million tons, or 40 per cent of the whole. Western Europe considered as a unit produces at least 60 million tons, the U.S.S.R. about 40 million tons, and the rest of the world put together no more than 35 million tons.

If the output of the Saar is taken as the unit, output in the United States is 36 times as great and the other leading nations in terms of

	Population		*Crude steel production*		*Energy consumption*		*Industrial consumption of raw cotton*		*Cement production*	
	No. million	%	*M. long tons*	%	*M. metric tons*	%	*'000 metric tons*	%	*M. metric tons*	%
World	2,700	100	225	100	3,600	100	8,000	100	189	100
Total for countries listed	1,128	44	214	95	2,500	70	5,600	70	143	76
United States	162	6·2	94	42	1,200	33	2,020	25	46	24
U.S.S.R.	214	8·0	40	18	400	11	950	12	19	10
United Kingdom	52	2·1	19	8	240	7	380	5	12	6·4
Western Germany	49	2·0	17	7	135	4	210	2·5	16	8·4
France and Saar	43	1·7	13	6	100*	3*	260	3·5	10	5·3
Belgium-Luxemburg	9	0·4	8	4	40	1	120	1·5	4	2·1
Japan	88	3·4	8	4	72	2	400	5	11	5 8
Czechoslovakia	13	0·5	4	1 8	n.a.		n.a.		n a.	—
Canada	15	0·6	3	1·5	100	3	100	1·2	4	2·1
Italy	52	2·1	4	1·8	40	1	200	2·5	9	4·7
Poland	25	1·0	4	1·8	n.a.	—	n.a.	—	3	1·6
India and Pakistan	390	16·1	2	0·9	40	1	800	10	5	2·6
Sweden	7	0·3	2	0·9	25	0·7	30	0·4	2	1·0
Australia	9	0·3	2	0·9	27	0·8	—	—	2	1·0

n.a. — not available * Excludes Saar.

Fig. 81. The industrialized countries

Saar output would be: the U.S.S.R. 14, the United Kingdom 7, Germany 6, France 4, Japan 2·5, Belgium 2, Czechoslovakia 1·5, Canada 1·5, Luxemburg 1, Italy 1, and Poland 1.*

Fig. 81 brings together a few of the key statistics referred to above – enough to indicate the leading industrial countries and hence the leading manufacturers.

From this table it is obvious that the United States is the world's leading manufacturing nation and that she probably produces between two and three times the volume of manufactured goods produced in the U.S.S.R. The U.S.S.R. probably produces twice or rather less than twice the volume of manufactured goods produced by the other leading manufacturers, the United Kingdom, Western Germany and France. These figures, however, are not a measure of industrialization

	Steel consumption per head (kilos)	*Energy consumption per head (coal equivalent: metric tons)*
United States	600	8·0
Canada	360	6·2
Sweden	320	3·5
Australia	290	3·2
United Kingdom	280	4·7
Belgium	250	4·2
Western Germany	220	2·8
France	190	2·3
Netherlands	180	2·1
Norway	180	4 6
Switzerland	n.a.	2·5
Denmark	160	2·1
U.S.S.R.	140	n a.
Union of South Africa	120	2·0
Chile	n.a.	0·9
Japan	70	0·9
Italy	50	0·8
Argentina	n.a.	0·9
Venezuela	n.a.	0·9

Fig. 82. Steel and energy consumption per head of population

*The implications of these figures in the realm of power politics, even in an atomic age, are obvious, and the significance of the rapid conquest of certain key territories on the continent of Europe in time of war becomes immediately apparent. The odds against Germany and her allies in the Second World War were probably of the order of 2 : 1, but her conquest of the U.S.S.R., had it been complete, would have made an enormous difference. In any consideration of the present it must be remembered that Russian steel production is increasing rapidly and manpower or population figures have been left out of account. However, a calculation of strength in steel production which could be amassed by various possible groups of nations in the event of a third world war is not without its interest, the new significance of atomic power notwithstanding.

per head of the population since a country like Japan, and, even more, a country like India, appears high on the list by reason of the size of its population alone. The table above, therefore, brings together the energy and steel consumption figures on a *per capita* basis, thus making due allowance for the fact that a country with a small population, like Norway, may nevertheless be much more highly industrialized in proportion to its population than a country with a large population, like Japan. From Fig. 82 it is evident that North America, Western Europe and Australia are the most highly industrialized regions in the world, with the U.S.S.R., the Union of South Africa, three South American countries, Japan and Italy coming in the next flight.

TRADE IN MANUFACTURED GOODS

If we examine world trade statistics we can obtain an approximate estimate of the value – as measured in United States dollars – of the *net* exports of manufactured goods from the principal trading countries, together with the proportionate value of manufactured goods as part of the country's total exports. Thus, the United States, the world's leading exporter of manufactured goods, exports manufactures to the value of about $7,000 million net each year and manufactured goods normally form 65 per cent, by value, of her total exports. The other leading exporters are given in Fig. 83.

	Approximate Net Worth ($ million)	*Manufactured Goods ÷ Total Exports* (per cent)
United States	7,000	65
United Kingdom	4,500	85
Germany	2,700	82
France	2,000	63
Belgium-Luxemburg	1,100	83
Japan	900	89
Italy	170	64
Austria	100	70

Fig. 83. Exports of manufactured goods

It is possible that Czechoslovakia, Eastern Germany and Poland might find a place towards the bottom of this list if trade figures between the U.S.S.R. and other communist-governed countries were available, but the overwhelming importance of the first six countries would not be seriously affected; together they share the great bulk of the world's trade in manufactures.

When we examine the chief customers of these countries it is interesting to discover how much of the total trade is carried on between

themselves. Thus, in order of importance, the chief importers of manufactured goods are the *United States*, Australia, Brazil, the *United Kingdom*, Argentina, Canada, *Belgium-Luxemburg*, *France*, South Africa, Venezuela, *Germany*, *Italy*, Indonesia, Algeria, Cuba, Egypt, Malaya, New Zealand, Pakistan, Mexico, French Morocco, Turkey, the Belgian Congo, Colombia, Hong Kong, Eire, Norway, Nigeria and Spain. There seems little warrant for supposing, as some writers have done, that trade in manufactured goods will necessarily fall as other countries become more and more industrialized – unless political factors cause such a decline.

Such trade at present consists largely of trade in transport equipment, machinery of all kinds, textiles and clothing, and, to a less extent, chemicals, and rubber and paper manufactures.

The first two groups account for the major part of United States exports in this field, her chief customers being Canada, the United Kingdom, Mexico, Japan, Brazil, Cuba, Venezuela, Germany and Italy.

In the United Kingdom, general iron and steel manufactures, motor vehicles, cotton and other fabrics, electrical machinery and other machinery are all groups of major importance, with ships, power-generating machinery, chemicals and rubber making up the bulk of other exports. Australia is normally the chief customer followed by the United States, South Africa, Canada, New Zealand, India, Eire, Malaya and Sweden.

German exports follow much the same pattern, though with motor vehicles taking a rather less prominent place, and scientific instruments and toys being relatively more important among the miscellaneous manufactured articles. With no overseas territories, however, Germany finds her main markets at present on the continent of Europe, in the Netherlands, France and the Saar, Sweden, Belgium-Luxemburg and Switzerland. After these come the United States, the United Kingdom, Italy, Brazil, Denmark, Austria and Turkey.

In France iron and steel manufactures other than machinery and transport equipment take pride of place, though textiles, motor vehicles, metal-working and electrical machinery, pharmaceutical products, inorganic chemicals and fertilizers are all important. Here the main customers are Algeria, Indo China and Switzerland, followed by French Morocco, the United Kingdom, Belgium-Luxemburg, Germany, French West Africa and other French territories.

General iron and steel manufactures are far more important in Belgium-Luxembourg and Japan than transport equipment. Among the lesser manufactures of importance in the former country are photographic materials, fertilizers and ships, and the Netherlands, the United Kingdom, Germany, the United States, France, the Belgian

Congo and Sweden provide the principal markets. Japan's important exports include textiles and toys, her main post-war customers being found in the United States, Pakistan, the United Kingdom, Malaya, Indonesia, Formosa, Hong Kong (and thus, indirectly, China), and the Ryūkyū Islands.

By comparison Italian and Austrian exports of manufactured goods are small, a large part of the former's exports being made up of textiles and clothing. It is also perhaps worth recording that although, on balance, Canada is an importer of manufactured goods, she has important exports of paper, the United States and the United Kingdom being her main customers.

Trade rivalry between the leading industrial nations has had important repercussions in international politics for more than a century – to look no further back in history than the adoption of modern mass-production methods. The United Kingdom, France and Belgium have all found important markets in overseas dependencies and associated countries, and the United States, in addition to its own vast home market, has had a special sphere of influence in the Americas and the Philippines. Between the wars Germany, Japan and Italy had no 'dependent' outlets of this kind and much of the history of the last half-century is explicable in these terms alone. South America, the Far East and Africa offer growing markets for the future and it remains to be seen whether the prospective trade will be pursued along peaceful lines. If it is not, it is doubtful whether the rewards will be commensurate with the costs. In the world as a whole there is still need enough for all the manufactures which can be produced.

Chapter 19

Transport

INTRODUCTION

All modern business and trade is dependent on transport. It is not usually sufficient that a commodity should be grown, mined or manufactured; to serve its purpose it must also be carried to the consumer, and the highest standards of living are impossible without the roads, railways and shipping which allow of specialization, large-scale production and the exchange of products between different regions.

To railway transport the world owes the rapid developments which followed upon the mechanical inventions marking the beginning of the industrial revolution. To the steamship and the railways it owes the extraordinarily rapid development of the United States, Canada, South Africa, Australia and Argentina in the second half of the nineteenth century.

In the twentieth century, although there is still much scope for the further construction of railways in such vast and relatively undeveloped countries as India, China and the U.S.S.R., there has been some tendency for the railway mileage in the more highly industrialized countries to fall, and the world's greatest debt has been to the spectacular developments in motor transport. Along with the growth of motor transport, there has also been the application of the internal combustion and jet engines to the air.

Each of these methods of transport has its own peculiar advantages. Distance for distance, the carriage of goods by water is undoubtedly the cheapest method and the deep-sea and coastwise carriage of goods in ships is, of course, of tremendous importance. Each year well over 700 million tons of goods are borne between countries by ships, without counting such traffic as the carriage of coals from Newcastle to London, which is internal to a particular country.

In many countries, artificially-developed canal systems or improved natural waterways supply cheap internal transport and, very shortly, the completed St. Lawrence seaway will allow ocean-going ships of

up to 8,000 tons to sail over 2,000 miles into the heart of North America (as well as doubling the hydro-electric power derived from the Niagara Falls). But, as the St. Lawrence scheme itself shows, artificial or improved waterways can involve immense capital expenditure and such charges must be borne by the traffic.*

For carriage by land, the railways provide the cheapest method for such heavy freight as coal, iron ore and building materials provided the volume of traffic merits their construction, for less tractive effort is required to haul a vehicle on rails than on a road, and heavy traffic wears down rails more slowly than it does the surface of a highway. Distance for distance, railway transport is both faster and safer than motor transport; no time need be wasted in stopping for meals and, for those riding, the journey is more comfortable. Over medium distances of from two to six hundred miles there is much to commend railway travel to the passenger, provided he does not have to travel part of the way by ship.

On the other hand, the motor vehicle has obvious advantages for short distances since it goes from 'house to house' and involves no trans-shipment of goods or passengers. Furthermore, it is not bound by time-tables. The result has been that the motor vehicle has tended to skim the 'cream' off the traffic which went by rail and has become, in many countries, the means of transport for the lighter, more valuable goods which can bear heavier freight charges.

Although the motor vehicle is ideal for the short haul, it also has advantages for the relatively long-distance transport of such perishable goods as fish and soft fruits, and for the transport of valuable machinery, spare parts, glassware and pottery, for it is in these fields that minimum handling and a speedy 'house to house' service are all-important. On the continent of Europe long-distance road services traversing several countries have been developed (there is even a bus-service from Stockholm to Geneva) and their further development is hindered only by licensing and frontier difficulties, and by the lack of international road conventions. In the United States, where such difficulties do not exist, the transcontinental carriage by road of both passengers and freight is not uncommon.

In the developing countries, too, motor transport has considerable advantages over rail for less capital investment is required to begin with, and the service can be expanded gradually as the traffic grows. even though, as has been pointed out above, a road surface is more

*In England – the first country to build canals on a large scale – the development was uneven and the cost of transhipment high., Furthermore, the canals were deliberately neglected in the second half of the nineteenth century when many were bought by the railways. These factors help to explain the comparative unimportance nowadays of internal waterways in the United Kingdom.

expensive to maintain than metal rails, it must be remembered that the road does not create the same engineering problems and the motor vehicle can go up and down steep hills where the railway would require a tunnel or cutting. In the opening up of a country, roads now come first and railways, if they come anywhere, come second; it is the motor route which crosses the modern desert – from Nigeria to Algeria, for example, and from Damascus to Baghdad. If all kinds of carrier are considered, it is probable that more traffic moves by road than by all other means of transport combined, and the tendency is for this to become more rather than less true.

The airways are still developing rapidly and, over long distances, are becoming increasingly important for the carriage of passengers and mails. At least forty-five million people – practically the population of the United Kingdom – make a journey each year by air, and the cheap air-letter form is very generally used for keeping in touch with those who live a long way off. Even so, the airways remain the least important of the major means of transport so far as the actual volume of traffic is concerned, though – subsidized as they are – they form a serious threat to the passenger ship.

In all the highly industrialized countries transport itself is a major industry on which the prosperity of a large part of the community depends. In the United States, for example, three million people are directly engaged in running transport – one-half of them on the railways – and a further two million make transport equipment, a combined total of 10 per cent of the working population. The importance of transport in peace and war has led everywhere to direct or indirect governmental control and intervention in its main branches, and, in the U.S.S.R., France and the United Kingdom, the government owns the whole or some considerable part of the means of transport. In both world wars their control of the seas was a factor decisive to the success of the Allies, and transportation by rail – until it was disorganized by bombing – was a major source of German strength. Air and motor transport have revolutionized military strategy and the development of the Autobahnen was an intrinsic part of Hitler's war plans.

To turn to more peaceful pursuits, the rapid development in communications alone made it possible for the United States to absorb millions of immigrants, and the Trans-Siberian railway was a key factor in the unification and development of the U.S.S.R. – as Bismarck's development of the railways was in Germany. In China it may be expected that the development of road and rail will have similar effects.

MOTOR TRANSPORT

The mass production of motor vehicles on standardized lines did not begin until after the establishment of the Ford Company in the

United States in 1903, and even by 1914 there were barely more than a quarter of a million motor vehicles in use. Between the wars, however, after being overshadowed by the railways for nearly a century, road transport came well and truly into its own again and, with over 70 million motor vehicles exclusive of motor cycles in use throughout the world, it is again the principal method of communication.

As with much else of the world's wealth, however, motor transport is most unevenly distributed between the family of nations, and the United States – with some 60 per cent of the world total – possesses even more in this field than she does in most others. In the United States, with its 1½ million miles of improved highway and an equal length of inferior roads, there is, on the average, one motor vehicle to every three inhabitants. Since three-quarters of all motor vehicles are private cars, there is a car to almost every American family. No other country can approach this figure as yet, but the more highly developed areas of the British Commonwealth – New Zealand, Canada and Australia – have a motor vehicle to every six people for, not only are they rich, but distances are great and railways less close upon the ground than they are in Europe. In Western Europe – the United Kingdom, France, Denmark, Sweden, Norway and Germany – there is a three- or four-wheeled motor vehicle to every twenty or thirty of the population, still far more than in those poorer countries of Asia and Africa where there is but one car to every thousand or more of the population. In many parts of these two continents one would be far more likely to die in the course of a year than take a ride in a car, but elsewhere motor transport has already done much to transform life by bringing isolated farms and villages into easy communication with urban centres. A vast expansion is still to come.

RAILWAYS

The world's railway mileage is not far short of one million miles – or one mile of rail for every ten miles of good road – and of this large total 25 per cent is to be found in the United States. The U.S.S.R., India, Canada, France and Germany have a further 25 per cent between them, in not vastly different proportions, and Australia, Argentina, the United Kingdom and Brazil share another 10 per cent.

Nowadays the world's railways carry over 2 billion (million million) net ton-kilometres of freight each year (the unit representing one metric ton of freight hauled one kilometre) and this is 70 per cent more than in pre-war days. More than half this rise is accounted for by the increase in the freight traffic of North America railroads since the war and the traffic over these lines now amounts to half the world total, but there has been an even greater proportionate rise in the carriage of freight in Africa.

In the same period there has been a similar increase in passenger traffic and this now amounts to nearly 500,000 million passenger-kilometres each year. By every means of mechanical transport, there has been far more travelling done by the civil population since the war than in any other period in history.

AIRCRAFT

The development of civil aircraft followed closely behind that of motor transport and, although it was not until the nineteen-thirties that trans-oceanic routes were established, the carriage of passengers, mails and freight on regular commercial services dates from the end of the First World War.

International air services result in much political bargaining, since permission has to be obtained from each sovereign state for aircraft to fly across it as well as to land on it. The consequence has been that most nations, however small, have felt compelled to run air services of some kind to maintain their prestige and it is the exception everywhere to find air transport covering its costs. Unlike most other forms of transport, civil aviation has been dependent from its earliest beginnings upon government subsidy or support, and most of the major countries outside the United States have created a national air line under public ownership.

Owing to the difficulties which international frontiers involve, it follows that air transport can develop best in such continent-straddling countries as the United States and the U.S.S.R. where there is an internal demand for long-distance air services. In fact that development has made most progress in the United States and twelve of the world's fifteen largest air companies are American, the other three being the British Overseas Airways Corporation, Royal Dutch Airlines (K.L.M.) and Trans-Canada Air Lines, though none of these is much more than a quarter the size of the two largest United States companies, American Airlines and United Airlines.

The advantages of air transport lie, of course, in its speed and in its ability to fly over such terrestrial obstacles as seas and mountains. In part, these advantages are lost on short journeys through the time taken in going to and from the airports themselves, though the development of the helicopter may make even short journeys by air practicable. At the moment there are about 125 air-lines operating some 2,000 aircraft on regular services over 500,000 miles of air routes, and they are particularly important for the carriage of business men and others whose time is precious, and for the carriage of mails. Passenger traffic is now more than thirty times what it was before the war and, measured in passenger-kilometres, amounts to one-fifteenth that of the railways, though the chief reason for this large proportion is the immensely

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Fig. 84 Main inter-continental air routes

longer distance travelled by the average aircraft passenger. In one aspect, in particular, that of passenger-carrying by sea, the subsidized air-liner competes seriously with an established means of transport. Over one-half of those travelling from the United States and Canada to the United Kingdom now come by air, and even though, so far, this has not meant any fall in the numbers travelling by sea (since more people are making the journey), the days of the very large passenger ship are probably numbered.

If, in going from one place to another, more than one means of transport is involved in the journey by land and sea, air transport may well be cheaper even now to the passenger and, in some countries at least, there is a growing rivalry between rail and air for those passengers to whom time is more important than money.

For the carriage of freight, on the other hand, aircraft is still the most expensive means of transport and, even though the volume of freight carried has also increased by more than thirty times in the past two decades, it still amounts to little more than a million net-ton kilometres, and the railways carry two million times as much. Where the point of origin or destination is far from the sea, however, air freight for spare parts and goods valuable in relation to their weight may even now be cheaper – as well as quicker and safer – than the journey by sea, rail and road with all its attendant risks of handling and pilferage.

MERCHANT SHIPPING

The international sea haulage of bulk cargoes is the cheapest means of transport man has devised, and by sea are carried most of those goods which enter into world trade. Since merchant shipping also earns foreign currencies for the services which it renders to countries other than those in which it is owned, this transport service is of special interest to the economic geographer.

Despite the holocaust of the Second World War, in which the United Kingdom alone lost 11 million tons gross of shipping, the world's merchant navies, totalling some 100 million tons gross, have increased by nearly 40 per cent in the past quarter of a century. The relative position of different countries, however, has changed considerably and, on paper, the United States has replaced the United Kingdom as the world's leading maritime power. In practice, however, a large part of the United States fleet is laid up and the United Kingdom remains – by a small margin – the principal shipping country even though her share of world tonnage has fallen from 44 per cent to under 20 per cent in the past forty years. The United Kingdom and the United States together own 50 per cent of the world's tonnage. Norway takes third place, as she has long done, but now Liberia – a country under whose flag there was a negligible tonnage in the nineteen-thirties – ranks

fourth. After these come Panama, France, Japan, Italy, the Netherlands, Sweden, Germany, the U.S.S.R., Denmark, Spain and Greece.

It may seem strange that Panama and Liberia – and, lower down the list, Honduras – should be among the states in which some of the world's largest fleets are registered, and it *is* strange in that the peoples resident in these countries neither own, man nor operate the ships on their registry. The explanation is to be sought in the fact that some shipowners – particularly Americans, Greeks, Italians and Norwegians – register their ships under these flags in order to avoid high

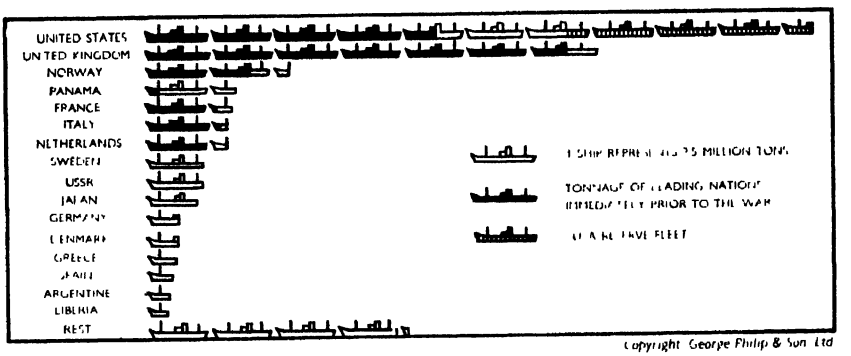

Fig. 85. Merchant shipping tonnage. The chart represents the position in 1952. See text for order in 1956

taxation in their own countries and, in the case of American shipowners, to avoid paying the high wages demanded by American crews. In other words, these fleets are artificial creations.

A second feature of the post-war shipping situation is the tendency for some nations – Argentina and other South American republics among them – to feel that for their well-being and prestige they should possess merchant navies of their own. In consequence, they have given assistance of various kinds to domestic fleets, including direct and indirect subsidies and clauses in trade agreements reserving proportions of the trade covered to ships of the contracting parties. The United States itself has not been guiltless of some of these practices.

Thirdly, in addition to the tremendous growth in the world's merchant navies there has been a considerable change in their composition. Merchant shipping falls, broadly speaking, into three main classes: the tramp ship which trades wherever there is cargo to be carried, the cheapest means of transport of them all; the more specialized and more expensive liner, operating on a scheduled route at scheduled times, thus guaranteeing to the shipper and to the passenger a certain type of regular service; and the oil-tanker, carrying crude and refined petroleum about the world and spending perhaps half its sea-time in

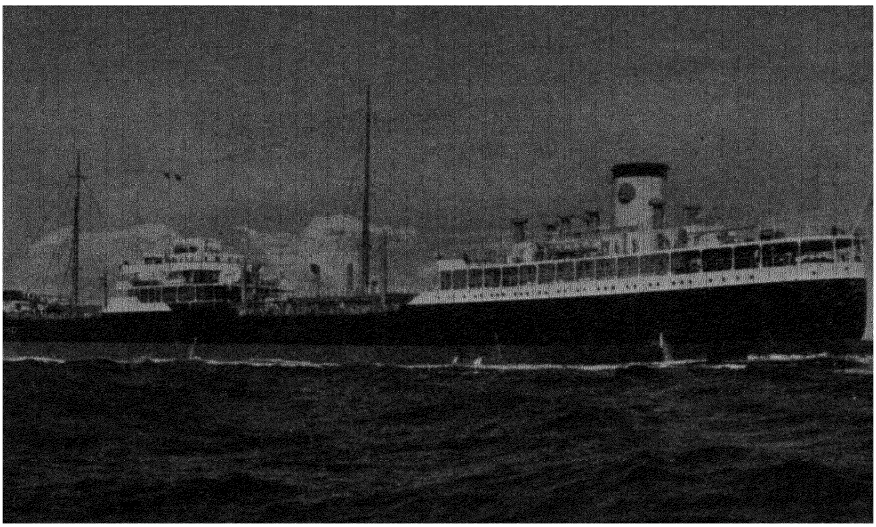

Fig. 86. The 28,000-ton oil-tanker *Velutina*; much bigger ones are in commission

ballast. Since the war there has been a decline in the world's tramp tonnage – in the United Kingdom alone it has declined by over 30 per cent in little more than two decades – and one reason for this has been a decline in the coal trade, including the trade in bunker-coal to fuel the merchant navies themselves since these have become increasingly oil-fired. On the other hand, the tonnage of the oil-tanker fleet has more than doubled in the same period and, as a proportion of world tonnage, increased from one-quarter to over one-third.* The tendency, however, is for the tankers themselves to become much larger (32,000 tons is no uncommon size and still bigger ones have been built) so that the number of ships has not increased in the same ratio. All tankers, but particularly the smaller ones, operate in much the same way as tramps, going wherever oil is needed and frequently being re-routed at sea, but unlike tramps they carry no return cargo.

As shipping fleets have increased in size so, too, has the total of goods transported increased in volume. The tonnages of goods loaded for international trade reached 1937 levels again in 1948 and, since then, have increased by 45 per cent, though the increases have come mainly from the American continent – and, to a less extent, from Asia – and Europe and Oceania import rather more goods than they ship to other countries. For the earning of foreign currencies, their merchant navies are particularly important to the United Kingdom and Norway, two countries which have long been famous for their

*In 1900 there were about 100 tankers in the world – perhaps 500,000 tons deadweight. Now there are over 2,600 tankers totalling 35·5 million tons deadweight.

seafaring. These countries stand to lose most by the growing practice of 'flag discrimination'.

CONCLUSION

According to Macaulay those inventions which abridge distance have done more for civilization than any others, with the exceptions of the alphabet and the printing press. It should not be forgotten that the chief obstacles which engineers and inventors have had to contend with have often been geographical ones. Water transport is cheap because no capital need be spent in laying down a road, except between the Asian and African continents at Suez, between the Americas at Panama, and into many of the world's ports. The depths of water in harbours is the most serious limitation upon the size of ships and limits the size of tankers to-day as it limited the number of places to which the *Queen Mary* and the *Queen Elizabeth* could be sent during the war. Motor transport could not have come had not the road engineer solved the problem presented by the roads in the eighteenth century, when it was no uncommon thing for the villages of England to be cut off for weeks at a time in winter, and even to-day there are no roads into Nepal. Nowadays railways are not limited to a level track as once they were, but that early limitation made the English railways the most expensive in the world to construct.

Whatever the marvels of engineering, geographical obstacles impose costs, and natural advantages in the way of deep ports or open country are as important to the wealth of a nation as natural resources of other kinds.

Chapter 20
World Trade

With this chapter the outline of economic geography which forms the subject of this book comes to an end. Most of what it might contain has been dealt with in the commodity chapters, including the chapter on manufactures, and there is no need to repeat what has gone before. Here it is only necessary to draw threads together in such a way as to indicate that in the end is the beginning. To use another metaphor, the wheel has come full circle and world trade brings us back to those first principles which took up the pages of Part I.

Since the years immediately before the war, world trade has increased in volume by some 35 per cent, but, since in this same period industrial production has increased by 80 per cent and world population has increased by more than 20 per cent, the increase in trade as a proportion of income is by no means startling. In 1929 the value of world trade measured as a percentage of world income was perhaps 11–12 per cent. By 1937 it had declined to 10 per cent. Now it may be as high as 12–13 per cent.

The change is due largely to a growth in United States exports to the rest of the world, though trade between the countries of Western Europe has also increased, facilitated perhaps by the setting up of the European Payments Union. A relatively small number of countries has always dominated world trade and the Second World War did nothing to increase their number. In the nineteen-thirties, United States exports were 12-13 per cent of the world total; in recent years they have been 20 per cent. The comparative figures for the United Kingdom and Germany respectively are 8 per cent and 5–6 per cent before the war, and 10 per cent and 6–7 per cent since. If Canada, France and Belgium-Luxemburg are added to these three giants, the six countries together account for rather more than half the world's exports.

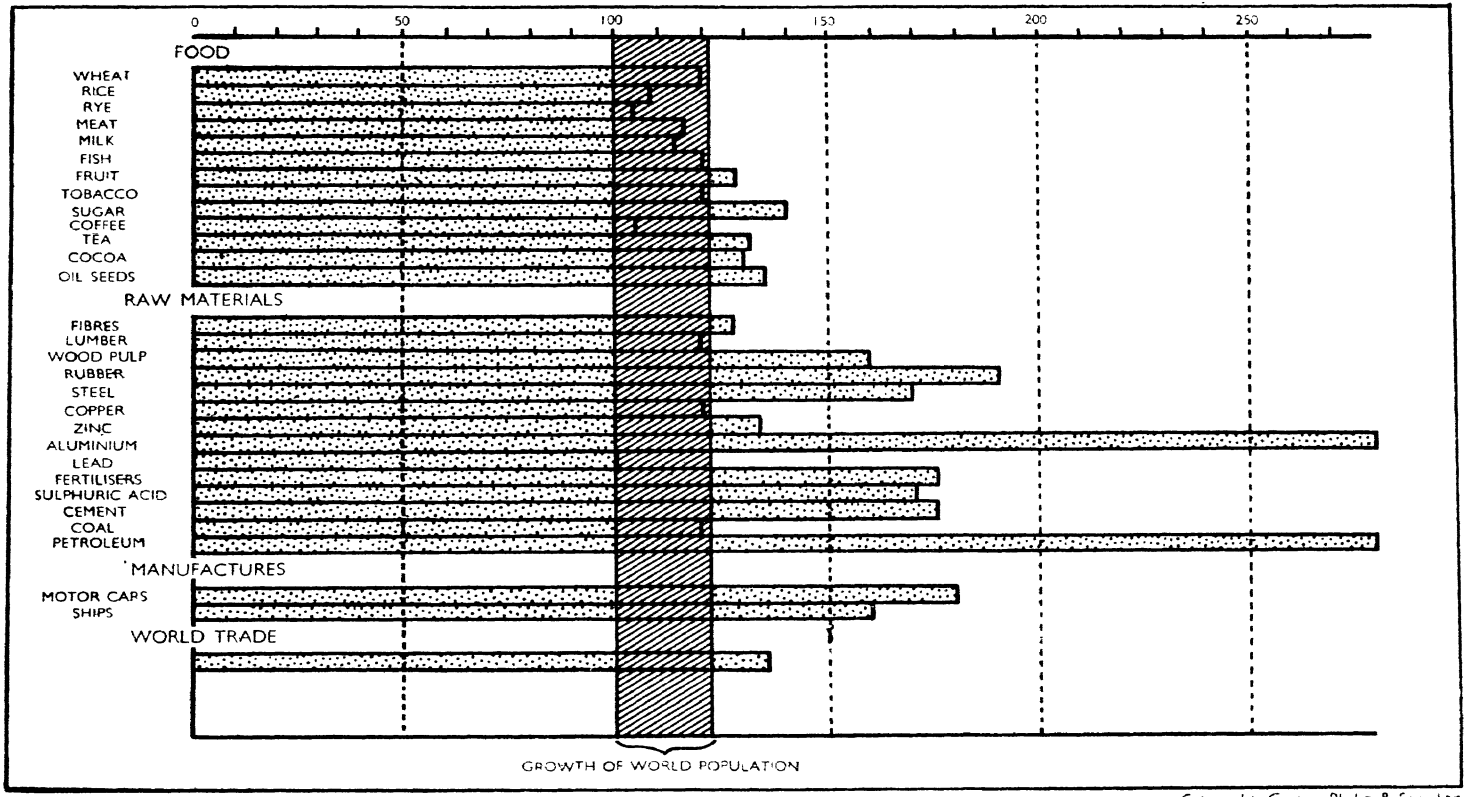

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Fig. 87. World commodity production (1938 = 100)

Fig. 88. The shopping centre at Letchworth Garden City, England

The pattern of trade between areas is indicated by the matrix table (Fig. 90), which may be taken as typical of recent years. It will be observed that the major part of Western Europe's trade is with Western Europe and this would be even more apparent if Western Europe's trade with the United Kingdom were added in. Germany, in particular, has long found the bulk of her markets in neighbouring countries. Much of the United Kingdom's trade, on the other hand, is with other countries of the Commonwealth, though more than half the balance is with her geographical neighbours. For the United States, Latin America, Canada and – to a smaller extent – Japan are traditional trade outlets, though trade with Western Europe and the Sterling Area is considerable. To the three principal areas – Western Europe, North America and the Sterling Area – no less than 80 per cent of the world's trade is confined, though in population and area they account for less than half this percentage.

Broadly speaking, it is the small countries of Europe whioh are most dependent on trade, and the fragmentation of Europe into small political units is in part responsible for the volume of international trade. Contrariwise, it is the large countries – the United States, the U.S.S.R., China and India – which have the lowest imports in proportion to their national incomes, despite the overwhelming importance of United States exports to the rest of the trading world.

This is not to say that size is the only, nor even the most important,

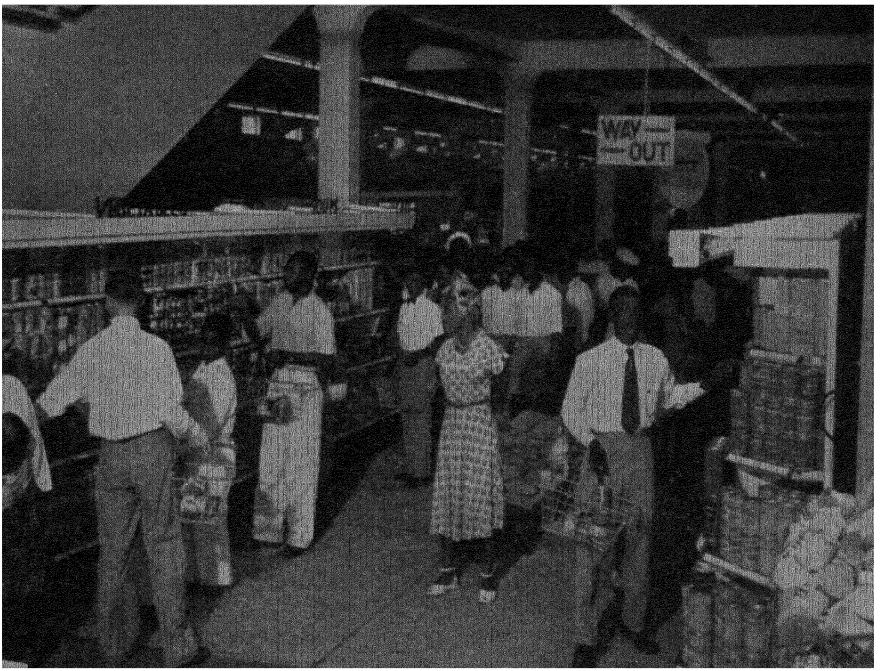

Fig. 89. A self-service store at Lagos, Nigeria

factor determining the volume of trade in which a nation engages. Obviously, climatic differences and the accident of mineral location account for a large volume of exchanges between countries, as between regions within a country, and industrialized countries tend to trade to a greater extent than unindustrialized ones: wealth increases not only the volume but the diversity of demand.

Fig. 90 serves a further purpose in that it draws attention to what is undoubtedly the world's major trading problem: the continuing indebtedness of the rest of the world, and Western Europe (including the United Kingdom) in particular, to the United States. North America and, to a much smaller extent, Latin America export more than they import. Western Europe and certain other regions import more than they export. For half a century, the United States has been repaying old debts (now long since repaid) or making gifts (voluntary and otherwise) to the rest of the world, and the net outflow of goods from the United States to Europe alone in the thirty years after 1918 has been conservatively estimated at $75,000 million. The United States is far and away the world's leading creditor country, her exports are larger in volume and worth more than those of any other country, and yet neither her exports nor her imports are vital to reasonable prosperity within her vast dominions. In 1929 the credit outflow, which has done so much to maintain prosperity elsewhere, stopped temporarily, and the world suffered severe depression and unemployment.

The problem for the future is to raise living standards throughout the world, and to the solution of this problem a steadily increasing volume of world trade has much to contribute. Indeed, there is some warrant for assuming from past experience that rising living standards and increased trade go together. But how to ensure a steadily increasing volume of trade and the elimination of large-scale fluctuations is another matter. In the first half of the nineteenth-century world trade was an exchange of European manufactures for the products of less developed societies – the spices and silks of the East, or the hides of California. In the second half of that century, to the immense benefit of the countries in which investment took place, European capital began to develop some of these less developed societies. Money was invested in ports, railways, mines and plantations, and rubber, wheat, sugar, meat, beverages and minerals of all kinds began to flow back, as they do to-day. Now, economic development is going further, as it has done already in the United States, Japan and elsewhere, and some of the hitherto 'under-developed' countries are building their own factories and establishing their own industries. There is still room for a vast expansion in the poor countries, room for a vast investment, for example, in India and China, and the United States, as the richest country, is best placed to make such investment. But is the United States willing to make this investment? And are the poor countries willing to accept of it?

Exports of from / to Imports of	*North America*	*Sterling Area*	*Western Europe*	*Latin America*	*Eastern Europe*	*Rest of World*	*World*	*Deficit*
N. America	6,000	2,000	1,500	3,500	100	1,300	14,400	—
Sterling Area	3,500	9,000	3,500	500	500	1,800	18,800	800
W. Europe	4,000	4,000	12,000	2,000	600	1,600	24,200	3,200
Latin America	4,000	500	1,500	600	20	150	6,770	—
E. Europe	0	500	600	20	1,050	300	2,470	—
Rest of World	2,000	2,000	1,900	380	230	850	7,360	1,360
World	19,500	18,000	21,000	7,000	2,500	6,000	74,000	
Surplus	5,100	—	—	230	30	—		5,360

Fig. 90. World trade by areas
(*values in millions of U.S. dollars*)

In theory a happy triangular development can be suggested: an expansion of productivity in Asia and parts of Africa for which the United States supplies the money and Europe some of the goods so that Europe, with the dollars thus earned, can import her own requirements from the United States. Of course, if the United States were ever to be repaid, she would eventually have to import vastly greater quantities of raw materials from Asia and Africa.

To some extent – a much smaller extent than can be imagined – such a development is taking place, and, of course, the traditional exchange of raw materials for manufactures continues.

The study of economic geography alone cannot take us further. The economic geographer, on the basis of his researches, can suggest where economic and geographic factors may limit men's actions or set boundaries to their hopes. He can also make recommendations. But he cannot legislate. He cannot lay down the law because his science is only part of the science of sociology, only part of the study of man in society related to his environment and, while the economic and geographic factors are important factors in determining what H. G. Wells called the work, wealth and happiness of mankind, they are not the only ones. They act upon and influence the political factors but they do not wholly explain them, for man does not live by bread alone. The materialist explanation of man's actions is not enough because man is no automaton, no simple creature of circumstance, but the most rational of the animals. Because this is so, however, we sometimes forget that his reasoning powers are limited, that he is not omniscient, and that he does not always act in his own best interests.

After all, he does not always know what his own best interests are.

STATISTICAL APPENDIX

NOTES

These tables are printed in the order in which their subjects are dealt with in the text, with the exception of tobacco which appears after rye instead of after grapes for the convenience of the printer.

The statistics themselves are to the nearest unit indicated, e.g. population '0' means that population is less than 500,000; apples '0·2' means that the weight of apples grown is normally between 150,000 tons and 249,000 tons.

The statistics do not apply to a particular year but are thought to be typical of post-war figures after recovery from the effects of the war itself. Since harvests vary considerably, olive production, for example, is the average of a number of years; since annual output has been increasing for many years, the petroleum production figures, on the other hand, are those for the latest year available (1954).

Where a country is omitted altogether it may be assumed that its contribution is negligible in terms of the units used. Similarly, a space left blank indicates that the country makes no appreciable contribution to the total and not that the statistics are not available. The symbol 'n.a.' indicates that statistics are not available but that the country in question is likely to contribute significantly to the total figures.

Principal exporters are indicated by the symbol § and principal importers by the symbol ¶. It may be assumed that the countries thus marked, taken together, export or import at least 75 per cent of total exports or imports.

For the principal sources of these statistics see the preface.

COUNTRY	AREA thousand sq. mls	POPULATION millions	INCOME per head, per annum U.S. $	GRAIN CROPS production per annum · million tons						TOBACCO production per annum th tons wet wt
				WHEAT	CORN	RICE	OATS	BARLEY	RYE	
1	2	3	4	5	6	7	8	9	10	11
WORLD	56,000	2,700	230	175	130	95	60	55	42	3,100
ALGERIA	222	9	100	1				1§		20
ANGOLA	488	4	75							
ARGENTINA	1,133	18	330	5§	8§		1§	1§	§	36
AUSTRALIA	2,975	9	680	5§			1§			2
AUSTRIA	34	7	230							
BAHREIN	0	0	100							
BARBADOS	0	0	150							
BELGIAN CONGO*	931	16	75							
BELGIUM-LUXEMBURG	13	9	540	1¶	¶			¶	¶	6¶
BOLIVIA	415	3	55							
BORNEO	292	3	50							
BRAZIL	3,289	54	120	1¶	6§	2§				120§
BULGARIA	43	8	270	2	1					75
BURMA	254	19	40			4§				50
CAMEROONS (FRENCH)	144	3	70							
CANADA	3,846	14	870	1½§	¶		7§	5§		70
CANARY ISLANDS	3	1	250							
CEYLON	25	8	70			¶				
CHILE	290	6	190	1						
CHINA	4,135	602	35	2‡	7§	3‡	1	7		600
COLOMBIA	462	11	135							
COSTA RICA	23	1	125							
CUBA	44	6	300			¶				40
CYPRUS	4	0	130							1
CZECHOSLOVAKIA	50	12	375	2			1	1	1	
DENMARK	17	4	680				1	2	¶	
DOMINICAN REPUBLIC	19	2	75							25
ECUADOR	226	3	40							
EGYPT	386	21	100	1¶	1¶	1§				
EIRE	27	3	420				1			
ETHIOPIA	398	12	40							
FIJI	7	0	45							
FINLAND	130	4	350				1		¶	
FORMOSA	14	6	n.a.			1				
FRANCE	213	43	485	7	¶		4	2¶	1	55
FRENCH EQUATORIAL AFRICA	977	4	70							
FRENCH WEST AFRICA	1,830	14	70			1				
GAMBIA	4	0	70							
GERMANY	138	65	320‡	4			4	3	6	n.a.
GERMAN FEDERAL REPUBLIC	97	48	450	3¶			3¶	2¶	3¶	27¶
GOLD COAST	88	4	80							
GREECE	51	8	130	1						60§
GUADELOUPE	0	0	100							
GUATEMALA	45	3	80							
GUIANA (BRITISH)	83	0	130							
GUIANA (DUTCH)	54	0	120						*	
HAITI	11	4	40							
HAWAII	6	0	n.a.							
HONDURAS	44	2	85							
HONG KONG	0	2	60							
HUNGARY	36	9	270	2	3			1	1	30
ICELAND	41	0	480							
INDIA	1,138	390	60	7¶	2	22¶		2		260§
INDOCHINA	287	28	30			3				12
INDONESIA	735	78	25		2	6¶				100
IRAQ	172	5	85	1				1		
ISRAEL	8	1	390							
ITALY	131	52	235	7¶	3		1			80

*Includes Ruanda-Urundi.
‡E. Germany.
§Principal Exporters.
¶Principal Importers

COUNTRY	AREA thousand sq. mls.	POPULATION millions	INCOME per head, per annum U.S. $	GRAIN CROPS production per annum · million tons						TOBACCO production per annum th. tons wet wt.
				WHEAT	CORN	RICE	OATS	BARLEY	RYE	
1	2	3	4	5	6	7	8	9	10	11
JAMAICA	4	1	120							
JAPAN	264	88	100	1¶	¶	9¶		2¶		95
JORDAN	30	1	70							
KENYA	225	6	80							
KOREA	85	29	30			3		1		30
KUWAIT	4	0	100							
LEBANON	4	1	125							
LIBERIA	43	3	40							
LIBYA	413	1	40							
MADAGASCAR	228	5	100			1				
MALAYA	51	7	50			1¶				
MAURITIUS	1	1	n.a							
MEXICO	758	27	125	1	3					35
MOROCCO	173	10	100	1				1¶		
MOZAMBIQUE	298	6	60							
NEPAL	54	7	40							
NETHERLANDS	14	10	505	¶	¶		¶	¶		¶
NEW CALEDONIA	6	0	45							
NEW GUINEA	330	1	30							
NEW ZEALAND	104	2	860							-
NIGERIA	373	30	80							
NORWAY	125	3	590						¶	
NYASALAND	49	2	60							17
PAKISTAN	365	76	55	4		8				70
PANAMA	32	1	185							
PARAGUAY	157	1	85							
PERSIA (IRAN)	628	19	85	2				1		
PERU	483	9	100							
PHILIPPINE ISLANDS	115	21	45		1	2				25
POLAND	121	25	300	2			2	1	6§	
PORTUGAL	35	9	250	1						
PUERTO RICO	3	2	100							13
QATAR	8	0	80							
RHODESIA, NORTHERN	290	2	80							5
RHODESIA, SOUTHERN	150	2	105							50§
ROUMANIA	92	16	270	4	5					17
SAAR	1	1	500							
SALVADOR	13	2	95							
SAUDI ARABIA	927	5	45							
SIAM (THAILAND)	198	19	40			5¶				
SIERRA LEONE	28	2	60							
SPAIN	191	28	220	4	1		1	2	1	15
SUDAN	977	9	60							
SWAZILAND	7	0	70							
SWEDEN	173	7	780	1			1			
SWITZERLAND	16	5	850							
SYRIA	71	3	100	1						
TANGANYIKA	363	8	80							3
TRINIDAD	2	1	150							
TUNISIA	45	3	70							
TURKEY	294	22	125	5	1			2	1	90§
UGANDA	94	5	70							2
UNION OF SOUTH AFRICA†	473	13	265	1	2§					25
UNITED KINGDOM	83	52	780	2¶	¶		3¶	2¶		¶
UNITED STATES	3,022	162	1,460	30§	75§	1§	20	6§	1§	1,020§¶
URUGUAY	72	2	335							
U.S.S.R.	8,708	214	310	37	4§		12	9	2¾	400
VENEZUELA	364	5	325							
YUGOSLAVIA	96	17	150	2	4§					30
BRITISH COMMONWEALTH	14,435	540	—	33	6	30	11	9	1	550
WORLD EXPORTS				25	5	5	1	4	1	700

†Includes South-West Africa.

COUNTRY	LIVESTOCK millions			MEAT B = mainly beef; M = mainly mutton, P = mainly pork.	FISH	FRUIT A = apples; O = oranges; B = bananas, exports only.	GRAPES	SUGAR B = beet; C = cane.	BEVERAGES production per annum · thousand tons		
	CATTLE	SHEEP	PIGS	Production per annum: million tons					COFFEE	TEA	COCOA
1	12	13	14	15	16	17	18	19	20	21	22
WORLD	760	780	310	40	27	27	30	B13	2,370	900	700
								C22			
ALGERIA		5				O0 2§	1 7				
ANGOLA					0 2				50§		
ARGENTINA	42	50	3	B2 3§	0 1	{O0 4¶ A0 2§	1 5	C0 6			
AUSTRALIA	15	116	1	B1 0§		{A0 2§ O0 1	0 4	C0 9		¶	
AUSTRIA	2		2	PB0 2		A0 3		B0 1			
BAHREIN											
BARBADOS								C0 2			
BELGIAN CONGO*	1								20		
BELGIUM-LUXEMBURG	2		1	P0 3¶	0 1	A0 3¶		B0 3	¶		
BOLIVIA	1	4									
BORNEO	1										
BRAZIL	53	14	26	B1 1	0 2	{B0 2§ O1 2§	0 2	C1 0	1,100§		120§
BULGARIA	1	n.a.	n.a				0 4				
BURMA	1										
CAMEROONS (FRENCH)											45§
CANADA	9	2	6	BP0 8§	0 7§	A0 3§¶		B0 1¶			
CANARY ISLANDS						B0 1§					
CEYLON	1									160§	3
CHILE	2	6	1	B0 2	0 1						
CHINA	n a.	12	60	P5 0	3 0					300§	
COLOMBIA	15	1	3	B0 5		B0 2§		C0 2	350§		
COSTA RICA						B0 2§			21		
CUBA	4					¶		C7 0§	30		
CYPRUS							0 1				
CZECHOSLOVAKIA	4		3	P.0 3		A0 2		B0 7			
DENMARK	3		3	P0 6§	0 3§	A0 2		B0 4			
DOMINICAN REPUBLIC								C0 6§	30		30§
ECUADOR						B0 2§			15		20§
EGYPT	1				0 1	O0·2		C0 2		¶	
EIRE	4	3	1	BP0 2				B0 1		¶	
ETHIOPIA	1	n.a.	n.a.								
FIJI								C0 1			
FINLAND	2	1			0·1						
FORMOSA								C0 5		12§	
FRANCE	16	8	7	BP1 8	0 5¶	A3 0¶	6 5	B1 2	¶		¶
FRENCH EQUATORIAL AFRICA											
FRENCH WEST AFRICA	1					B0 1			50§		60§
GAMBIA											
GERMANY	15	3	21	n.a.	0 8	A0 9¶		B1 8	¶		
GERMAN FEDERAL REPUBLIC	11	2	14	P1 6¶	0 7¶	A0 7		n.a	¶		¶
GOLD COAST											250§
GREECE	1	8	1			O0 1	0 9				
GUADELOUPE						B0 1§					
GUATEMALA						B0 2§			60§		
GUIANA (BRITISH)								C0 2			
GUIANA (DUTCH)											
HAITI									35		
HAWAII								C0 9§			
HONDURAS						B0 3§					
HONG KONG											
HUNGARY	2	2	4				0 5	B0 3			
ICELAND					0 4§						
INDIA	148	n.a.	4		0 8			C1·6	20	315§	
INDOCHINA	1		n.a.		0·4					12	
INDONESIA	2		1		0 4¶			C0·6	40	50§	
IRAQ		7									
ISRAEL		n.a.				O0 3§					
ITALY	8	10	4	B 05¶	0 2¶	{A0 6§ O0 6§	6 5	B0 7	¶		

*Includes Ruanda-Urundi.

¶Principal Importers

Principal Exporters

COUNTRY	LIVESTOCK millions			MEAT B = mainly beef; M = mainly mutton; P = mainly pork.	FISH	FRUIT A = apples; O = oranges; B = bananas, exports only.	GRAPES	SUGAR B = beet; C = cane.	BEVERAGES production per annum, thousand tons		
	CATTLE	SHEEP	PIGS	production per annum: million tons					COFFEE	TEA	COCOA
1	12	13	14	15	16	17	18	19	20	21	22
JAMAICA						B0 1§		C0 3			
JAPAN	3	1	n.a.	BP0 1	3 8§	{A0 3 / O0 4		¶		50§	
JORDAN											
KENYA	5	3							10	8§	
KOREA	1				1 0						
KUWAIT											
LEBANON		n.a.									
LIBERIA											
LIBYA											
MADAGASCAR	6								30		
MALAYA	1		n.a.		0 2¶					2	
MAURITIUS								C0 5§			
MEXICO	15	5	6	B1 0	0 1	{O0 4 / B0 1§		C0 7	75§		
MOROCCO		10		BM0 1	0 1	O0 2§				¶	
MOZAMBIQUE											
NEPAL											
NETHERLANDS	3		2	P0 5§	0 3§	A0 3§¶		B0 4		¶	¶
NEW CALEDONIA											
NEW GUINEA											
NEW ZEALAND	5	35	1	M0 5§		A0 1				¶	
NIGERIA	4	2	n.a.			B0 1					100§
NORWAY	1	2		BP0 1	1 6§						
NYASALAND										8§	
PAKISTAN	24	n.a.	n.a.		0 1			C0 1		26§	
PANAMA						B0 1§					
PARAGUAY											
PERSIA (IRAN)	4	18								6¶	
PERU	n.a.	18	1		0 1			C0 5			
PHILIPPINE ISLANDS	n.a.	4		P0 1	0 3¶	¶		C0 9§			
POLAND	7	2	9	P1 3§	0 1	A0 2		B0 9			
PORTUGAL	1	4	n.a.	PB0 1	0 3§		1 0				
PUERTO RICO								C1 2§			
QATAR											
RHODESIA, NORTHERN	1										
RHODESIA, SOUTHERN	3										
ROUMANIA	3	8	2	B0 3		A0 1	0 9				
SAAR											
SALVADOR									75§		
SAUDI ARABIA											
SIAM (THAILAND)	5		n.a.		0 2						
SIERRA LEONE											
SPAIN	3	21	3	PB0 4	0 6	{A0 1 / O0 8§	2 6	B0 2			
SUDAN	1	6									
SWAZILAND											
SWEDEN	3		1	P0 3	0 2¶	A0 2¶		B0 3	¶		
SWITZERLAND	2		1	PB0 2		A0 3					
SYRIA		3									
TANGANYIKA	6	2							18	1	
TRINIDAD								C0 1			8§
TUNISIA		3									
TURKEY	10	25		MB0 1	0·1	A0 1	1 3	B0 2			
UGANDA	3	1							40§	2	
UNION OF SOUTH AFRICA†	14	35	1	B0·4	0 5	O0 2§	0 5	C0 5			
UNITED KINGDOM	11	20	4	B1·1¶	1 0§¶	A0·7¶		B0 7¶	¶	¶	¶
UNITED STATES	80	31	63	PB9 8¶	2 3§¶	{A2 3§¶ / O4 5§	2 6	{C0 5¶ / B1·5	¶	¶	¶
URUGUAY	8	23	n.a.	B0 4§							
U.S.S.R.	58	93	25	BP5·0	2 5	n.a.	n.a.	B2 6		20¶	
VENEZUELA	6		1	¶	0 1				50		16
YUGOSLAVIA	5	10	4	n.a.		A0 2	0 9	B0 2			
BRITISH COMMONWEALTH	225	224	14	4 5	3·5	{B0 2 / A1 3 / O0·4	1·0	{C4 7 / B0·9	100	528	370
WORLD EXPORTS				2·0	1·5	6·0		13	1,700	500	700

† Includes South-West Africa.

COUNTRY	PRINCIPAL OIL-SEEDS production per annum: thousand tons									
	GROUNDNUTS unshelled	COTTON SEED	SOYA BEANS	RAPESEED	SUNFLOWER	LINSEED	COPRA	PALM KERNELS commercial production	PALM OIL commercial production	OLIVE
1	23	24	25	26	27	28	29	30	31	32
WORLD	9,500	12,000	18,000	5,000	4,400	3,500	2,500	750	500	800
ALGERIA										16
ANGOLA		10								
ARGENTINA	90	200§			900§	600§				2
AUSTRALIA	5									
AUSTRIA										
BAHREIN										
BARBADOS										
BELGIAN CONGO*	160	100						130§	180§	
BELGIUM-LUXEMBURG						15¶		¶	¶	
BOLIVIA										
BORNEO										
BRAZIL	140	800				30				
BULGARIA		16	50		100					
BURMA	150	17								
CAMEROONS (FRENCH)	100							30§	5§	
CANADA		¶	90		10	200§				
CANARY ISLANDS										
CEYLON							200§			
CHILE					70					
CHINA	3,000	1,600	8,500§	3,000						
COLOMBIA										
COSTA RICA										
CUBA	5									
CYPRUS										2
CZECHOSLOVAKIA						10				
DENMARK						15				
DOMINICAN REPUBLIC	15									
ECUADOR										
EGYPT	15	800§								
EIRE										
ETHIOPIA										
FIJI										
FINLAND										
FORMOSA	70									
FRANCE	¶		¶	130	10	14¶		¶	¶	4¶
FRENCH EQUATORIAL AFRICA		50						10	4	
FRENCH WEST AFRICA	700§							80§	12§	
GAMBIA	65§									
GERMANY				200		30				
GERMAN FEDERAL REPUBLIC			¶	100		10¶	¶	¶		
GOLD COAST								5		
GREECE		50								100
GUADELOUPE										
GUATEMALA										
GUIANA (BRITISH)										
GUIANA (DUTCH)										
HAITI										
HAWAII										
HONDURAS										
HONG KONG										
HUNGARY					200	10				
ICELAND										
INDIA	3,600	1,200¶		800		400§	200¶			
INDOCHINA										
INDONESIA	300		300				600§	30§	130§	
IRAQ										
ISRAEL										3
ITALY	7			11		12				200§

* Includes Ruanda-Urundi. §Principal Exporters ¶Principal Importers.

COUNTRY	PRINCIPAL OIL-SEEDS production per annum, thousand tons									
	GROUNDNUTS unshelled	COTTON SEED	SOYA BEANS	RAPESEED	SUNFLOWER	LINSEED	COPRA	PALM KERNELS commercial production	PALM OIL commercial production	OLIVE
1	23	24	25	26	27	28	29	30	31	32
JAMAICA										
JAPAN	12		350	120						
JORDAN										
KENYA										
KOREA		50	500							
KUWAIT										
LEBANON										7
LIBERIA										
LIBYA										8
MADAGASCAR										
MALAYA							100§	10§	50§	
MAURITIUS										
MEXICO	60	400				50				
MOROCCO					10	20				12
MOZAMBIQUE		50								
NEPAL										
NETHERLANDS				40		15¶	¶	¶	¶	
NEW CALEDONIA										
NEW GUINEA										
NEW ZEALAND										
NIGERIA	450§	30						380§	160	
NORWAY										
NYASALAND										
PAKISTAN		500§		300		10	¶			
PANAMA										
PARAGUAY	10	25								
PERSIA (IRAN)		60								
PERU										
PHILIPPINE ISLANDS							1,200§			
POLAND				100		70				
PORTUGAL										50
PUERTO RICO										
QATAR										
RHODESIA, NORTHERN										
RHODESIA, SOUTHERN										
ROUMANIA		10			300					
SAAR										
SALVADOR										
SAUDI ARABIA										
SIAM (THAILAND)	50		10							
SIERRA LEONE								70		
SPAIN	12	10								200§
SUDAN	20	130§								
SWAZILAND										
SWEDEN				150§		40				
SWITZERLAND										
SYRIA		65								7
TANGANYIKA	5	20								
TRINIDAD										
TUNISIA										50§
TURKEY	4	250			70§	30				40
UGANDA	150	125§								
UNION OF SOUTH AFRICA†	90				45					
UNITED KINGDOM	¶	¶	¶			20¶	¶	¶	¶	
UNITED STATES	900	4,000§	8,000§			1,000§	¶		¶	2¶
URUGUAY	6				90	100§				
U.S.S.R.		2,000	180¶		2,400	650				
VENEZUELA										
YUGOSLAVIA					100					3
BRITISH COMMONWEALTH	4,400	2,000	100	1,200	60	630	500	400	210	0
WORLD EXPORTS	900	200	500	—	25	400	2,000	750	500	100

† Includes South-West Africa.

COUNTRY	FIBRES production per annum: thousand tons					FUEL WOOD	WOOD FOR OTHER PURPOSES	RUBBER N = natural; S = synthetic.	IRON ORE	IRON ORE: Net imports (−), net exports (−)	STEEL
	COTTON	WOOL greasy basis	RAYON	SCUTCHED FLAX (F) and JUTE (J)	HEMP H = henequen; M = manilla; P = phormium; S = sisal T = true hemp.	million cubic metres, solid volume of roundwood		thousand tons, dry	million tons per annum		
1	33	34	35	36	37	38	39	40	41	42	43
WORLD	8,000	2,000	2,000	F850	900	750	750	N1,800	290		225
				J2,000				S900			
ALGERIA									2	2	
ANGOLA	6				S23§						
ARGENTINA	140	200§	8	J·1							
AUSTRALIA		520§		J·1		8	7	¶	2		2
AUSTRIA			40§			1	5§		2		1
BAHREIN											
BARBADOS											
BELGIAN CONGO*	50					5		N15§			
BELGIUM-LUXEMBURG	¶	¶	30	J 30¶	¶		2¶	¶	3	·8	8
BOLIVIA											
BORNEO					M2			N65§			
BRAZIL	500§	23	25	J20	S40§	90	10	N30§	1	1	1
BULGARIA	9				T6						
BURMA	8					1		N15§			
CAMEROONS (FRENCH)						4					
CANADA	¶	5¶	30			23	70§	S60¶	3	+1	3
CANARY ISLANDS											
CEYLON								N100§			
CHILE		22	3		T3				3	-2	
CHINA	700	30	3								
COLOMBIA			2								
COSTA RICA					M2						
CUBA			10		H20						
CYPRUS											
CZECHOSLOVAKIA			30	F14	T5	3	8	¶	1	·1	4
DENMARK						1	1				
DOMINICAN REPUBLIC											
ECUADOR											
EGYPT	400§		5	J·2							
EIRE		7									
ETHIOPIA						8	1				
FIJI											
FINLAND			10	F3		8	22§				
FORMOSA				J12							
FRANCE	¶	20¶	110	F38§¶	T5¶	13	12¶	¶	25	-7	11
FRENCH EQUATORIAL AFRICA	30						1				
FRENCH WEST AFRICA					S1						
GAMBIA											
GERMANY		10	250	F20	n.a.	11	28		n.a.	n.a.	17
GERMAN FEDERAL REPUBLIC	¶	7¶	180§	F4¶	T7¶	8	19	S1¶	9	+5	12
GOLD COAST						4	1				
GREECE	28		2			4					
GUADELOUPE											
GUATEMALA											
GUIANA (BRITISH)											
GUIANA (DUTCH)											
HAITI	2				S35§						
HAWAII											
HONDURAS						7					
HONG KONG											
HUNGARY			1	F2	T7						1
ICELAND											
INDIA	600¶	33	4¶	J830¶		15	13	N17	3		2
INDOCHINA								N50§			
INDONESIA					MS17	1	2	N800§			
IRAQ											
ISRAEL											
ITALY	6¶	17¶	125§	F4¶	T65§	6	9	¶			4

*Includes Ruanda-Urundi §Principal Exporters. ¶Principal Importers.

COUNTRY	FIBRES production per annum, thousand tons					FUEL WOOD	WOOD FOR OTHER PURPOSES	RUBBER N = natural; S = synthetic.	IRON ORE	IRON ORE: Net imports (+), net exports (−)	STEEL
	COTTON	WOOL greasy basis	RAYON	SCUTCHED FLAX (F) and JUTE (J)	HEMP H = henequen; M = manilla; P = phormium; S = sisal T = true hemp.	million cubic metres, solid volume of roundwood		thousand tons, dry	million tons per annum		
1	33	34	35	36	37	38	39	40	41	42	43
JAMAICA											
JAPAN	¶	¶	185	F4¶	T6¶	13	30	¶	1	+1	8
JORDAN											
KENYA	3				S40§						
KOREA	25				T15	1					
KUWAIT											
LEBANON											
LIBERIA								N32§			
LIBYA											
MADAGASCAR						3					
MALAYA							2	[N680§]			
MAURITIUS					2						
MEXICO	290§		12		H90§						
MOROCCO		15				1			1	1	
MOZAMBIQUE	30				S17						
NEPAL				J9							
NETHERLANDS			35	F20§	¶		¶			+1	
NEW CALEDONIA											
NEW GUINEA											
NEW ZEALAND		190§		F1	P4	1	3				
NIGERIA	20						1	N20§			
NORWAY			16				7				
NYASALAND	2					6					
PAKISTAN	200§	12		J1,100§		1					
PANAMA											
PARAGUAY	13										
PERSIA (IRAN)	30										
PERU	100§		1								
PHILIPPINE ISLANDS					M130§		3				
POLAND			35	F50	T6	3	8		1	+1	4
PORTUGAL			2								
PUERTO RICO						2					
QATAR											
RHODESIA, NORTHERN						1					
RHODESIA, SOUTHERN	2					3					
ROUMANIA	8		2	F6	T30						
SAAR											3
SALVADOR					H3						
SAUDI ARABIA											
SIAM (THAILAND)							2	N110§			
SIERRA LEONE						3			1	−1	
SPAIN	10	40	28		T5	6	2		2	−1	1
SUDAN	75§										
SWAZILAND											
SWEDEN			18	F3	T4	9	25§	¶	13	−12	2
SWITZERLAND			20			2	2				
SYRIA	60				T3‡						
TANGANYIKA	12				S140§	20					
TRINIDAD											
TUNISIA									1	−1	
TURKEY	170§	35	1		T10	5	1				
UGANDA	70§					10					
UNION OF SOUTH AFRICA†	6	120§						¶	1		1
UNITED KINGDOM	¶	45¶	185§	F11¶	¶	1	3¶	¶	13	+8	19
UNITED STATES	3,300§	120¶	640§	F1¶	T1¶	55	220¶	S800¶	100	+6	94
URUGUAY		85§									
U.S.S.R.	1,050	215¶	45	F650	T135	600		¶	44		40
VENEZUELA											
YUGOSLAVIA		17		F10	T20	10	18		1		
BRITISH COMMONWEALTH	1,000	950	220	F13 J1,940	180	102	93	950	23		22
WORLD EXPORTS	3,000	1,000	275	J1,800	550		100	N1,600			

† Includes South-West Africa. ‡ Includes Lebanon.

COUNTRY	NON-FERROUS METALS									ASBESTOS
	Production per annum: thousand tons metal content, bauxite excepted.								GOLD	
	COPPER	ZINC	LEAD	MANGANESE	BAUXITE	ALUMINIUM	CHROME	TIN (T) and NICKEL (N)	thousand fine Troy ounces	thous. tons
1	44	45	46	47	48	49	50	51	52	53
WORLD	2,500	2,400	1.600	2,500	15.000	1,800	2 500	T170 N140	25,000	1,500
ALGERIA		10	3							
ANGOLA	1		9	25§						
ARGENTINA		15	20	1						
AUSTRALIA	16	200§	215§	4	5		1	T2	870	4
AUSTRIA	3	5	5		5¶	35				
BAHREIN										
BARBADOS										
BELGIAN CONGO*	200§	95§		50§				T14	330	
BELGIUM-LUXEMBURG	¶		¶	¶				¶		
BOLIVIA	5	30	30§					T32		
BORNEO										
BRAZIL				80§	15		2			
BULGARIA							5			
BURMA								T2		
CAMEROONS (FRENCH)									10	
CANADA	235§	340§	150		¶	400		N110	4,400	850
CANARY ISLANDS										
CEYLON										
CHILE	400§		4	20§						
CHINA				15		5		T4		
COLOMBIA										
COSTA RICA										
CUBA	18			60§			25			
CYPRUS	20						6			15
CZECHOSLOVAKIA			2							
DENMARK										
DOMINICAN REPUBLIC										
ECUADOR										
EGYPT				50§						7
EIRE										
ETHIOPIA										
FIJI									100	
FINLAND	20	9							7	5
FORMOSA										
FRANCE	1¶	13¶	11¶	¶	1,100§	120‡			55	6
FRENCH EQUATORIAL AFRICA			2							
FRENCH WEST AFRICA					10					
GAMBIA										
GERMANY	30	200	100		25					
GERMAN FEDERAL REPUBLIC	2¶	80	50¶	¶	¶	120‡				
GOLD COAST				400§	120				690	
GREECE		8	5		200		12			
GUADELOUPE										
GUATEMALA										
GUIANA (BRITISH)					2,000§				20	
GUIANA (DUTCH)					2,500§					
HAITI										
HAWAII										
HONDURAS										
HONG KONG										
HUNGARY				20	600§	8			20	
ICELAND										
INDIA	9		1	600§	50	4	9		190	
INDOCHINA				4§						
INDONESIA				4§	500§			T32		
IRAQ										
ISRAEL										
ITALY		100	39¶	10	200¶	50			12	24

* Includes Ruanda-Urundi.
‡ Includes recovered metal.
§ Principal Exporters.
¶ Principal Importers.

COUNTRY	NON-FERROUS METALS									ASBESTOS
	Production per annum: thousand tons metal content, bauxite excepted.								GOLD	
	COPPER	ZINC	LEAD	MANGANESE	BAUXITE	ALUMINIUM	CHROME	TIN (T) and NICKEL (N)	thousand fine Troy ounces	thou. tons
1	44	45	46	47	48	49	50	51	52	53
JAMAICA										
JAPAN	45	80	15	70	¶	45‡	16			5
JORDAN										
KENYA										
KOREA			10	20		5			23	
KUWAIT										
LEBANON										
LIBERIA										
LIBYA										
MADAGASCAR										
MALAYA								T55	18	
MAURITIUS										
MEXICO	60	200§	250§	40§						
MOROCCO		20	75§	170§						
MOZAMBIQUE					2					
NEPAL										
NETHERLANDS								¶		
NEW CALEDONIA				28			50	N5		
NEW GUINEA									90	
NEW ZEALAND									80	
NIGERIA		15						T8	3	
NORWAY	15	6			¶	50				
NYASALAND										
PAKISTAN							9			
PANAMA										
PARAGUAY										
PERSIA (IRAN)			2							
PERU	30	100§	80§							
PHILIPPINE ISLANDS	12			9§			150			
POLAND		85	17							
PORTUGAL	3		1	4					15	
PUERTO RICO										
QATAR										
RHODESIA, NORTHERN	320§		15	1					1	
RHODESIA, SOUTHERN							240		520	75
ROUMANIA			3	20					71	
SAAR										
SALVADOR										
SAUDI ARABIA										
SIAM (THAILAND)										
SIERRA LEONE							10		3	
SPAIN	7	80§	40	12§	12	2				
SUDAN									3	
SWAZILAND									2	30
SWEDEN	15	36	23	3		8‡			80	
SWITZERLAND					¶	21				
SYRIA										
TANGANYIKA									65	
TRINIDAD										
TUNISIA		3	20§							
TURKEY	20			30			350			
UGANDA									1	
UNION OF SOUTH AFRICA†	45	15	50	330§			250	N1	11,700	120
UNITED KINGDOM	¶	¶	4¶	¶	¶	110‡		T1¶		
UNITED STATES	835¶	600	370	60¶	1,700§	1,000‡	3	N1¶	1,800	48
URUGUAY										
U.S.S.R.	220	210	240	1,200	500§	190	400	N25	3,000	150
VENEZUELA										
YUGOSLAVIA	40	45	80§		400	2	30			2
BRITISH COMMONWEALTH	600	510	400	800	1,800	350	500	T70 N110	18,000	1,000

† Includes South-West Africa.

COUNTRY	COAL and lignite	COAL: Net imports (+), net exports (−)	CRUDE PETROLEUM	CRUDE PETROLEUM: Net imports (+), net exports (−)	DEVELOPED WATER POWER capacity of water wheels in million kilowatts.	ENERGY CONSUMPTION tons per head: coal equivalent.	MANUFACTURES gross value, million U.S. $.	MERCHANT SHIPPING million tons.	VALUE OF IMPORTS c.i.f.	VALUE OF EXPORTS f.o.b.
	million tons per annum								million U.S. $	
1	54	55	56	57	58	59	60	61	62	63
WORLD	1,700		690		70	1.43		100	80,000	75,000
ALGERIA						0 18	n.a.		600	400
ANGOLA						n.a.			90	95
ARGENTINA		+1	4	+2		0 87	3,400	1 0	1,500	1,500
AUSTRALIA	26					3 21	5,700	0 6	2,000	1,900
AUSTRIA	5	+5	3			n.a.	n.a.		650	500
BAHREIN			2	−2		n.a.			n.a.	n.a.
BARBADOS									n.a.	n.a.
BELGIAN CONGO*						0 09	n.a.		400	390
BELGIUM-LUXEMBURG	10	−1		+2		4 16	n.a.	0 5	2,500	2,500
BOLIVIA						n.a.	25		90	140
BORNEO			4	−4		n.a.			50	100
BRAZIL	2				2	0 24	4,000	0 8	2,000	1,500
BULGARIA	4					n.a.	n.a.		90	90
BURMA						0 02			160	200
CAMEROONS (FRENCH)						n.a.			100	65
CANADA	19	+24	9		9	6 96	10,500	1 7	4,200	4,400
CANARY ISLANDS									n.a.	n.a.
CEYLON						n.a.	n.a.		350	350
CHILE	2					0 92	1,800	0 2	370	450
CHINA	31					n.a.	n.a.	0 6	600	600
COLOMBIA			6	5		0 29	300		410	460
COSTA RICA						0 23	50		68	73
CUBA						n.a.	n.a.		630	700
CYPRUS						n.a.	n.a.		55	55
CZECHOSLOVAKIA	49	+2				n.a.	4,200		800	800
DENMARK	1	+4				2 08	1,700	1 6	1,000	850
DOMINICAN REPUBLIC						n.a.	160		60	110
ECUADOR						n.a.	30		56	70
EGYPT			2			n.a.	n.a.	0 1	600	550
EIRE		+2				n.a.	750		500	300
ETHIOPIA						n.a.			45	45
FIJI						n.a.			24	16
FINLAND		+1			1	n.a.	2,500	0 6	800	800
FORMOSA									n.a.	n.a.
FRANCE	55	+12		+14	5	2 34	n.a.	3 9	4,500	4,000
FRENCH EQUATORIAL AFRICA						n.a.			110	60
FRENCH WEST AFRICA						n.a.	n.a.		350	230
GAMBIA						n.a.			10	10
GERMANY	329	−15		n.a.		n.a.	n.a.	2 7	n.a.	n.a.
GERMAN FEDERAL REPUBLIC	204	−22	2	+2	3	2 78	n.a.		4,000	4,000
GOLD COAST						n.a.	n.a.		190	210
GREECE						n a.	n.a.	1 3	350	120
GUADELOUPE						n.a.			35	28
GUATEMALA						n.a.	42		80	80
GUIANA (BRITISH)						n.a.			40	36
GUIANA (DUTCH)									n.a.	n.a.
HAITI						0 02			52	52
HAWAII									n.a	n.a.
HONDURAS						n.a.		0 5	55	35
HONG KONG						n.a.	n.a.	0 2	700	600
HUNGARY	7					n.a.	n.a.		200	200
ICELAND						2 37	50	0 1	55	45
INDIA	35				1	0 10	2,500	0 6	1,700	1,400
INDOCHINA	1					n.a.			450	150
INDONESIA	1		9			0 06	n.a.		900	1,000
IRAQ			27	−25		n.a.	n.a.		170	80
ISRAEL						n.a.	520	0 1	300	50
ITALY	2	+8		+5		0 81	n.a.	3 9	2,200	1,500

COUNTRY	COAL and lignite	COAL: Net imports (+), net exports (−).	CRUDE PETROLEUM	CRUDE PETROLEUM: Net imports (+), net exports (−).	DEVELOPED WATER POWER capacity of water wheels in million kilowatts.	ENERGY CONSUMPTION tons per head: coal equivalent.	MANUFACTURES gross value, million U.S. $.	MERCHANT SHIPPING million tons.	VALUE OF IMPORTS c.i.f.	VALUE OF EXPORTS f.o.b.
	million tons per annum								million U.S. $	
1	54	55	56	57	58	59	60	61	62	63
JAMAICA						n.a.	n.a.		90	50
JAPAN	40			+4	8	0 87	11,000	3 7	2,000	1,500
JORDAN						n a.			40	15
KENYA						n.a.			230*	220*
KOREA	1					n.a.	n.a.		200	30
KUWAIT			41	- 40		n.a.			n.a.	n.a.
LEBANON						n.a.			140	50
LIBERIA						n.a.		4 0	10	15
LIBYA						n.a.			22	8
MADAGASCAR						n.a.			135	95
MALAYA						0 47			1,250	1,250
MAURITIUS						n.a.			48	50
MEXICO	1		11	n.a.		0 66	650	0 2	740	580
MOROCCO						n.a.	n.a.		500	300
MOZAMBIQUE						n.a.			75	50
NEPAL						n a	n.a.		n.a.	r.a.
NETHERLANDS	12	+ 4	1	+ 5		2 06	4,700	3 7	2,300	2,100
NEW CALEDONIA						n.a.			20	18
NEW GUINEA						n.a.			18	12
NEW ZEALAND	3				1	2 34	1,100	0 2	650	650
NIGERIA	2					n.a.	n.a.		320	320
NORWAY		+ 1			3	4 59	1,700	7 2	850	600
NYASALAND						n.a.			25	18
PAKISTAN	1	+ 1				n.a.	n.a.	0 1	600	650
PANAMA						n.a.	n.a.	4 0	70	12
PARAGUAY						n.a.			33	31
PERSIA (IRAN)			30	−30		n.a.			200	300
PERU			2			n.a.	100	0 1	280	240
PHILIPPINE ISLANDS						0 10	350	0 1	450	350
POLAND	87	− 31				n.a.	n.a.	0 3	550	550
PORTUGAL		+ 1				n.a.	n.a.	0 5	330	260
PUERTO RICO						n.a.	250		n.a.	n.a.
QATAR			4	- 4		n.a.			n.a.	n.a.
RHODESIA, NORTHERN						n.a.			120	230
RHODESIA, SOUTHERN	2					n.a.	140		250	155
ROUMANIA	3		4			n.a.	n.a.		200	200
SAAR	16	− 7				8 16	n.a.		n.a.	n.a.
SALVADOR						n.a.			66	86
SAUDI ARABIA			40	- 40		n a.			n.a.	n.a.
SIAM (THAILAND)						0 02			120	110
SIERRA LEONE						n.a.			30	30
SPAIN	12					n.a.	n.a.	1 4	450	450
SUDAN						n.a.			150	130
SWAZILAND										
SWEDEN		+ 5		+ 1	3	3 52	6,000	2 8	1,700	1,600
SWITZERLAND		+ 2			3	2 51	n.a.	0 1	1,250	1,100
SYRIA						n.a.			140	145
TANGANYIKA						n.a.			105	130
TRINIDAD			3	+ 2		n.a.	n.a.		140	135
TUNISIA						n.a.			185	115
TURKEY	4					n.a.	800	0 5	550	400
UGANDA						n.a.			†	†
UNION OF SOUTH AFRICA‡	24	− 2		+ 2	4	1 95	1,900	0 4	1,200	1,000
UNITED KINGDOM	226	− 10		+ 17	1	4 65	36,000	19 4	9,500	7,300
UNITED STATES	523	- 26	316	+ 20	20	8 02	240,000	26 4	11,000	15,000
URUGUAY						n.a.	600	0 1	250	220
U.S.S.R.	300		52		n.a.	n.a.	n.a.	2 5	n.a.	n.a.
VENEZUELA			92	− 85		0 85	n.a.	0 2	750	1,500
YUGOSLAVIA	12					0 40	2,000	0·3	n.a.	n.a.
BRITISH COMMONWEALTH	300		31		16			23 2		
WORLD EXPORTS			380						80,000	80,000

*Includes Uganda. †Included in Kenya. ‡Includes South-West Africa.

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