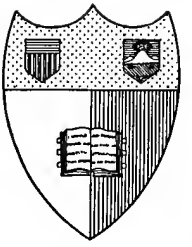
THE OXFORD SURVEY OF THE BRITISH EMPIRE

AUSTRALASIA



THE OXFORD SURVEY OF THE BRITISH EMPIRE

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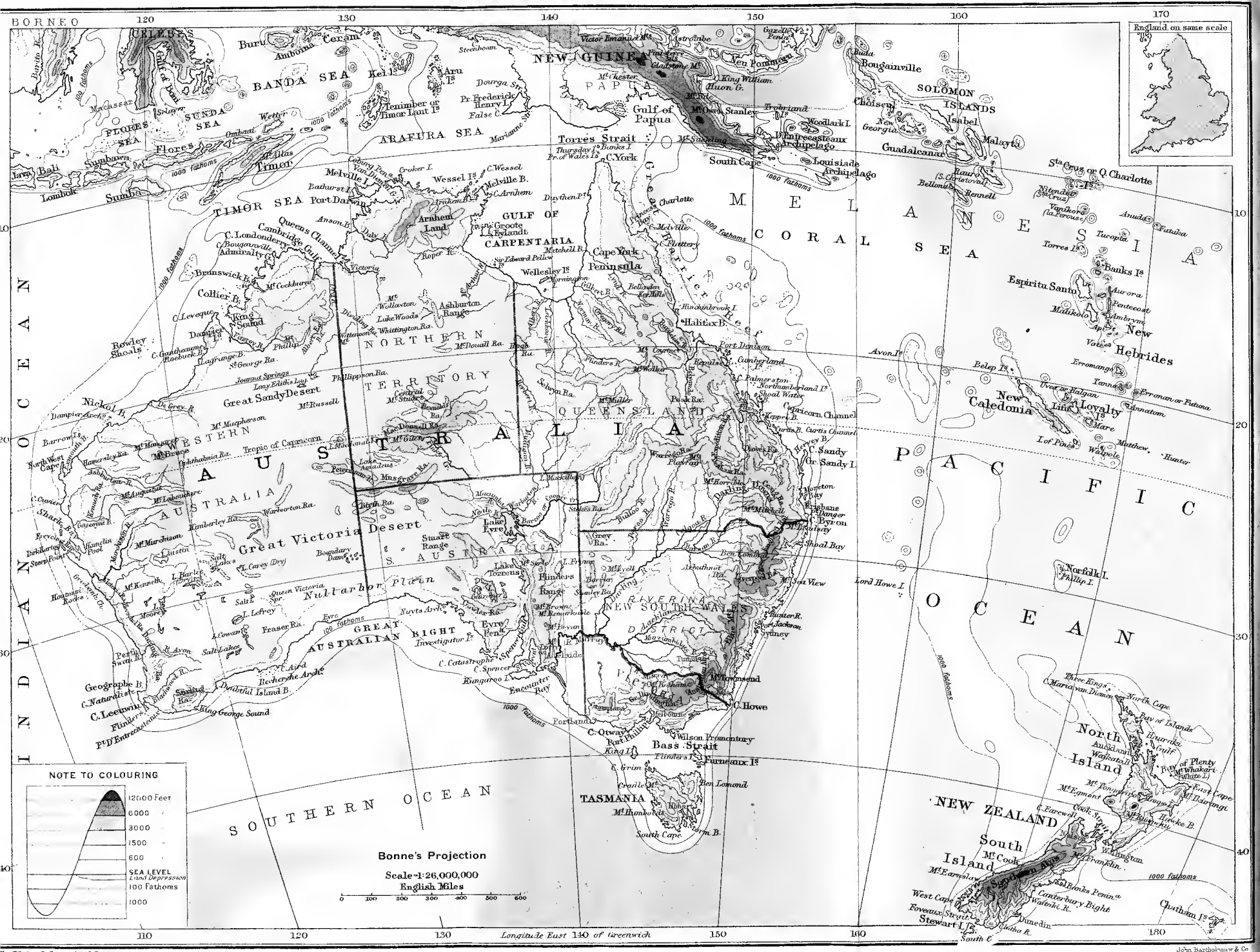

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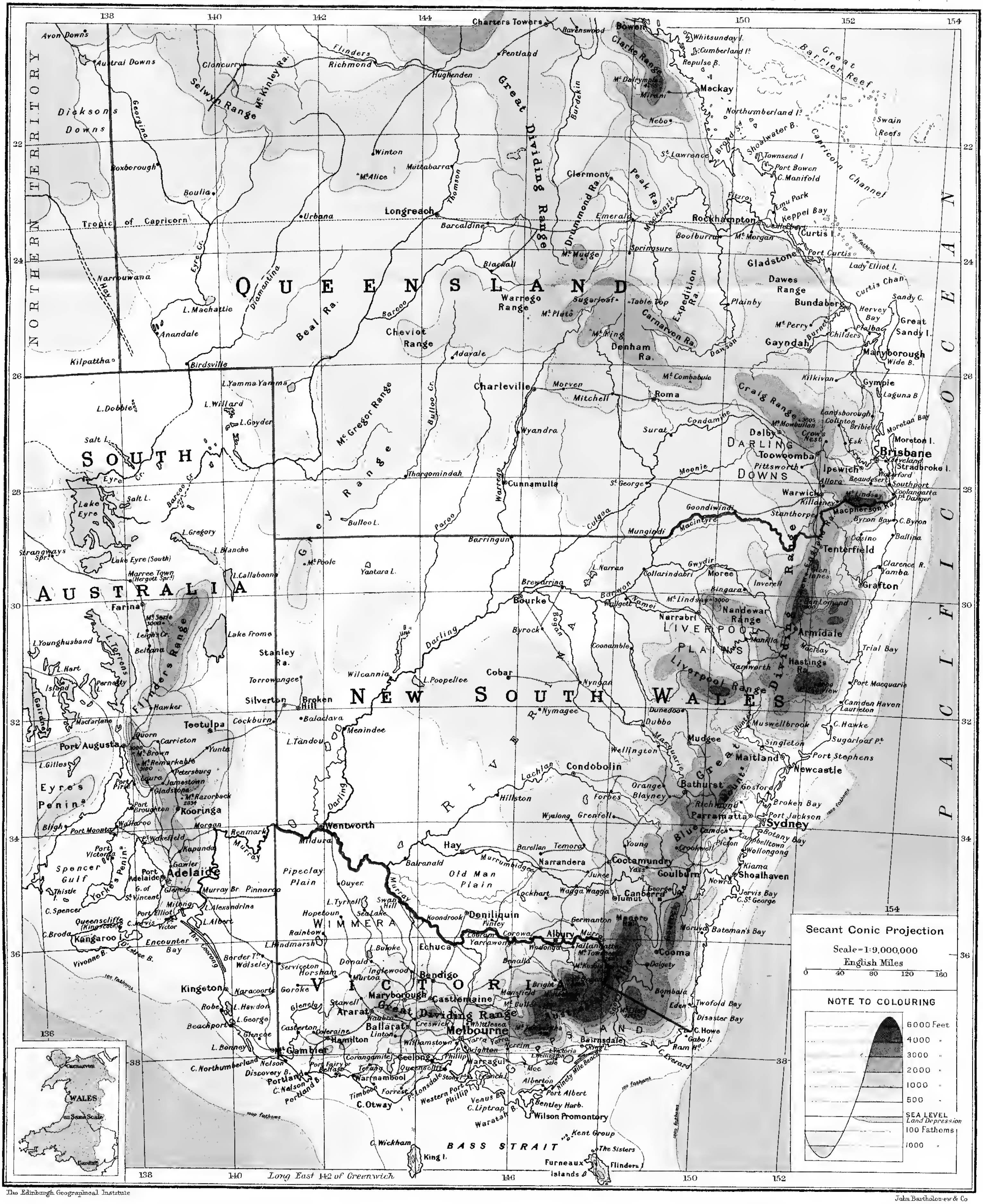

The Edinburgh Geographical Institute

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THE OXFORD SURVEY OF
THE BRITISH EMPIRE

AUSTRALASIA

INCLUDING AUSTRALIA, NEW ZEALAND, THE WESTERN PACIFIC & THE BRITISH SECTOR IN ANTARCTICA

With 40 Photographs, 3 Coloured Maps, and 70 Figures in text

Edited by

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PREFACE

THE object of this series is to furnish a survey of the British Empire and its constituent parts in their geographical and allied aspects, together with their economic, administrative, and social conditions, at the present time. History has not been included as an integral part of the scheme, except for the inclusion of a general historical summary in the General Volume; for the rest, historical references have been included only in so far as they were found desirable for the explanation of existing conditions. The history of the Empire has been brought under review elsewhere, notably in the Oxford *Historical Geography*, edited by Sir Charles Lucas.

The series is in six volumes, and the subject-matter is thus distributed:

I. The British Isles and Mediterranean territories (Gibraltar, Malta, Cyprus).
II. Asiatic territories.
III. African territories (with adjacent islands, Mauritius, &c., St. Helena, Ascension, and Tristan da Cunha).
IV. American territories (with the Falkland Islands and dependencies).
V. Australasian territories (including islands in the Pacific Ocean and the British sector in Antarctica).
VI. General.

The Editors have been in close consultation throughout as to the general plan and details of the work. They have shared between them the arrangements with the contributors, for whose collaboration they express their thanks. Professor Herbertson has undertaken the major part of the work connected with the maps; Mr. Howarth has carried out the greater part of the editorial work in its later stages, has dealt with the illustrations (in the five topographical volumes), and has seen the volumes through the press.

It is desired to acknowledge Mrs. Howarth's collaboration in the work of indexing, and Mr. O. Brilliant's assistance in the compilation of the gazetteer references in the topographical volumes.

Notes in the text enclosed in square brackets are editorial.

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NEW ZEALAND

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Australia.

New Zealand.

Western Pacific and Antarctica.

The names of the authorities or individuals who have supplied photographs are stated on each plate. The Editors desire to express their thanks, for the loan of photographs, to the High Commissioners for the Commonwealth of Australia and for the Dominion of New Zealand, to Professor J. W. Gregory, Mr. Basil Thomson, Sir Everard F. im Thurn and Mr. Geoffrey Smith, and to Mr. Griffith Taylor and Commander Evans of the British Antarctic Expedition, 1910. They have also to thank Sir Charles Lucas for valuable advice.

COLOURED MAPS

MAPS AND DIAGRAMS IN TEXT

Australia.

Methods of cultivation.

One of the main factors in the profitable cultivation of wheat from land yielding such a small average crop, especially in a country where wages are high, is economy in putting in and taking off the crop. In the big wheat areas in every state it is usual to plough the land with multifurrow ploughs, to drill in the seed (of which less than half the amount usual in England is sown to each acre) with a machine which distributes artificial fertilizers at the same time, and to gather the wheat by means of a 'stripper' or 'combined harvester'. The last is a wonderful labour-saving machine, horse-driven and tended by one man. It passes through the crop tearing off the heads of the wheat and throwing them into a revolving drum, where they are thrashed and winnowed, and whence the wheat is automatically delivered into bags, which only remain to be lifted from the harvester, sewn up, and carted to the railway station or market town.

Other crops.

Hay, the second crop of the Commonwealth, is made of wheat or oats, cut usually before it is perfectly ripe, and used for feeding horses or cattle. The other crops of Australia occupy an inconsiderable area compared with that given to them in many other countries. In 1910–11, 617,000 acres were devoted to oats, 340,100 acres to maize, 375,000 acres to green fodder plants, 183,000 acres to orchards, 150,000 acres to potatoes, and 101,000 acres to sugar cane. Barley, rye, flax, and various root crops are grown in small quantities. More than half the oats grown are at present cultivated in Victoria. New South Wales produces more than half the maize, and Queensland three-quarters of the remainder.

Fruit.

Everywhere the planting of orchards is making great progress. Tasmanian apples have long been known in European markets, and they are now exported in increasing quantities from all the states of the Commonwealth, particularly from Victoria, South Australia, and the south-western portion of Western Australia. New South Wales is ahead of the other states in the cultivation of citrous fruits, while currants, raisins, and apricots for drying are grown chiefly in the irrigation settlements of

Victoria and South Australia, on the Murray River. Queensland exports pine-apples and bananas to the Southern States.

Tropical products.

Sugar-cane, the most important tropical product, in 1910–11 covered 142,000 acres in Queensland, and 14,000 acres in northern New South Wales. Sugar-growing appears to have begun in Queensland in 1862, when a crop of 20 acres figures in the statistical returns, and next year 2 acres were grown in New South Wales, where the area reached in 1895–6 a maximum of nearly 33,000 acres. In the mother state sugar is a declining crop, largely because the rich land of the northern rivers where it is grown are now giving very high returns for dairying, but in Queensland, in spite of occasional reverses, there is on the whole a steady increase in the area under cane. For many years before the establishment of the Commonwealth the labour used for sugar-growing was chiefly that of 'Kanakas', specially recruited from the Pacific Islands. The Commonwealth Parliament, however, put a stop to recruiting and ordered the gradual repatriation of the islanders. This it was declared by many would be a death-blow to the industry, but the fear has proved groundless. The crop of 1910–11 amounted to 1,682,000 tons of cane, yielding 226,000 tons of sugar, and of this more than 209,000 tons were produced by white and less than 9,000 tons by black labour. The Commonwealth levies an excise duty of £4 per ton on manufactured sugar, and pays a bonus of 6*s*. per ton on cane grown by white labour and yielding 10 per cent. of sugar, on condition that the rates of wages and conditions of labour are fair and reasonable, in accordance with provisions of the Act.

Wine.

At a very early period in Australian history it was thought that the country would be suitable for vine-growing, and vines were first introduced into New South Wales in the eighteenth century. Since 1880 the mother state has made comparatively little progress, but a considerable amount of wine is made in South Australia and Victoria, while Western Australia is also attracting the attention of vine-growers, and taking advantage of its

AUSTRALIA

CHAPTER I

INTRODUCTORY SURVEY AND GOVERNMENT

By the Right Hon. Sir G. H. Reid

British settlement.

The following sentence is quoted from an article in an Australian paper: 'There is room for over fifty million energetic white settlers.' The word 'white' was not italicized and yet it appears more than aptly to describe the situation. Australia is pre-eminently a country for the white man and its people hope that it may ever remain so. The Commonwealth, set in the distant Pacific, has had no internal disturbances to threaten the peace of its citizens, no racial clamour has intruded, no wars have marred its splendid progress. Australia to-day is as truly British as Britain itself. Of its total population, over 96 per cent. are of British descent, and these settlers[1] are pursuing their avocations in a climate which comparative death-rates show to be—with New Zealand—the healthiest in the world.

It is not a function of this chapter to deal with the early discovery of Australia, or to narrate episodes of the times when transportation was in force. A fault of many elementary text-books is that they dwell at such length on these early episodes that the mind fails to grasp the idea of a modern Australia, with its great cities, its immense resources, its boundless opportunities. Until recently this serious fault was general. The progress of immigration has led to a better understanding of the Commonwealth.

Immigration.

Since 1905 immigration records have been very favourable. From 1861 down to 1905 the facts roughly

[1] The distribution of the population is dealt with in detail in Chapter VIII.

summarized are as follows: The average net immigration from 1861 to 1891 was 24,714 a year. The average from 1891 to 1900 was 2,487 a year. From 1901 to 1905—that is, for the five years immediately preceding the adoption of the present policy of assisted emigration—there was actually a loss by emigration of 3,358 a year. The figures for the succeeding six years (1906–11) showed a net gain of 172,712 or a yearly average of 28,785. Adding the net gain for six months of 1912—viz. 43,785—the total gain for the six and a half years of the assisted policy was 216,497 or a yearly average of 33,307. The present rate of increase is nearly three times greater. The recent figures may be viewed with satisfaction not so much for the actual increase they suggest, as for the growing volume they reveal.

Australians have resolved that their country shall be 'white'. They realize that one of the most effective methods of keeping it so is to encourage their kinsmen from overseas to join them. So strong is the feeling to preserve the racial type that a suggestion was made in 1912 that only the people of the United Kingdom should be assisted to the Commonwealth. Such a restriction has not been, and the writer hopes it never will be, adopted, but the directing of British emigrants to British dominions has been a pleasing development in recent years which has already kept many thousands within the Empire who otherwise would have gone to foreign countries.

Defence. In the twentieth century Australia has realized that great privileges involve great responsibilities and that to maintain Australian ideals two things are essential. The first, a great population, is being slowly secured by some practical encouragement: the second, a capacity for self-defence, is being developed by the adoption of a military service scheme and the establishment of a local fleet unit. Militarism can never prevail in Australia; but the obligation that every man owes to his country is insisted upon. The scheme for compulsory training was passed amid general approval, and although, from partisan or conscientious motives, there have been

objectors, yet the new movement has been safely launched with less opposition than attended the introduction of compulsory education. A local fleet unit was established in 1912, and it may be added that in the same year a population numbering not much above 4,500,000 was cheerfully assenting to estimates providing for an expenditure during the year of nearly £5,000,000 on defence alone. The tangible preparations for defence are indications of Australian loyalty towards the King and the mother country, as well as a result of the increasing danger arising from the rapid growth of foreign fleets. The frequent visits of Australian public men to the heart of the Empire gave them an opportunity of getting in touch with the leaders at Westminster and a friendly interchange of views often dissipated erroneous or provincial ideas. Then, too, the Commonwealth and its component states have been fortunate in the selection of governors-general and governors who have done much to foster imperial ideas.[1]

City development.

In discussing the modern Australia one is forced to the conclusion that in the latter half of the nineteenth century and the beginning of the twentieth the capital cities increased out of all fair proportion to the population of the interior. This tendency is being checked to some extent by preferring emigrants possessing farming experience. The resumption and subdivision of large estates by the different state governments and the new land tax of the Federal Parliament are intended to work in the same direction.

The leading cities in Australia already attract the admiration of travellers. The stately edifices and fine streets do not merely attest the commercial wealth of their inhabitants, for the public buildings and institutions and pleasure reserves compare very favourably with the cities of the Old World. Art galleries and museums, lecture halls and theatres, universities and conservatoria, give evidence of widespread culture as well as rapid progress. In the sphere of art and that of music Australians

[1] Australian defence is dealt with in detail in Chapter XV.

have already taken a prominent place. From the literary point of view results have not yet been so striking, so far as the world of books is concerned, but the remarkably high level of excellence to which the leading journals have attained suggests no lack of promise for the future, when the reading public is of larger number.

Australia can lay claim to favourable consideration as a country to live in, as well as a place to visit. In the walks of industry and enterprise many fortunes have been made, but the chief glory of Australian development is that the general prosperity is more fairly and evenly diffused than, perhaps, in any other civilized community.

Amenities of residence in Australia.

In sport, representatives of the Commonwealth have always taken a foremost part and have won distinction in practically every branch of athletics. There is in Australia abundant scope for the field sportsmen. Good shooting is obtainable, ranging from the buffalo in the Northern Territory to the black duck in the Victorian lakes and swamps, whilst the trout-fisher may whip the streams of the Snowy River in New South Wales or perchance cross to Tasmania and obtain splendid baskets from the Blue Lake. Ski-ing and tobogganing are annual recreations at Mount Kosciusko.

It follows, too, that a great pastoral country should produce many lovers of horses, cattle, and sheep. The chief race meetings, no less than the 'Royal' Agricultural Shows, attract enormous crowds, and there is no rural district without its races and its annual shows.

The people are orderly in the extreme: there are few, if any, appearances at the police courts as the sequel of such outings. The Australian of to-day enjoys his leisure to the full, but he works hard for it, and can enjoy relaxation conscious that he has earned it. The prosperity of the Commonwealth is due to the fact that the standard of humanity is high alike in competence and industry.

Education.

The all-important question of education [1] has not been neglected. Primary education is compulsory, secular, and free, while the promising student is encouraged by

[1] Further details will be found in Chapter VIII.

bursaries and scholarships to enable him to go through school and university free of charge. There are, in each state, fine public schools of the English type, which have produced citizens who are to-day the leaders of Australian thought. The recent establishment of universities in Queensland and Western Australia has completed the academic chain, and now every state has its own seat of learning. Sydney ranks, alike in age and importance, as the ' first colonial university of the Empire '. Founded mainly through the efforts of William Charles Wentworth in 1852, it has developed from a small body consisting of a meagre teaching staff and a handful of students, to a renowned institution granting degrees that carry the label of sound and earnest scholarship. The writer has always taken a very great interest in this university, and recalls with satisfaction that, while Minister of Public Instruction in 1883, he introduced the system of evening lectures, which enable those who have to work during the day to obtain university instruction and degrees in spite of that obstacle. A system of state technical education which he established in New South Wales during the same year has also been successful.

Physical Survey [1]

Relief of the land.

Great mountains, great lakes, great rivers, marked physical features of any kind are singularly wanting in Australia, which for the greater part of its area of 3,000,000 square miles consists of an immense tableland averaging 2,000 feet in height in the east, 1,000 feet in the west, and in the north a little more. Along the eastern coast from north to south is a narrow belt of well-watered coastal plain, seldom more than 60 to 70 miles wide, sometimes much less, and averaging in width from 40 to 50 miles. Inland from this coastal belt is a highland, the Great Dividing Range, which runs from the north of Queensland to the south of New South Wales and sweeps westward through Victoria. This highland with its many lateral

[1] For details of physical geography and geology, see Chapters II and VI; for climate, Chapter III.

spurs slopes gradually to the westward plain, which, north of Spencer Gulf in South Australia, is in some places below sea-level. There is an imperceptible rise in the land to the western tableland of Western Australia, beyond which, bordering the Indian Ocean, is another strip of coastal plain. The highlands of South Australia where the Flinders Range runs north and south from Cape Jervis into the salt lake area, are quite disconnected from the eastern highlands, the axis of which is traced across Bass Strait into Tasmania, and across Torres Strait into New Guinea. The Eastern Highlands, which extend much further from the sea in Queensland than in New South Wales, are never distant more than 250 miles, and in the latter state approach in places within 27 miles of the coast.

The Eastern Highlands nowhere reach the level of perpetual snow, and the rivers which they feed are consequently limited in regularity and volume. In Queensland the highest point is Mount Bartlefrere, 5,440 feet; in New South Wales, Mount Kosciusko, the highest mountain of Australia, situated near the borders of Victoria, rises to 7,300 feet; and in Victoria, Mount Bogong, to 6,510 feet. In Tasmania, Cradle Mountain has a height of 5,070 feet, and there are numerous other peaks rising to nearly the same level. In South Australia the highest mountains are Mount Remarkable and Mount Brown, both 3,000 feet. In the Stirling Range, Western Australia, Bluff Knoll rises to 3,640 feet, Mount Bruce in the Hammersley Range to 3,800 feet. In the centre of Australia, the Macdonnell Range runs east and west across the track proposed for the north to south Transcontinental Railway. Though it is not of great height, it has precipitous cliffs and deep gorges, and is the source of several streams. The lower slopes of the highlands of the eastern states and Tasmania are heavily forested with valuable timbers, principally of the eucalyptus family.

Rivers. While none of the rivers of Australia can compare in magnitude with such streams as the Nile, the Mississippi, and the Amazon, some of them are nevertheless much

larger than is commonly supposed. The greatest of the river systems is that of the Murray-Darling, which rivers, together with their tributaries, drain an area of 520,000 square miles. The Murray has its source in the Australian Alps in the south-west corner of New South Wales; the Darling rises in the Dividing Range in southern Queensland, and joins the Murray near the borders of Victoria and New South Wales. Together these rivers have a length of 3,282 miles, and in their natural state without any locks they are navigable at certain seasons of the year for 2,546 miles. It is characteristic of the Murray, the Darling, and the important tributaries of the former, such as the Murrumbidgee, the Lachlan, and the Goulburn, to vary greatly in the volume and flow according to the nature of the season and the time of year. After heavy floods, as in 1890, the Darling may be a sheet of water 100 miles wide, moving south across the great western plains of New South Wales; after months of drought, as in 1902–3, it may be in its upper reaches but a slender trickle between high red banks. The Murray, while it does not change so much and is fed, as the Darling is not, from the snows melting upon the Australian Alps in early summer, is nevertheless subject to great variations, and storage reservoirs upon it and upon its tributaries are necessary to provide all the water needed for irrigating two or three hundred thousand acres in the summer months.

Of a different type are the numerous rivers running eastward to the sea in Queensland and New South Wales. They likewise are liable to flood, but are strong streams even in the time of greatest drought. The nearness to the sea of the mountains where they take their rise denies them the possibility of great length, the largest in New South Wales being the Hawkesbury, 330 miles long and draining an area of nearly 9,000 square miles.

As a rule there are sandy bars at the mouths of these rivers, but nevertheless several of them are navigable by steamers of light draught for 50 miles and more.

The Fitzroy river in Queensland, which flows into the

Pacific Ocean, is a large river with a drainage area of 55,000 miles, and other important navigable streams flow northward into the Gulf of Carpentaria. In Queensland numerous rivers, some of them hundreds of miles in length, flow inland from the coastal ranges, and have great volume after heavy rain, but shrink away in dry weather and eventually lose themselves in the plains. The rivers of this type constantly misled the explorers, who formed exceedingly different judgements of them, according to the season in which they saw them.

A number of large and true permanent rivers running north and west have their mouths on the northern and the north-western coasts. Their sources are in the low inland mountain ranges of the Northern Territory and Western Australia. Some are navigable for 150 miles and drain a large area, the country watered by the Victoria, for instance, being 90,000 square miles in extent.

On all the southern and the south-western coast there is no river (except the Snowy, which rises in the Australian Alps in New South Wales) of any great importance, the largest being the Glenelg, on the borders of South Australia and Victoria, which has a length of 280 miles, and would be navigable for some distance but for a bar at the mouth.

Lakes.

The continent of Australia is singularly wanting in true freshwater lakes of any size. Mention has already been made of the lake district in South Australia, where Lake Eyre, a large salt basin, lies 35 feet below sea-level, while south of and divided from it by a range of hills is Lake Torrens, a vast shallow salt lake about 80 feet above the level of the sea. To the east of Lake Eyre is a chain of other salt lakes connected with it in wet seasons, and Lake Gairdner, another immense salt marsh or lake, lies north of the Gawler Ranges. Western Australia has numerous salt lakes and freshwater lagoons, which become swamps in the dry season. In Victoria a salt lake, Lake Corangamite, covers 58,000 acres, and Lake Colac, a true freshwater lake, 6,500 acres, while

in the south-east there is a chain of shallow freshwater lakes with an entrance to the sea, the largest, Lake Wellington, being 34,000 acres in extent. The most important inland lake in New South Wales is Lake George, situated at an elevation of 2,100 feet. It is 25 miles long by 8 miles wide.[1] Small deep lakes of fresh water with no outlet or inlet, yet always full, are found in various parts of Australia, and along the banks of the Darling and of other rivers are lagoons, aggregating hundreds of thousands of acres in area, which are filled in flood time and gradually empty themselves by reflow into the rivers as their waters fall, and by evaporation. It is probable that many of these will in time be converted into storage reservoirs to provide water for irrigation.

Water-supply.

A source of water-supply which yearly becomes of greater importance to Australia is the artesian basin which lies west of the Great Dividing Range, taking in more than half Queensland, a considerable strip of New South Wales, the north-eastern portion of South Australia, and the south-eastern portion of the Northern Territory. Its area is nearly 570,000 square miles, of which 376,000 are in Queensland, 110,000 in South Australia, and 83,000 in New South Wales. The supply to this basin is supposed to come from a watershed of 60,000 square miles, 50,000 square miles of which are in Queensland in the Great Dividing Range. It is believed that there is an outflow northwards into the Gulf of Carpentaria, and southwards into the Great Australian Bight, but absolute proof of this has so far not been obtained. The artesian area is now tapped by about 1,700 bores, which are frequently sunk to a depth of 2,000 feet and more, and yield in some cases up to 4,000,000 gallons a day. The water is usually of a high temperature and is often strongly mineralized, which detracts from its value for irrigation, but is immensely useful for watering stock, for which it is always suitable. While it is generally believed, as stated above, that the artesian water is provided by the rainfall which percolates into the ground from the mountain watershed,

[1] Compare p. 54.

this is disputed by Professor Gregory, who holds that the water is not impounded rain-water, but comes up from the older rocks, being plutonic and not meteoric. He maintains that the water is impounded in molten lava from volcanoes, or in solidified quartz and granite, and he suggests that the pressure of overlying rock and gas pressure arising from the heat of the earth causes the flow of the bores.

The rainfall,[1] upon which all the rivers are dependent, is heaviest on the north coast and on the coastal belt in the east, the south-east, and the south-west. Geraldton in north-east Queensland has an average annual rainfall of 145 inches. The driest part of the continent is in the neighbourhood of Lake Eyre, where the average rainfall is 5 inches per year; in the inland districts of Western Australia the average is from 10 to 12 inches. Roughly, similar areas of the continent have less than 10 inches, and from 10 to 20 inches, of rain per year, each area somewhat exceeding a million square miles, while more than 20 inches of rain falls on about 860,000 square miles (cf. p. 102). Thus a huge area is abundantly watered for all purposes; the whole of the land which has 10 inches of rain is useful for pasturage, and stock thrive in many parts which do not receive 10 inches of rain in the year. Within the area favoured with more than 20 inches of rain is the whole of the coastal belt between the Great Dividing Range and the sea, the island of Tasmania, and the south-western coastal portion of Western Australia. In the capitals of the various states the average rainfall is as follows: Brisbane, 47 inches; Sydney, 48; Melbourne, 25·6; Adelaide, 20·6; Hobart, 23·5; Perth, 33·2. In the north the heaviest fall is in the summer; in the coastal district of New South Wales it is greatest in the first six months of the year, and in Perth in the winter.

Intimately related to the rainfall of Australia is the density of the forests[2] and their value. Generally speaking, the whole of the coastal district is or has been in the past

[1] See further, Chapter III. [2] See further, Chapter IV.

well timbered with useful trees, some of them, as in Victoria, attaining to enormous size. All the forest trees of Australia are evergreens, and most of them belong to the eucalyptus family, which has some of its finest representatives in the karri and jarrah of Western Australia, covering a large area of the well-watered coast. On the inland plains there is a limited amount of pine of some value, but generally speaking as the rainfall decreases so does the size and quality of the timber growing upon them, and that found in the interior, except along the banks and water-courses, is small and of little use.

Islands of the Australian coasts.

Australia has a remarkable number of islands, most of them small, some of them mere barren rocks, but others large and fertile. Off the coast of New South Wales are about 40 islands, the largest of which is Broughton Island, near Port Stephens, with an area of 1,145 acres; the islands off the Victorian coast number about 80, many of them mere rocks, but French Island and Phillip Island in the great bay of Western Port, designed as one of the Commonwealth naval bases, have areas of 41,000 and 24,000 acres respectively. Off the coast of Queensland are some 550 islands, many of them covered with tropical vegetation; Mornington Island, 12 miles from the mainland, has an area of 217,000 acres, and Moreton Island, which is 9 miles from the coast, of 46,000 acres. The largest of some 120 islands in South Australian seas is Kangaroo Island, which is over 1,000,000 acres in extent. Off the shores of the Northern Territory lie Melville Island of 1,500,000 acres, Bathurst Island, closely adjoining, of 500,000 acres, and Groote Eylandt of 608,000 acres, the last being situated in the Gulf of Carpentaria. The islands of the Northern Territory number about 75 in all. There are upwards of 300 islands dotted along the coast of Western Australia, the greater number in the north-west. Dirk Hartog Island, about one and a half miles from the mainland, has an area of 150,000 acres and Augustus Island of 60,000 acres. The largest of some 70 islands near Tasmania is Flinders Island, with an area of 500,000 acres, 34 miles from the

coast; King Island, 56 miles away, is 270,000 acres in extent. Both of these are well timbered and grassed and are occupied by pastoralists and farmers.

Economic Review [1]

Extending as it does over 30° lat. and with a climate ranging from fully tropical in the north of Western Australia, the Northern Territory, and Queensland, to cool and temperate in the south of Tasmania, Australia produces, or is capable of producing, almost all trees and plants of economic value. Nor are any of the useful metals or minerals wanting; most of them are already profitably worked, while known deposits of others are at present neglected only because the existing conditions of transport and labour are unfavourable.

All the domestic animals of Europe have been bred with extraordinary success. The seas and rivers are well supplied with native fish, crustaceans, and shell-fish. Trout imported from England have thriven and multiplied, and pearls and pearl-shell of considerable value are taken on the northern and western coasts.

Thus Australia contains within its own shores and seas everything required for the economic life of the country. Endeavours have been made by means of tariffs and bonuses to develop some of its latent resources and potentialities (as for instance in the matter of sugar, cotton, rice, tobacco, and coffee growing, and mineral oil production), and to foster all branches of manufacturing.

Early development of industries.

The order in which the staple industries of Australia came into existence does not quite correspond with their present relative importance. When Captain Phillip landed in 1788, wheat-growing first occupied his attention, lands near Sydney being sown under government supervision, while others were granted to retired soldiers; but, even as late as 1804, so little grain was locally grown that the non-arrival of store-ships expected from Great

[1] Chapters V, VI and VII deal in further detail with the economic products, industries, and commerce of the Commonwealth.

Britain and India brought the colony to the verge of starvation. At this time Australia, which, but for a settlement made in Tasmania in 1804, consisted practically of a coastal strip of New South Wales, extending as far north as Newcastle, had hardly any cattle or sheep, the flocks and herds in 1800, when the population of the country was 5,317, being 1,044 cattle, 6,124 sheep, 4,017 pigs, and 203 horses. Fifty years later the live stock consisted in round numbers of 16,000,000 sheep, 1,900,000 cattle, 160,000 horses, and 114,000 pigs. Coal was first discovered in 1797, and the Australian mining industry made its beginnings a little later, when a pit was opened near the mouth of the Hunter River and a sub-colony of 20 persons was established at Newcastle to work it. In 1800 the export trade began with the shipment of a few tons to India, while the *Porpoise* took 600 tons valued at over £5,000 by the Cape of Good Hope.

Timber export.

Another industry established at a very early date was the export of timber, which was greatly encouraged by Governor Hunter. A general order in 1802 forbade the cutting down of cedar on the Hawkesbury River without permission, the penalty being confiscation of the cart or boat used in transporting it. In 1803, Governor King wrote of timber as 'our only staple', and even before the end of the eighteenth century Australian eucalyptus was regularly exported for use in British dockyards, where on account of its hardness it was much favoured for the manufacture of cogwheels and wheels for gun-carriages, while ships up to 160 tons were made from it in New South Wales.

Sealing and whaling.

Sealing and whaling also played an important part in the economic life of the country in the very early days. In 1806 the seal and oil fisheries employed 400 hands and 20 small colonial vessels were engaged in them. Between 1800 and 1806 these vessels had taken 711 tons of oil and had exported nearly 120,000 seal skins to England and China. Larger English ships did the whaling, and in 1802 a full whaler took Governor King's dispatches to the Secretary of State from Sydney to England.

Modern industries.

All the industries above mentioned are still pursued within the Commonwealth, but their relative importance has greatly altered. Sheep-farming, indeed, still holds its own as the most productive of all; wheat-growing is high on the list; timber though largely exported forms but a minor item in the trade returns; the value of the coal mined is far exceeded by that of metals and minerals not discovered in the first half-century of Australian history; seals have been almost exterminated on the islands and coasts, and whaling, in spite of a recent revival, is of little importance.

Statistics of production.

At the present time, Australia is primarily a pastoral country. More of the country's wealth is derived from sheep and cattle than from either manufacturing, agriculture, or mining, which contribute their proportions in the order named. In 1910 the Commonwealth Statistician estimated the total value of the production of all industries at £187,734,000, which on a population of 4,500,000 makes the average production per head of the population about £41 14*s*. To this total, pastoral pursuits contributed (in round figures) £57,000,000, manufacturing £45,600,000, agriculture £39,750,000, mining £23,500,000, dairy farming and poultry £17,400,000, and forests and fisheries £4,800,000. In this estimate full justice is not perhaps done to the manufacturing industry, since the value of certain manufactured articles, such as butter and cheese and sawn timber, has been included among the products of dairying and forestry. The total value actually added in that year by processes of manufacture to the raw material subjected to them, was in excess of £48,000,000.

Pastoral industry.

The pastoral industry plays a great part in every state and territory of the Commonwealth, New South Wales leading the way in the number of sheep, while Queensland occupies first place with regard to cattle. In this state and in the Northern Territory the greater number are bred for beef; but Victoria has more milking cows than Queensland, though dairying is making great strides in the north, as it is elsewhere in the Commonwealth. The

PLATE I. SHEEP-FARMING DOWNS IN VICTORIA
(High Commissioner for Australia)

PLATE II. PALMERSTON, NORTHERN TERRITORY
(High Commissioner for Australia)

manufacture of cheese is comparatively neglected, the milk being used for butter-making. The basis of success in this industry has been co-operation and the gradual improvement and cheapening of the sea transport of butter.

Australia formerly possessed both sheep and cattle in greater numbers than to-day, for the country has not quite recovered from the disastrous drought of 1902–3. In 1895 the cattle were a few thousand more than in 1910, Queensland having had 6,800,000 in the former year. In 1890 the number of sheep in the Commonwealth was estimated at 98,000,000, while in 1860 the total was only 20,000,000. In 1902 drought had reduced the sheep to 53,500,000, but between 1902 and 1910 there was the extraordinary increase of 38,500,000.

Establishment of sheep-farming.

The first sheep went out to Australia in 1788 with Captain Phillip, but they were of poor quality. Spanish sheep, however, were brought about 1798 from the Cape, and Governor Hunter wrote that the fleece improved with every generation. As early as 1801, Macarthur, the father of sheep-breeding in Australia, had realized its possibilities and offered to raise in New South Wales all the wool required in England, if he might have land and shepherds. He was assisted by King George III with gifts from his stud of merino sheep, and Macarthur's confidence was justified.

Wool.

The exports of Australian wool in 1910 were worth £28,000,000, and in spite of the cutting up of large estates formerly used only for grazing, the number of sheep continues to increase. The small flocks kept by farmers as an adjunct to cultivation grow yearly in numbers, while the opening up of new country in western New South Wales and Queensland, by means of artesian wells, which provide water and permit the travelling of flocks, is enlarging the area for sheep-breeding. In Western Australia also, particularly in the more southern portion, and in the southern part of the Northern Territory, sheep are becoming more numerous. Up to now the tropical portions of this state and of the Territory have been found

more suitable for cattle. There is, however, no state without a large proportion of its area peculiarly fitted by soil and climate to produce wool to perfection.

These natural advantages, combined with the highest skill and care on the part of generations of breeders, have made the Australian merino the best wool sheep in the world. How great has been the improvement effected in the sheep as a wool-producing animal is shown by the estimated average weight of the fleece sheared from Australian merinos being 4 lb. in 1877, 5 lb. 9 oz. in 1887, 5 lb. 12½ oz. in 1897, and 7 lb. 6¾ oz. in 1905. Though the number of sheep fell from 98,000,000 in 1890 to 53,500,000 in 1902 owing to the great drought, the weight of wool produced did not decline proportionally. Indeed, in New South Wales, the 5 years ending with 1890 gave a return of wool averaging 1,200,000 lb. less per year than the 5 years ending with 1905, though the sheep numbered 13,500,000 more in the earlier year than in the later one. Mr. Hans Irvine, M.P., a Victorian pastoralist, states that good merino wethers of high class in the western district of Victoria now yield annually on the average from 9 lb. to 12 lb. of wool, and merino ewes from 7 lb. to 9 lb. This wool is worth in the grease from 1*s.* to 1*s.* 6*d.* and higher.

Tallow.

In 1843, after a severe financial crisis in New South Wales had reduced the value of sheep, which could not then be exported, to 6*d.* per head, and of cattle to 7*s.* 6*d.* per head, Australians first turned their attention to the boiling down of sheep for tallow, a process which a visitor to Russia had reported to be largely practised in that country. A considerable trade in tallow immediately came into being, and has continued.

Frozen meat.

Next in importance to wool as a product of the sheep comes mutton and lamb, the export of which in the frozen state was first begun on a business basis in 1879, though freezing works were established at Darling Harbour in Sydney as early as 1861 by Mr. Thomas Mort, and much money was sunk in shipping experiments which were a failure. In February 1880 the steamer

Strathleven arrived in London Docks from Australia with 40 tons of frozen meat in excellent condition, which were sold at 4½*d.* to 6*d.* per lb.

Only second in importance to sheep farming is the cultivation of wheat, which is grown in all the states, only Queensland now failing to grow enough for its own needs, while all the rest except Tasmania usually have a considerable surplus for export. The year 1903 was the last in which the Commonwealth found it necessary to import wheat from abroad. In this year over 10,500,000 bushels were imported, the harvests everywhere having partially or totally failed, but since that time methods of farming have so much improved and such a large area has been added to the wheat lands, that even in a drought such as that of 1901–2 Australia would probably be now able to supply all the wheat that is required. The harvest of 1911–12, the largest ever reaped, yielded 95,100,000 bushels from 7,370,000 acres. Wheat.

The land used for wheat-growing is not as a rule the richest and best watered, which is more often devoted to other crops and to dairying. A rainfall as low as 16 inches on light soil gives paying crops of hard wheat so cheaply harvested that a yield of 10 bushels to the acre is profitable, and where the rainfall is regular, though light, as in Western Australia, wheat-farming is possible with an annual rainfall of 12 to 14 inches. An important fact for the future of Australia is that in 1911 a crop of Indian wheat giving 16 bushels to the acre was grown without irrigation in the Northern Territory. Up to the present Victoria has produced the most wheat in any one year, nearly 35,000,000 bushels ; next comes New South Wales with 28,500,000 bushels, and South Australia with over 25,000,000 bushels. South Australia, in early days, was the greatest wheat-producing state, but New South Wales, where large pastoral properties are being cut up for farming, promises soon to take the lead. Western Australia, with immense areas watered by a small but regular rainfall, may become the chief grain state of the Commonwealth. Distribution of wheat production

comparative nearness to England has begun the experiment of exporting table grapes, with some promise of success. Of 60,600 acres of vineyards in 1911, Victoria and South Australia had about 23,000 acres each, New South Wales over 8,000, and Western Australia nearly 3,000. The wine production for the year was nearly 5,000,000 gallons. Outbreaks of phylloxera at various periods have checked vine-growing, particularly in New South Wales and Victoria, but many vineyards have since been replanted with resistant stocks. Insufficient care has too frequently been exercised in the choice of prolific plants, and a leading grower states that in Victoria yields of 200 gallons per acre are common, where good vines of the same variety would yield 600 gallons. As much as 2,000 gallons per acre have been obtained from certain vines in South Australia.

Minerals: Coal.

As mentioned earlier, coal was the first mineral discovered and mined in Australia, and since that time seams have been opened up in every state, but New South Wales, with an annual output of about 9,000,000 tons, accounts for nearly nine-tenths of the production in the Commonwealth. In Victoria a state coal-mine opened in 1910 now turns out nearly 300,000 tons of coal per year. While the total Australian output is at present only an insignificant proportion of the world's supply, the Commonwealth has vast coal resources to draw upon. Over 60,000 square miles of proved coal-bearing lands are known in New South Wales and Queensland, and geological authorities agree that there are well over 1,000,000,000 tons of coal available in the former state without taking into consideration deposits at depths exceeding 4,000 feet. It is interesting to note that in spite of the wages paid to miners—from 10*s.* to 11*s.* 3*d.* per day—coal is cheaply worked in New South Wales, the average pit-mouth price from the group of mines where it is highest having been (according to the Commonwealth statistician) 8*s.* 1·44*d.* per ton, as against an average of 8*s.* 2¼*d.* per ton in the United Kingdom, both figures being for the year 1910.

First among Australian metals in the value of output, though not in the order of discovery, comes gold. When alluvial gold was found in 1851 it occasioned a 'rush' to Australia, and in the following year New South Wales produced £2,700,000 worth, a yield which has never there been exceeded. Victoria, however, quickly outdistanced New South Wales and yielded £12,000,000 worth of the precious metal in 1856. Later came discoveries in Queensland and (on a smaller scale) in South Australia and Tasmania; and last of all in Western Australia, which had its highest output of £8,750,000 in 1903. In the same year Queensland also obtained its highest yield, £2,840,000. Gold.

Copper was first mined in 1844 in New South Wales, and immensely rich deposits were discovered next year at Burra Burra in South Australia, the mine paying £800,000 in dividends. Another mine at Moonta in the same state was the first mine of any kind in Australia from which the dividends reached £1,000,000. As a copper-producing state, South Australia gave place first to Tasmania and then to Queensland. Copper.

To the mines of Broken Hill, in New South Wales, are due the vastly greater part of the great annual output of silver and silver lead. From the same mines zinc is produced. Tin is mined in all the states, but on only an insignificant scale in Victoria. Iron is not at present mined on a considerable scale except in New South Wales, where 40,000 tons valued at £162,000 were produced under the encouragement of a bounty (no part of which has been claimed in any other state) in 1910. Extensive iron deposits have been discovered in Queensland, South Australia, Western Australia, and Tasmania. At the Iron Knob near Port Augusta in South Australia, the estimated amount of iron ore in sight has been set down as 21,000,000 tons. Other metals.

Indirectly it is to the discovery of gold in Australia that the manufacturing industry has now grown to such large dimensions in the Commonwealth. There had been small factories working up local products before 1851, Manufactures.

but between that year and 1861 immigrants arrived in Victoria at the rate of 40,000 per annum, and as the alluvial mines began to fail, there was surplus labour crying out for employment. Part of it went to develop agriculture, another portion to stimulate manufacturing, and long ago, Victoria with the same object in view established protective duties. Whether they were then successful in their object is a matter of dispute, but at any rate ever since the decline of alluvial digging a determined effort has been made, not only in Victoria but elsewhere, to establish manufactures, and since the formation of the Commonwealth, with internal free trade and a common tariff, they have made great increase.

For some years before the federation of the colonies, Victoria, which had made special efforts to develop her manufactures, employed more people in them than any of her neighbours, but even then New South Wales gave employment in factories to more adult men than Victoria, the additional numbers in the latter being principally composed of women engaged in boot-making and in the clothing trade. After federation, which opened the markets of the other states to New South Wales, besides giving her manufacturers protection against the rest of the world, the number of factories and of hands employed increased at an even greater rate than it did in Victoria. Between them these two states do the bulk of the manufacturing work of Australia.

Federation and Government

Evolution of state and federal constitutions.

Though the Australian constitutions, state and federal, derive their validity from statutes of the Imperial Parliament and not from immemorial custom and the sanctity of precedent, they are nevertheless in a remarkable way the product of evolution in Australian thought and material development. When Governor Phillip landed in 1788, and for many years afterwards, during which time the government of New South Wales was the government of all settled parts of Australia, the governor exercised a degree

of despotic power limited only by such instructions as he received from the Secretary of State for the Colonies. The laws which he administered were those of England at the date of the first settlement, in so far as they were applicable to the conditions of the colony. There were no civil courts—these were not established until 1814. There was no trial by jury, which was first provided for in 1824. Every one in the colony, bond and free, was subject to the authority of General Orders, which regulated life and conduct in all its aspects. It is interesting to note that modern developments, under which Australian governments are already regulating wages and some people propose to fix prices, are suggestive of the early days when Australian governors did all this with a minuteness and thoroughness which could not be excelled by any Wages Board or Arbitration Court. The regulations made by the governors, however, were frequently evaded. Government at that period also conducted all trade and industry, except that of agriculture, in which retired officers and a handful of free settlers were assisted by assigned labour. The corn grown was purchased by government at prices fixed by the officials, and all goods were supplied to the settlers from the state stores, again at official prices. The few factories that had come into existence, such as woollen and linen factories, brick works, a brewery, the coal-mines on the Hunter River, and several other enterprises established in the first twenty years of the colony, were all in the hands of the government, so that the Australian socialist of to-day is not so original as he often imagines himself to be, in seeking to extend the sphere of state activities. In Australia it has done in the past all that he would have it do, and more, and it only gradually resigned its powers as they were considered to be inconsistent with the development of a free people.

Development of self-government.

The first step towards giving the people of Australia permission to manage their own affairs was the creation in 1823 of a council of from 5 to 7 members to advise the governor (but without power to overrule him) in

matters of legislation. Here were the rudiments of self-government, but all laws and ordinances approved by the council had to be laid before the British Government.

In 1828, in the governorship of Sir Ralph Darling, by an Act of the British Parliament which applied also to Van Diemen's Land, the powers and the membership of the councils were increased, but it was not until 1842 that New South Wales received a representative legislature. This consisted of a council of 36 members—12 nominated by the Crown, and 24 elected by the inhabitants.

New South Wales Council of 1843, and later developments.

The council was opened on August 1, 1843, by the Governor, Sir George Gipps, and among the first elected members were William Charles Wentworth and John Dunmore Lang, two men whose names are indissolubly linked with the subsequent political progress of Australia. This is not the place to trace this progress in detail, but 1843 was the turning-point in Australian political history. At this time Victoria and Queensland, only recently settled, were still portions of New South Wales, the former already beginning to ask for separation. Western Australia, founded in 1829, and South Australia in 1836, were distinct colonies which had never been under the rule of New South Wales. Tasmania, known until 1853 as Van Diemen's Land, had obtained separation from the mother colony in 1825. In the other parts of Australia, as well as in New South Wales, the ambition for complete self-government was by no means allayed, but on the contrary was stimulated by the concessions of 1843. From that date onwards the people of Australia entered upon a struggle for complete self-government. What had been conceded was accepted, if not grudgingly, at least with firm and reiterated requests for more. In framing and pressing specific demands upon the Imperial Government, no members of the council were more active than Wentworth and Lang, and secretaries of state for the colonies found that they could no longer close their ears to Australia. To do them justice they showed no disposition to refuse anything which they thought might be granted with due regard to the interests of the Empire as a whole, and

finally in 1855 all the colonies, except Western Australia, which remained a Crown Colony until 1890, were granted responsible government with complete liberty to manage their own internal affairs, and with this great boon the control of the Crown lands also was conferred.

Colonial constitutions.

The constitutions of the different colonies, while marked by minor differences, were all upon the same model, with legislative assemblies corresponding to the House of Commons, and legislative councils corresponding as far as practicable to the House of Lords. Although the constitutions were enacted as schedules to the imperial Acts conferring them, they were the work of Australian statesmen, only slightly modified, thus bearing out the fact that the desire and capacity for self-government which are inherent in the British race were nowhere more strongly in evidence than among the Australian colonists.

During the period between 1843 and 1855, political thought and aspiration were running in three separate currents. Australians generally were demanding a greater instalment of self-government; Victoria was clamouring loudly and Queensland less earnestly for separation from New South Wales, while in all the political divisions there was a feeling in favour of some kind of federal union, greatly hampered by provincial rivalries. Then, as later, the differing tariffs of the colonies made federation desirable but also made it difficult.

Movements towards federation.

The Home Government realized even more clearly than the local legislatures the difficulties and confusion which would arise from the establishment of a number of entirely separate self-governing communities in Australia, and endeavoured to alleviate them. In 1851 Sir Charles Fitzroy was given a commission as Governor-General of Australia, with separate commissions as Governor of Victoria, Tasmania, South Australia, and Western Australia, where the Queen's representative was given the status of lieutenant-governor; and one of the instructions to the governor-general was to endeavour in consultation with the lieutenant-governors to smooth away differences between the colonies, especially on tariff

matters. Any power which he might have had in this direction was lost when responsible government was established, and although the title of governor-general was borne by the governor of New South Wales until the appointment of Sir John Young in 1861, it had ceased for a long time to be of real significance. The British Government, however, had taken other steps towards bringing about federation, steps which are interesting, not only because they faintly foreshadowed the lines upon which union was ultimately accomplished, but because the coldness of their reception gave another proof of the fact that Australians were determined to work out their own political destinies.

Proposals for General Assembly.

As far back as 1846, Governor Fitzroy had suggested, in a dispatch to the Colonial Office, that a General Assembly should be established to deal with matters of general Australian interest, and Earl Grey, who approved the idea, in his dispatch to the governor announcing the intention of creating Victoria a separate colony, outlined a scheme of Australian federation. A committee of the British Privy Council to whom the matter was referred reported in 1849 in favour of the creation of an Australian General Assembly of 25 members, and this report was embodied in a dispatch to the governor of New South Wales. The proposed assembly was to deal with customs duties, posts, roads connecting the colonies, lighthouses, port dues, the establishment of a Court of Appeal, the jurisdiction of such a court, weights and measures, and subjects upon which the colonies to be affected thereby might ask the assembly to legislate. The funds required by the assembly were to be obtained by levying an equal percentage upon the revenues of all the colonies, which then had a total population of 245,000. New South Wales with 135,000 people was to send twelve members to the assembly, Victoria with 33,000 was allowed four members, Tasmania with 46,000 five, and South Australia with 31,000 four members. Earl Grey's scheme was not well received; he himself was unpopular in the colonies; their desire to manage their own affairs was intense;

the smaller colonies were afraid of the predominance of New South Wales; and there were other obstacles in the way, including that of fiscal policy. Nevertheless the dispatch provoked a discussion which helped to create popular interest in federal proposals. In 1857 Wentworth prepared a memorial to Mr. Henry Labouchere, the Secretary of State for the Colonies, emphasizing the need for a federal assembly, and also drafted a short enabling Bill. This memorial was considered in the same year by a select committee of the New South Wales Legislative Council, and a Victorian proposal by the Hon. Charles Gavan Duffy for a conference was endorsed in New South Wales, but owing to various causes this conference was not held.

It is an interesting fact that Dr. Lang, who was a keen federalist, rather hindered than advanced the cause by advocating also separation from the mother country. This proposal was by no means in accord with Australian sentiment, which although characterized by a resolute spirit of local independence, was equally loyal to the British flag. The association of Australian union with Australian independence was a very unhappy way of advancing the cause of federation.

Federal Council.

The ideal of union, however, was kept alive, and at a conference which sat in Melbourne and Sydney at the end of 1880 and the beginning of 1881, Sir Henry Parkes proposed the formation of a Federal Council which eventually came into existence, but was never joined by New South Wales, Sir Henry Parkes and other New South Wales leaders having come to consider that the council, with its very limited power, stood in the way of the creation of an effective federal legislature, which they desired to see established. They consistently refused to subscribe to the view urged upon them by supporters of the council that out of it closer union might in time be evolved.

The work done by the Federal Council was not of great importance, and the foundation of the movement for union which was crowned with success in 1899 was laid

in 1890, at a conference called by Sir Henry Parkes as premier of the mother colony. This conference was composed of representative ministers of the colonies. It began its sittings in Melbourne; they were adjourned in 1891 to Sydney, and from them eventually emerged a draft constitution, which closely resembled that subsequently adopted, but had the disadvantage in the eyes of the people of having been framed by delegates chosen by the parliaments of the colonies, and not elected directly by themselves.

Conferences of premiers.

No definite step was taken until 1895, when a conference of premiers convened by the present writer as premier of the mother colony met in Hobart and resolved to plan the federal movement on a more popular basis. The premiers adopted a plan first outlined by Dr. (afterwards Sir John) Quick for the election of delegates from each state to a convention for the framing of a federal constitution. The premiers of New South Wales, Victoria, South Australia, and Tasmania gave practical effect to this proposal, by passing an enabling Bill for the election of delegates. In 1897 elections took place in the colonies named, and their delegates, forty in all, joined a few days later by a delegation from Western Australia, met first in Adelaide, then in Sydney, and finally in Melbourne in January 1898. In that year the constitution was submitted to the electors of the colonies, and received the necessary majorities in Victoria, South Australia, and Tasmania. In Western Australia no vote was taken. In New South Wales the majority fell short of the 60,000 votes required by the enabling Act in that Colony, and for the moment federation was defeated.

Another premiers' conference was called in 1899 by the present writer to consider amendments which he desired to propose in the draft constitution in order to secure the adhesion of New South Wales. At this conference Queensland was represented. As the result of its labours an amended Bill was submitted to the electors and received the required majority in all the states.

Inauguration of the Commonwealth.

An Imperial Act embodying the constitution was introduced by Mr. Chamberlain in 1900, and passed practically without amendment. On January 1, 1901, the Earl of Hopetoun, the first Governor-General, inaugurated the government of the Australian Commonwealth in Sydney. In May 1901 King George V and Queen Mary, then the Duke and Duchess of York, visited Australia, and the Duke opened the first Commonwealth Parliament in Melbourne on May 9, 1901.

Functions of Commonwealth and States governments.

Under the constitution of the Commonwealth of Australia[1] the component states retain all the powers which belong to them as self-governing communities, except those which they have expressly surrendered to the Commonwealth. They no longer concern themselves with defence and tariff and postal matters, which are among the most important subjects of federal legislation. Trade between all the states is absolutely free, and a uniform protective tariff, with duties lower in some respects than those of Victoria, which were the highest in pre-federation days, but much higher than those of New South Wales, which was a free-trade colony with the shortest tariff ever known, are in force against the outside world, with a preference to many articles of British origin.

Between them the states and the Commonwealth exercise all the powers of self-government under the British Crown which before federation belonged to the individual colonies. The untrammelled political existence of the colonies is at an end, but they retain, as already stated, all the powers not expressly surrendered, completely differing in status from the Canadian and South African provinces.

The right of borrowing, of imposing any taxation of any kind except by way of customs or excise duties, of controlling the land and the railways and education, of regulation of municipal government, and of industrial

[1] [See W. H. Moore, *The Constitution of the Commonwealth of Australia*, Melbourne, 1910; H. G. Turner, *First Decade of the Australian Commonwealth*, Melbourne, 1911 A. I. Clark, *Australian Constitutional Law*, Melbourne, 1905].

and factory legislation, remains to the states, though in some other matters the Commonwealth exercises concurrent power. The state governor is appointed directly by the Crown, and the legislative machinery remains just as it was before the colonies became states of the Commonwealth.

Judicial system.

Neither is the administration of justice seriously affected except in so far as an appeal now lies from the State Courts to the Federal High Court, as well as to the Privy Council. In matters affecting the power of the states in the Commonwealth under the constitution, there is no appeal from the High Court to the Privy Council unless the High Court certifies that it is a case which the Privy Council ought to determine. Upon this point there was very considerable disagreement between Her Majesty's Government and the Australian delegates who visited England. Mr. Chamberlain thought that the right of appeal to the Privy Council should not be in any way limited; the delegates pressed upon him the view that the Australian constitution should be interpreted by Australian judges. Eventually the Home Government gave way.

Legal profession and procedure.

So far, then, as the legal aspect is concerned it may be stated, generally, that the High Court is the interpreter of constitutional problems, while the State Courts retain their former functions. On the whole the English judicial system prevails and the forms of English law and procedure hold good. In some of the states, the branches of the legal profession have been amalgamated and it is possible for a practitioner to practise as solicitor and barrister, but that is not generally done in the larger centres. In New South Wales the two branches are kept distinct. The ceremonies in court, the attire of judges and counsel in Australia, accord with tradition, if not always with the climate. On the business side (registration of deeds, &c.), an excellent system prevails, and the Torrens Act making easy and indefeasible the title to and transfer of real property has proved an immense boon. The supreme power of legal decision still remains so far as ordinary issues are concerned with the

Privy Council, and it is possible for a litigant, whose case has been decided against him by the State Full Court, to proceed direct to the Privy Council without reference to the High Court at all. Of course, as has been said, questions arising upon the federal constitution cannot be taken to the Privy Council except on leave given by the High Court.

Legislature.

The legislature of the Commonwealth consists of a governor-general appointed by the Crown, a House of Representatives of 75 members elected by constituencies in the states, and a senate of 36 members, six elected by each state—in which the voting is as for one constituency. The constitution provides that as nearly as possible the number of representatives shall be twice that of the senators. For neither house is any property qualification demanded from members: women are eligible for election; for both houses there is universal suffrage, men and women over 21 years of age being equally entitled to vote. Members of both houses are paid at the rate of £600 a year. The House of Representatives, if not dissolved earlier, lasts for three years; members of the Senate are elected for six years, half retiring every three years in rotation. Extraordinary vacancies are filled by election by the parliament of the state concerned.

Responsible government upon the English plan prevails, but while the governor-general appoints all ministers it is understood that any labour member entrusted with the formation of an administration consults with labour members in caucus as to the choice of his colleagues. The number of paid ministers, including the premier, is at present seven.

Relations between House of Representatives and Senate.

In matters of finance the House of Representatives is supreme, the Senate not being allowed to amend money bills, though it may request that amendments be made. In the case of deadlocks arising owing to disagreement between the Senate and the House of Representatives, the constitution enables the governor-general to dissolve both houses, and, if agreement is impossible when the new parliament meets, a joint sitting of the Senate and

the House of Representatives takes place, at which the members vote as though they were members of a single house. Conflict between the Senate and the House of Representatives is unlikely. The greatest danger would arise when a government possessed of a majority in the representative house were in a minority in the Senate, which in the usual case can only be changed in its composition to the extent of one-half at an ordinary election.

The idea of the framers of the constitution was that the Senate, with equal numbers from each state, would be in a position to defend state rights against the possible pressure of the House of Representatives, to which the smaller states send comparatively few members. Many fought hard against the grant of equal representation to the smaller populations in the Senate, as being in flat contradiction of majority rule, but the latter made equal Senate representation a condition of joining the union.

Finance. In the negotiations for federation, one of the principal difficulties was the adjustment of state and federal finance. The Commonwealth, with the customs and excise revenue at its disposal, was assured of ample funds; not so the states which had relied largely upon the same source. It was decided that for the first ten years of the federation at least three-fourths of the customs and excise revenue should be returned by the Commonwealth to the states; Western Australia, more dependent upon its tariff than the other colonies, was given the special privilege of not abolishing its inter-state duties immediately, but reducing them to nothing in a period of 5 years.

The first-mentioned period of 10 years has elapsed, and in lieu of three-fourths of the customs duties the Commonwealth pays to each state 25*s*. per head of its population—a referendum, held in 1910, proposing that this payment should be assured to the states for 25 years was defeated, and the government subsequently agreed to make the payment at least for 10 years. Apart from customs the Commonwealth derives its principal revenues from a tax upon unimproved land values, while from state taxes upon the same subject and from income taxes

and stamp duties the states also raise a considerable sum. The profits upon railways and tramways and numerous government works of a reproductive character are also items of state revenue.

Since the establishment of federation, the payment of old age and invalid pensions has been taken over by the Commonwealth government at a cost of more than £2,000,000 a year, and the states which formerly granted such pensions have been relieved of a considerable charge.

Local government.

While Australian interests are the concern of the Commonwealth or state legislatures, municipal government plays a very important part in the life of the country. As far back as 1842 the towns of Sydney and Melbourne were incorporated, and now over much the greater part of the Commonwealth local governing bodies, city, town, and borough councils, shire councils or road boards, have charge of the health of the people, the making of streets and roads, and the administration of various Acts of Parliament. They do not, as in England, provide for education, police, or poor relief, which are all a charge upon Commonwealth or state revenues. The ports and harbours in the great cities, and drainage and water supply, are under the management of public bodies with, as a rule, special rating and borrowing powers. Many of the municipal bodies, both in town and country, own markets, gas works, tramways, baths, and other trading concerns. Rates are levied in Queensland entirely, and in New South Wales almost entirely, upon the unimproved value of the land. Annual rental value is the sole basis of rating in Victoria, and the principal basis in the other states. As an indication of the extent of local government in Australia, it may be mentioned that in 1910 the capital value of property rates (exclusive in the case of New South Wales and Queensland of the value of improvements) was close upon £31,000,000, and the revenue accruing to 1,097 local authorities in the Commonwealth was nearly £6,000,000.

[On social and political topics, in addition to works cited elsewhere, see Hon. W. Pember Reeves, *State Experiments in Australia*, London, 1902; V. S. Clark, *The Labour Movement in Australasia*, London, 1907.]

CHAPTER II

PHYSICAL FEATURES AND THEIR EFFECT ON SETTLEMENT

By Griffith Taylor

General Structure

Position and general physical character.

Australia lies to the south-east of the chief land mass of the Globe, the Old World. Connected thereto by the partly submerged but high mountain ranges constituting the East Indian Archipelago, it offers the strongest contrast to the latter in outline. In place of sporades of long narrow islands Australia presents perhaps the most unbroken outline of all the continents, and is certainly one of the lowest in elevation.

Both these features are probably due to one factor, the presence of a huge dense unmoving block in the Earth's crust in the form of the West Australian massif. Against this comparatively low resistant area the folding forces affecting the Earth's crust have again and again advanced the crustal ripples to which most elevated land is due. Nor is it improbable that the massif itself in reaching equilibrium has exerted an outward puckering force on the less solid sediments to the east. To this may be attributed the dominating direction of the north and north-west folds which occur in Australia, and tend to lie in concentric lines about a centre near Cape Leeuwin.[1] But on the whole Australia has been remarkably free from great folding forces in later geological times. Ordinary normal erosion by rivers and wind has been at work and has succeeded in wearing the greater portion of Australia to a uniform height of some 1,000–1,500 feet above sea-level.

[1] This aspect of Australian physiography is treated in a masterly fashion by Professor David in his presidential address to the Royal Society of New South Wales, 1911, which should be consulted.

Broadly speaking there are no large areas of Tertiary deposits in Australia. Since Cretaceous times there can have been no very important alterations in the surface of Australia as we know it, though undoubtedly as regards outline it then extended very much further to the south-east and east than at present.

Australia is approximately rectangular in shape—the north and south edges, however, being curved and concave Shape.

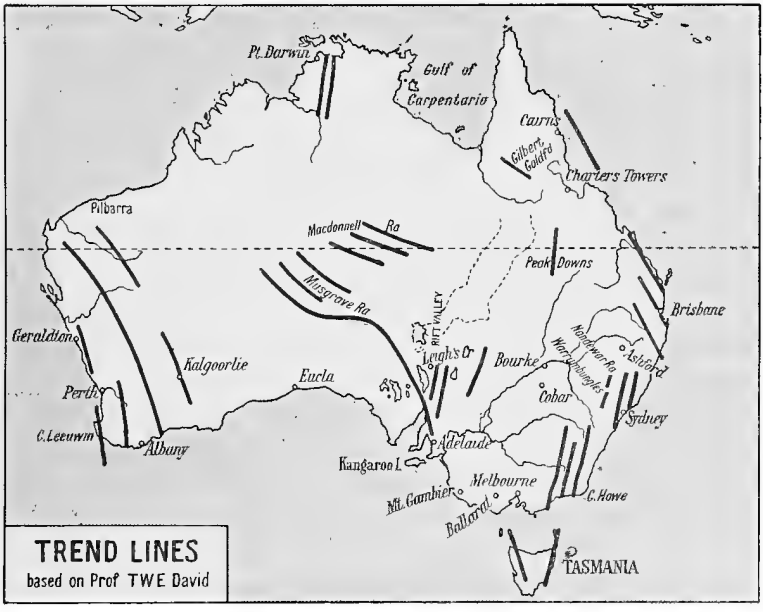

FIG. 1. Main Trend-lines of Australia. (After Prof. T. W. E. David.)

to the south. This concavity of the coasts is probably not unconnected with the folding forces which have operated throughout the South Pacific, for we can see similar curves concave to the south-west in the island-festoons off Australia, e. g. New Hebrides, New Caledonia, and New Zealand itself.

The western coasts (south of North-West Cape) and the east coast (perhaps along the whole extent) are determined largely by faulted blocks, whose lines of shearing are

approximately those of the main trend-lines, i.e. north to south or north-west to south-east.

Little is known of the physiography of the Gulf of Carpentaria, which is the most prominent indentation. It is shallow and on the whole probably undergoing elevation, for it is fringed by post-Tertiary deposits. It is perhaps a relic of the ancient Mesozoic sea which almost separated Western from Eastern Australia.

In the south the long Spencer and St. Vincent Gulfs are closely connected with extensive trough-faulting. This is still the most active seismic area in Australia, and in 'slips' along the old north-south axes of the Flinders Range the large Lake Torrens also originated.

Position. In position Australia is the most completely isolated large land mass (excluding Antarctica). Taking as a standard of length the distance from London to Algiers (about 1,000 miles), the journey from Perth to Colombo is more than three times this unit; and the same huge distance lies between Hong Kong and Thursday Island in the north of Queensland. Indeed, Java is the only large civilized area which is within a thousand miles of any portion of Australia.

But Australia itself is a country of vast distances. It is 1,600 miles from Perth to Adelaide, the capital of the next State; while to reach the third town of New South Wales (Broken Hill) from the capital (Sydney) a railway journey of some 1,400 miles (via Melbourne and Adelaide) is necessary.

Area. Australia, including Tasmania, has an area of 2,974,581 square miles; and with the region of Papua (British New Guinea), which is administered by Australia, the total rises to 3,065,121. This is considerably less than the area of Europe or of Canada, but almost exactly that of U.S.A. excluding Alaska.

Relief. The grain of Australia is from the north or north-west to the south or south-east. In large areas of the east this is so much the case that the strike of the older rocks has been called the travellers' rock compass. No accurate contour maps have yet been made of any portion of Australia; but railway and irrigation surveys, together

with the heights of numerous trigonometrical stations, enable us to make a close approximation to the truth in South-Eastern Australia.

Broadly speaking Australia consists of three well-defined and contrasted areas—the western ancient plateau of 1,000–1,500 feet in height; and two eastern belts. The more central of these is a meridional belt of low-lying level-bedded deposits (of Mesozoic age chiefly), while the eastern portion is an ancient cordillera forming a fairly complete bulwark barring out the Pacific Ocean from the central plains.

These three elements which build Australia are, however, somewhat complicated by local variations.

The Western Plateau is bounded on the west by a belt of later (Mesozoic and late Palaeozoic) sediments, closely resembling the better known belt of the same type along the east coast and in places folded into similar well-marked ranges.

Along the boundary between the Plateau and Central Lowland, the elevated knot of ranges called the Macdonnells (4,000 feet) is flanked by the Lake Eyre depression, where the lowlands sink below sea-level.

Further south the outlet of the lowlands (at the mouth of the Murray) is also a locally depressed area filled by Tertiary deposits. This lies in close juxtapósition with the South Australian Highlands (4,000 feet).

The abrupt change in direction near Mount Kosciusko, where the main trend-lines (fold directions) swing to the west, is accompanied by block-faulting which has given rise to the Bass Straits. Tasmania undoubtedly preserves to us a fragment of a lost (Pre-Tertiary) Australia, which originally extended perhaps some 300 miles to the east of its present eastern coast-line.

Regional Divisions

Political boundaries.

In Australia the political boundaries are artificial. With the exception of one or two natural lines of demarcation, such as the River Murray, they follow no natural inland features. Even this latter boundary was so

ambiguously defined that there are some grounds for the statement that the whole of southern New South Wales should belong to Victoria; for the Riverina region certainly does not lie 'to the north of the tributary of the Murray *rising nearest to Cape Howe*'.

It is preferable to consider the geography of Australia in terms of its chief natural regions and not in terms of the various States and territories. Since the Commonwealth

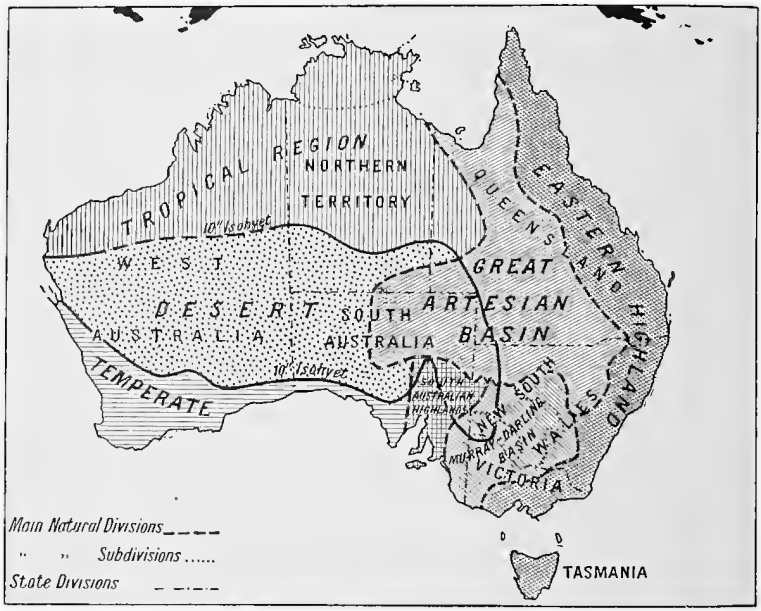

FIG. 2. Relation of Natural to Political Divisions.

(with its unity of policy) was constituted, the various State railway-systems are gradually being linked across the boundaries (an example has been the delay in linking the Riverina to Melbourne). These have been hitherto perhaps the chief factors in maintaining State differences within the artificial boundaries determined by the constitution.

Although Australia is a continent characterized by the slow change in the nature of its surface, by a monotony in the flora, and by vast uniform expanses of rolling grass-

land or more arid steppe, yet the larger States are so extensive that several types of environment occur therein and react each in its own way on the life and industries of the inhabitants.

The regions we shall adopt are : Natural regions.

(i) The Eastern Highlands fringing the Pacific and extending from Cape York to the Victorian Grampians and Tasmania.

(ii) The Murray-Darling Basin, a region chiefly below 1,000 feet and extending from Bourke to the mouth of the Murray.

(iii) The South Australian Highlands with their associated fault valleys ; extending from Broken Hill to Port Lincoln.

(iv) The Great Artesian Basin reaching from the Gulf of Carpentaria to Lake Eyre.

(v) The Western Region embracing the western half of the continent.

The political areas are built up as follows:

Political.	*Natural Elements.*	
	Lowlands.	*Highlands.*
Queensland 670,500 square miles	Eastern section of artesian basin (iv).	Northern section of E. Highlands (i).
New South Wales 310,372 square miles	South-east portion of artesian basin (iv); merging into the Murray-Darling Basin (ii).	Central section of E. Highlands (i).
Victoria 87,884 square miles	Southern portion of Murray-Darling Basin (ii).	Southern section of E. Highlands (i).
Tasmania 26,215 square miles		Isolated portion of E. Highlands (iii).
South Australia 380,070 square miles	Trough-faults to west of highlands (iii);	Highlands of Flinders Range, &c. (iii).
	Western portion of artesian basin (iv).	South-east portion of W. Plateau (v).
West Australia 975,920 square miles	Is wholly comprised in the Western Plateau Region (v).	
Northern Territory 523,620 square miles	Is provisionally also classed with the Western Plateau Region (v).	
Papua 90,540 square miles	A cordilleran region.	

The Eastern Highlands

The Great Dividing Range.

Perhaps the dominant feature on most maps of Australia is the so-called Great Dividing Range. This belt of highland undoubtedly constitutes the divide between the

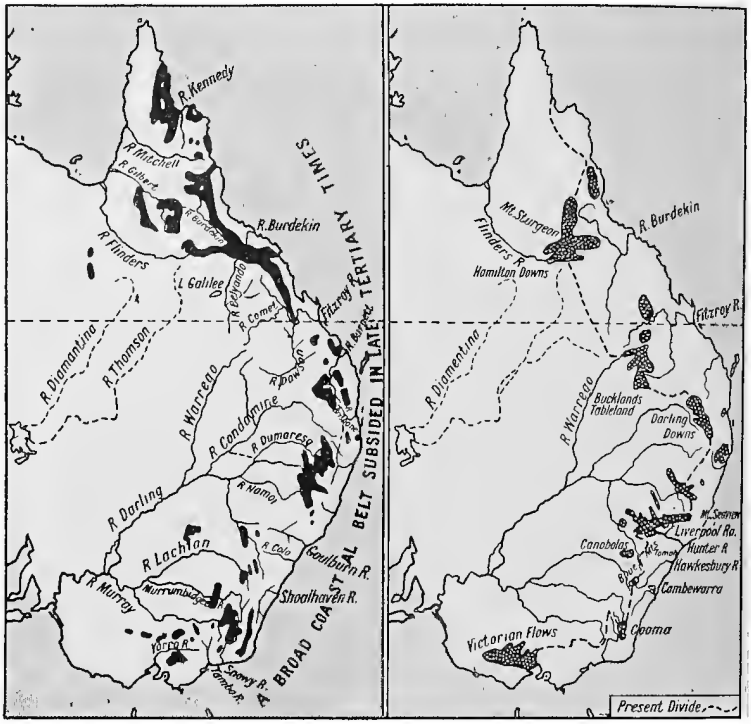

Fig. 3. (*a*) The granite areas of Eastern Australia, showing their agreement with the ancient pre-uplift divide. The probable arrangement of Tertiary drainage is indicated. (*b*) The later volcanics of Australia, chiefly late Tertiary basalts, showing their association with the warp constituting the present divide.

coastal drainage and that flowing westward to Lake Eyre or the Murray mouth. But if we examine it all closely it is seen to be in no sense a range, but is for the most part a series of disconnected elements of very diverse origin.

In Queensland it is only an important feature where formed of basalt-flows of comparatively late date. Be-

tween these it is often a mere warp-ridge, a few hundred feet above the general level. In New South Wales, in the north, the great divide runs on solid ground for 100 miles along the New England granite massif. But the Liverpool Ranges, quite a late geological formation, deviate it to the west. Here the divide is only a low water-parting (at Cassilis) between the Goulburn and Talbragar Rivers, where the cutting action of the Goulburn has driven the divide far to the west, and the latter is not 2,000 feet high.

The divide returns along the southern rim of the Goulburn Valley towards the coast, and runs southwards along a series of indefinite ranges, consisting here of basalt-flows, there of recent folds, and again of cols as at Lake George and Cooma. Near Cooma it zigzags, owing to recent river captures, around the heads of the Snowy and Tambo Rivers. In Western Victoria it crosses the Pleiocene basalt which has filled a previous lowland.

Eastern highlands.

Lying parallel to the modern divide, and in the north considerably to the east, is another belt of highlands nearly coincident with the coast-line. These coast ranges are formed of an almost continuous series of granite masses from Tasmania to Cape York. South of Queensland the modern basalt-capped divide and the granite masses are mingled to a greater degree. This broad complex of highlands of varying origin forms a fairly well-marked belt to which the name Eastern Highlands is here applied.

The following subdivisions of the Eastern Cordillera are convenient: (i) The Queensland Highlands; (ii) The South Eastern Highlands in New South Wales; (iii) The Victorian Highlands and their coast plains; (iv) Tasmania.

The Queensland Highlands

General structure.

This is a belt about 150 miles wide, extending from Cape York to the New South Wales border, possessing a fairly homogeneous structure. Along the coast extends a belt of ancient granite ranges often pierced by deep gorges through which the streams now reach the sea.

Within this bulwark is a belt of later Palaeozoic rocks (Devonian to Permian) which have been cut into by coastal rivers. Overlying these deposits on the west are later sediments of Mesozoic age. They have been subjected to gentle warping accompanied by volcanic outbursts in Tertiary times. This earth movement has led to the blocking of many rivers which originally flowed to the west (from the granite Coast Range), and the warping possibly gave rise to extensive inland lakes. Later these lakes were drained by rivers running to the east to a new coast-line determined by extensive faulting and subsidence all along the coast. On this subsiding coast has risen the Great Barrier Reef.

Great Barrier Reef.

For some 1,200 miles the coast is flanked by this coral reef,[1] which extends as far south as the tropic of Capricorn. Its steep outer margin is some 30 to 75 miles from the coast. Within this wall (where each small living reef represents a battlement) is an inland sea averaging about 20 fathoms in depth. In these clear tropical waters are found the pearl-shell, turtle, and bêche-de-mer whose collection constitutes industries which centre at Cooktown and Thursday Island.

Queensland: settlement.

Settlement has not radiated from the capital of the State to such an extent in Queensland as elsewhere in Australia. Mining led to the growth of coast towns such as Cooktown, Cairns, Townsville, and others in the far north. Short railways were pushed inland to reach the mines. The isolated sheep and cattle stations also made use of the railways, and the pastoral holdings soon increased in number and value.

Agriculture is confined practically to sugar and maize, the former being much the more important. These are grown along the coast, and only in the river-bottoms. Here alone are the conditions of deep soil and good rainfall to be found, for the highlands are in general too rocky for agriculture—while the rainfall rapidly decreases inland. So that many independent belts of settlement each connected to its port arose—a state of affairs very different

[1] Saville Kent, *The Great Barrier Reef of Australia*, London, 1893.

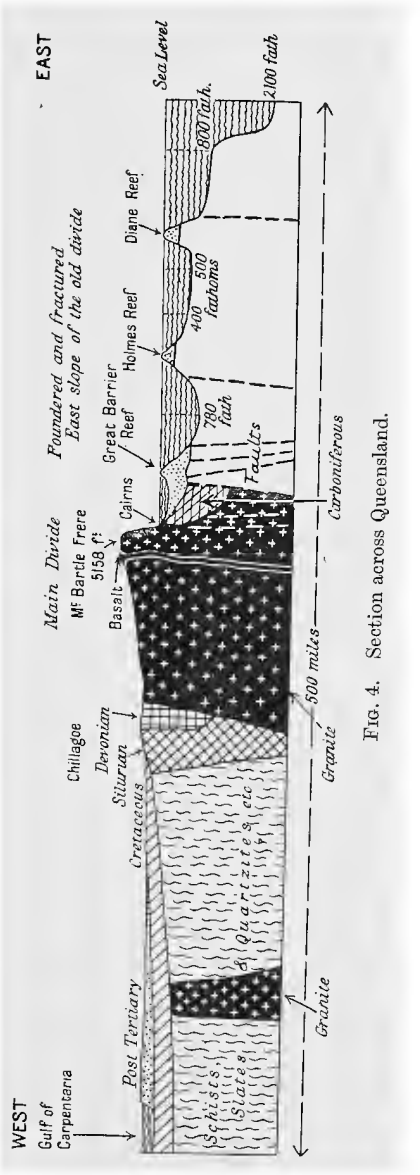

FIG. 4. Section across Queensland.

from that obtaining in New South Wales, Victoria, or South Australia.

Coast. The coast is in the main rocky, and is fringed with islands which are relics of the subsidence of coastal ranges. Where the north-south grain of the highland is truncated by the coast-line there are many bays and good harbours, e.g. Broad Sound, Townsville, and Cairns.

Railway routes, towns, and industries. There are four important railways crossing the cordillera in Queensland. The most northern line from Cooktown leads inland to the mining fields near Laura. At Cairns the Barron River is cutting back a six hundred foot gorge (into the edge of the fault scarp) which 'heads' in the famous Barron Falls. Up this gorge winds the railway to the Chillagoe Mines. The country has been found suitable for dairying, and now the railway is prolonged 100 miles south-west to Charleston, so that it reaches the lower country west of the highlands.

Burdekin basin. Inland from Townsville runs one of the chief Queensland railways. This makes no use of the main river valley, that of the Burdekin, for the latter cuts the coast range by an impassable gorge. The railway originally only extended inland to Charters Towers near the Upper Burdekin, but now reaches far inland almost to South Australia, and will perhaps link up with the projected trans-continental line to Port Darwin. Near Booroman it crosses the main divide, which is here barely noticeable, though to the north basalt ranges form a striking feature.

The southern tributaries of the Burdekin, the Cape River, and the Belyando rise in the warp-divide near the broad shallow lakes, Buchanan and Galilee. The latter would seem to be warp-lakes connected with the late origin of the divide, and there is a strong probability that in early Tertiary times these tributaries formed part of the Thomson-Barcoo and Warrego-Darling systems of the west.

Mackay. Further south along the coast is the port of Mackay, one of the most important sugar centres in Australia. It is connected by excellent steamer service to the other ports, but no railway yet links it to the capital. Wedged

in by the granite range to the west, it has a network of local railways bringing cane to the central mills.

The basin of the Fitzroy River exhibits the same features of stream capture as the Burdekin. Its chief Fitzroy basin.

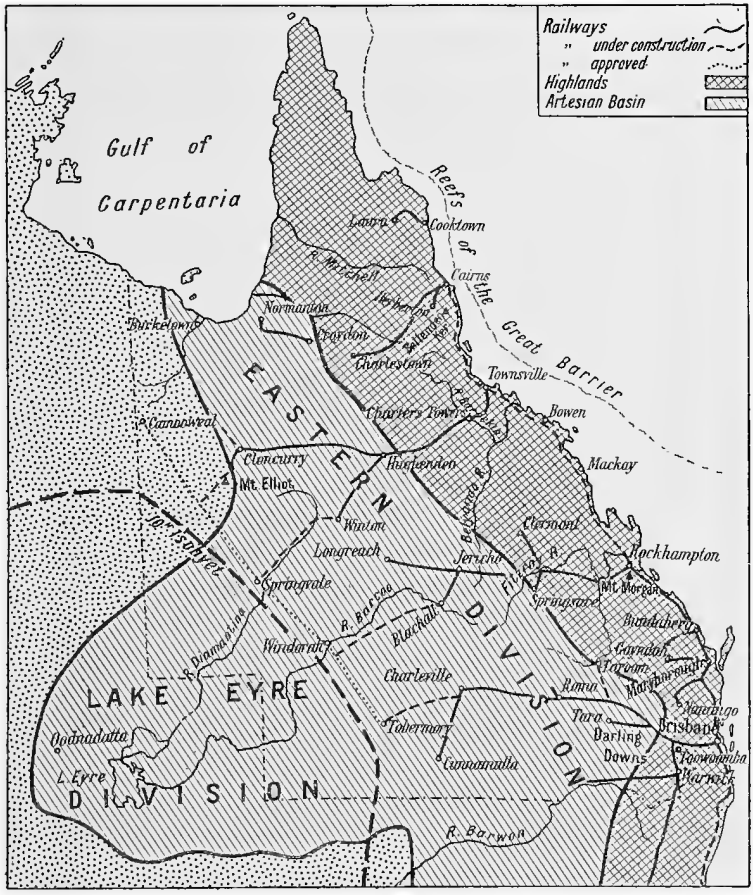

Fig. 5. Queensland and Artesian Basin.

tributary to the south (Dawson) rises in comparatively low ranges and is parallel to the western Condamine. The Comet and Nogoa are similarly only separated from the western systems by the late basalt-flows constituting the Carnarvon Range. After irregular courses (suggesting

stream reversal) the Dawson and Mackenzie unite and flow through a comparatively narrow rocky valley (near Gogango) cut through the coastal highlands to the sea.

Far inland along the tropic of Capricorn runs the railway from Rockhampton. It crosses the low divide at Jericho and at present ends at Longreach. A rich pastoral and mining region is served by this line. To the south-west of Rockhampton lie Mount Morgan (25 miles), one of the best known gold mines, and Dawson (80 miles), destined, perhaps, to be one of the chief coalfields of the Southern Hemisphere.

Southern Queensland.

The same general features as those described for the northern part of Queensland characterize its southern portion. Sugar ports, like Bundaberg and Maryborough, also serve as outlets to mining districts, such as Gympie and Kilkivan. A very flourishing area of basalt country, known as the Darling Downs, is chiefly devoted to agriculture. The railway from its chief town (Toowoomba) descends the scarp of the downs and reaches the coal basin of Ipswich; thence proceeding down the valley of the Brisbane River, it reaches the capital of the State.

Although a coast railway is projected from Brisbane for 1,000 miles north to Cairns, yet at present only the section from Brisbane to Rockhampton is completed. This delay in linking to the capital is directly due to the presence of the granite ranges. Though now forming the coast-line, and preventing easy communication, these were in Tertiary times flanked on the east by a broad area of piedmont, which has now sunk beneath the Pacific.

The South-Eastern Highlands in New South Wales

General features.

The structure of the highland region of the Mother State differs somewhat from that of Qucensland, and more is known of its physical features. These may be summarized as follows.

There are three massifs of Palaeozoic rocks buttressed by granite bosses. In the north is the New England Tableland (3,000–5,000 feet), extending from Queensland to the Liverpool Ranges. Then there is a well-marked broad

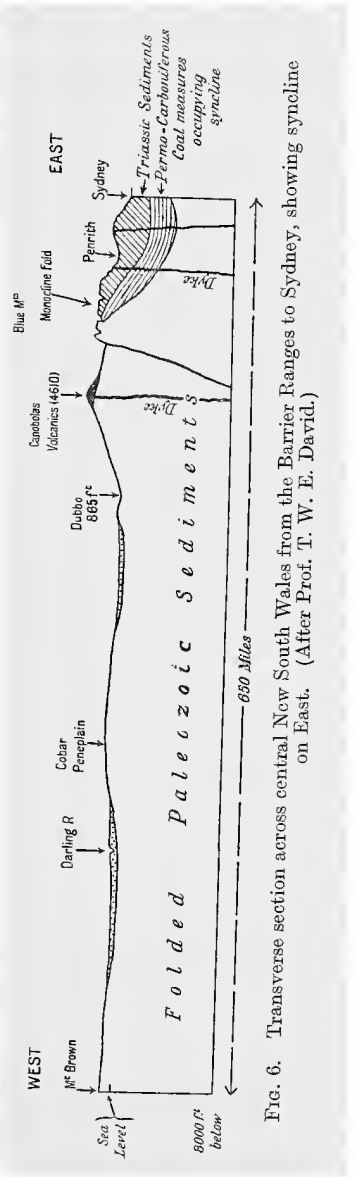

FIG. 6. Transverse section across central New South Wales from the Barrier Ranges to Sydney, showing synoline on East. (After Prof. T. W. E. David.)

gap where the divide sinks to 2,000 feet from heights of 4,000 feet north and south. To this gap, due to the erosion of the tributaries of the Hunter in the soft coal-measures, the name of the Hunter (or Cassilis) Gate has been given.

In the centre of the highland belt is another plateau of about 3,000–4,000 feet elevation extending from the volcanics of the Canobolas (Orange) to the great Blue Mountain scarp behind Sydney. It is bounded on the south by another broad gap, the Lake George Gate.

In the south is a pair of massifs, exceeding 7,000 feet in the south-west, separated by the long narrow valley of the middle Murrumbidgee.

The coal basin of New South Wales.

The most striking feature is the coal-measure basin, with Sydney near the middle. It extends north for 200 miles to the Liverpool Ranges, and south for 100 miles to Moruya. Two great beds of payable coal, the Newcastle and Greta seams, extend under a large portion of this area, like two black saucers whose eastern rim has been truncated by the faulted sea-coast. In the west the upper black 'rim' (Newcastle seams) crops out at Lithgow some 2,000 feet above the sea. At Newcastle on the north both seams rise to the surface. At Bulli to the south we find the Newcastle seam in the coast scarp 1,000 feet above the sea, and at Clyde River in the far south of the basin the coal of the lower (Greta) seam is exposed at about sea-level. Under Sydney the upper seam is nearly 3,000 feet below sea-level.

The effect of this syncline on the topography is not so strongly marked as might have been expected. Not only the Permo-Carboniferous coal-measures but also earlier and later deposits have participated in the far-reaching coastal movements of Tertiary times. We may describe the highlands here as having a gentle slope to the west, and an abrupt edge on the east, some 2,000 feet high, which has been truncated by coastal subsidences. These occurred so long ago that coastal erosion has gnawed away the sharp faulted edges. Moreover, where the rocks are softer, as in the basins of the Clarence and Hunter Rivers, and in the soft marine shales of Illawarra, a comparatively

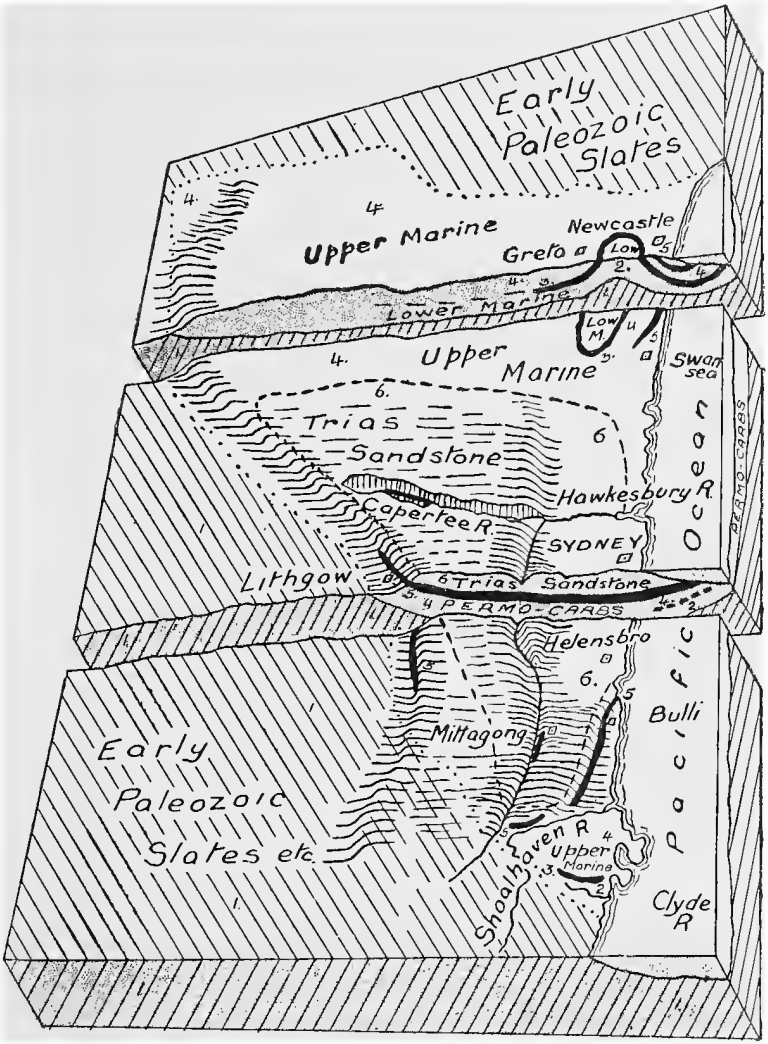

FIG. 7. Sketch-model of the Chief Coal-field of Australia, showing the Relation of the Coal Outcrops (black) to the Scarps and Valleys of the Blue Mountains. It is cut across at Sydney and Newcastle to show the underground relations of the main seams. 1 = Silurian Slates enclosing Coal Measures (hatched); 2 = Lower Marine Permo-Carb. Series; 3 = Greta Coal Seams; 4 = Upper Marine Series; 5 = Newcastle Seams; 6 = Trias Sandstone Capping.

wide coastal plain has resulted. Further, the Sydney lowlands are associated with a great monoclinal fold which has buckled the upper shale beds (of Triassic age), so that the western portion is 2,000 feet above the eastern around Parramatta, which is near sea-level. The effect of numerous faults will be considered in the next section.

Central plain of NE. New South Wales.

In the north-east the coastal plain watered by the Clarence, Richmond, and Tweed differs somewhat from the remainder of New South Wales. It is characterized by a 'soft-wood bush', a relic of Malay flora preserved here by suitable temperature and rainfall. Here also is grown all the sugar of the mother state, for it has been found too cold for the canes south of the Clarence Basin.

Grafton, Lismore, and Murwillumbah are devoted to sugar-growing and dairying, and are linked together by an isolated railway system of their own.

New England Plateau.

The New England Plateau is a resistant mass of Palaeozoic rocks uplifted in late Tertiary times whose eastern boundary appears to be determined largely by a series of grand fault-planes. The streams flowing to the sea cascade several thousand feet into deep narrow gorges, of which those at the head of the Macleay will undoubtedly become renowned beauty-spots. But the broken character of the hinterland between the plateau and the coast will long prevent settlement on any but an insignificant scale. Pastoral industries and mining form the chief occupations of the people in New England, and here English fruits thrive well. Armidale is the chief town, while Tenterfield and Glen Innes lie further to the north on the railway which runs along the plateau-like divide.

The Hunter Gate.

The Hunter Gate, drained by the Goulburn and Hunter Rivers, has a lower rainfall than any other portion of the state east of the divide. Associated with this is the appearance of some western plants (gidga trees, &c.) unknown elsewhere in the coastal belt. The valley is very fertile in its lower portions and grows great crops of lucerne and maize. Dairying is carried on also, but

PLATE III. IN THE NORTH COAST DISTRICT, NEW SOUTH WALES
(High Commissioner for Australia)

PLATE IV. GROSE VALLEY, BLUE MOUNTAINS

PLATE IV (High Commissioner for Australia) UNTAINS

coal-mining is the chief industry of the towns around Newcastle, while the upper portion (the Goulburn Valley) is occupied by sheep stations.

Blue Mountain Tableland.

The Blue Mountain area is typical of the topography of much of southern New South Wales. In place of steep ranges with broad valleys between, there are here rather broad undulating plateaus dissected by narrow deep gorges, and bounded by fault-scarps or huge monoclinal folds. The Blue Mountain Plateau is some 80 miles in diameter with an elevation of 2,000–4,000 feet. To the north is a barren

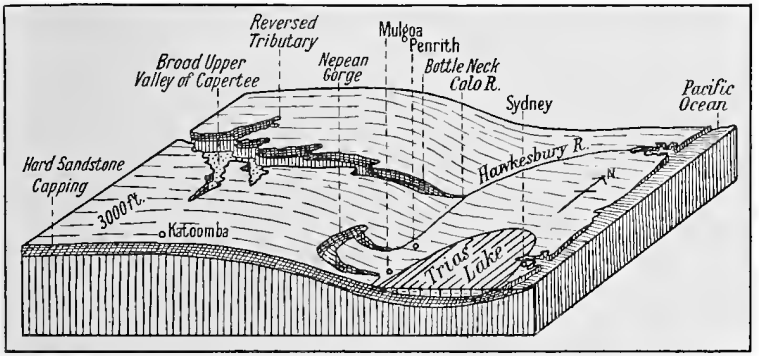

FIG. 8. Block-diagram showing Effect of the Late Tertiary Monocline on the Rivers and Valleys of the Blue Mountain Plateau.

expanse of Trias sandstone intersected by the Capertee River and its tributaries. To the west it is capped by the ancient volcanic cones of the Canobolas Mountains. On the south-east it is drained by the tributaries of the Hawkesbury River. The latter run now in deep valleys leading to the east, but the westerly course of many of their tributaries and the faulted boundary of the geosyncline along the meridian of 150° E. support the view that in Tertiary times all these coastal streams flowed westward towards the central Australian sea. The famous 'bottle-neck' valleys of the Blue Mountains with walls 1,000 feet high are due to the erosion of the soft coal-measures below the hard barren Trias capping. Where the river

runs through the hard rock of the lower limb of the monoclinal fold it has cut only a narrow notch, the 'bottle-neck' which amazed Darwin.

Railways, towns, and industries.

The late Tertiary subsidence along the coast has drowned many old river valleys and formed the harbours and bays at Sydney, Port Hacking, &c. Round Sydney the coastal plain is about forty miles broad, reaching to the River Nepean below the Blue Mountains. This plain is the centre of an old Triassic lake; for a great portion of it consists of bluish clays raised but a hundred feet above sea-level. These clays are more suitable for agriculture than the barren Trias sandstones underlying and surrounding them. The orange and apricot orchards to the west of Sydney occur on this soil. Northwards the railway to Newcastle passes over barren sandstone, of little use for aught but residential sites. The more fertile coal-measures are reached near Gosford. To the west runs the Western Railway through orchard country until the Nepean River is reached. Here on the flood-silts great crops of maize, lucerne, pumpkins, &c., are grown. Then the railway climbs to the tourist centres of Katoomba and Mount Victoria, built on the same barren sandstone. Later it crosses the divide beyond the manufacturing town of Lithgow and reaches the pastoral and mining region between Bathurst and Orange. These are situated on much older Silurian slates which, though not very fertile, are superior to the Trias soils. Only occasionally in this sandstone plateau where Tertiary volcanoes have enriched the soil, as at Mount Irvine and Mount Wilson near Mount Victoria, are there areas suitable for close farming.

The third railway radiating from Sydney runs to the south-west. It passes the manufacturing centres of Clyde and Granville and gradually climbs up the Nepean Valley to Mittagong. From here it runs at a fairly constant level through poor agricultural country (except where enriched by basalt-flows, as near Moss Vale) until the gap south of the Blue Mountain massif is reached near Goulburn. To the west of the line lies a maze of rugged gorges carved in the sandstone plateau, and containing few

settlements except that at Yerranderie, where silver is mined; or Wombeyan, where the limestone caves attract many visitors—both in deep valleys in older sediments below the barren Trias.

Finally, the South Coast Railway runs over the deep valley of Georges River, and having passed the steep coast of Trias sandstone, it descends to the Illawarra coastal plain in the softer coal-measures. Here is a well-watered and fertile dairy country, rich in easily worked coal-mines. Wollongong and Kiama are two important towns on small harbours formed by more resistant strata. Some five or ten miles back from the coast is the 1,000-foot scarp of the Triassic sandstone plateau. Only four roads—through Bulli, Macquarie, Jamberoo, and Barrengarry—climb this scarp to the main Southern Railway, each one patronized by tourists.

Correlation of physical conditions and settlement.

It will be seen in conclusion how closely the physical conditions and settlement are here related. A drowned river valley—luckily free from silting, for its head-waters had been captured by the Nepean River—is responsible for Sydney Harbour, and has led to the growth of the chief city of Australia. The Wianamatta clays have given rise to the gardens and orchards west of the city. The hard Hawkesbury sandstones have led to an inhospitable coast-line between Broken Bay and Bulli, so that the railways keep back from the coast. The late Tertiary uplift has led to the almost impassable plateau separating Sydney from the interior on the west. To this day there is only one main road (skirting the railway) whereby vehicles can reach the western plains near Bathurst. All routes are blocked by the deep gorges of the plateau. Not until we pass beyond the barren cap of Trias sandstones at Gosford in the north, at Lithgow in the west, and at Bulli in the south, do we reach an environment suitable for natural development.

The western slope.

The western part of this area has mainly mature or senile features. It is a mining and sheep-raising country; the chief towns being Bathurst, Orange, Mudgee, Blayney, Molong, and Crookwell.

The south.

South of this area is the Lake George Gate where the Southern Railway crosses the divide and commences its descent of the western slopes to the Murray River. The main divide here is somewhat indefinite. Some cartographers put it west of Lake George, others east of the same (through Tarago), while it is strictly in a neighbouring region known as Duck Flat. A late Tertiary or Pleistocene fault with a drop of 400 feet on the east has here blocked the head-waters of the Yass River, and given rise to Lake George—at times the largest freshwater lake in Australia.

The Yass River joins the main Murrumbidgee River a little above Burrinjuck. Here the latter river, as a consequence of the Tertiary uplift, is flowing down a 1,500-foot gorge cut in Palaeozoic slates and granites. Advantage of this has been taken to build a gigantic concrete dam 200 feet high which will hold the waters back for 40 miles. The water is to be taken some 200 miles west down the river bed and used to irrigate the western plains near Narrandera.

The land rises to the south of Lake George into two great massifs culminating in Tindery (5,000 ft.) and Kosciusko (7,300), and between them is the long rift valley of the Murrumbidgee.

Federal territory.

The northern portion of this valley with the adjacent highlands constitutes the Federal Capital Territory. This is an area of 912 square miles relinquished by New South Wales to the Commonwealth for the purpose of building a southern Washington. The site of the city itself (nine square miles) is at Canberra on the Molonglo River about 36 miles south of Yass (on the main southern railway) and 8 miles west from Queanbeyan (on the Cooma Railway). It is situated on a broad plain which is overlooked by three isolated hills 800 feet high, and is traversed by the meandering shallow waters of the Molonglo River. The latter is to be dammed to form a lake 4 miles long.

In the south-west of the territory is a great granite block (horst [1]) reaching in Bimberi Mount to 6,000 feet

[1] A 'horst' is a residual block of the earth's crust which has not participated in the widespread depression of the neighbouring country.

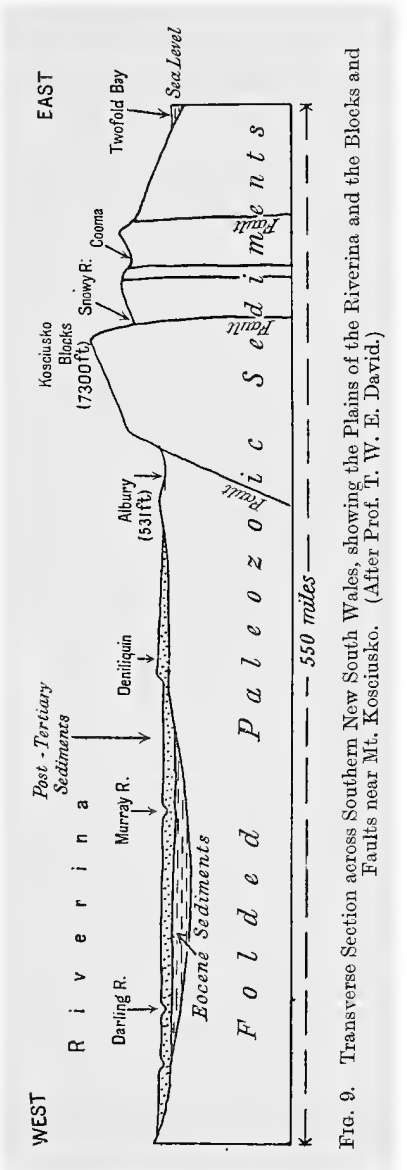

FIG. 9. Transverse Section across Southern New South Wales, showing the Plains of the Riverina and the Blocks and Faults near Mt. Kosciusko. (After Prof. T. W. E. David.)

and connected directly with Mount Kosciusko. This is traversed by deep north-south valleys, of which the Cotter Valley is to form the water-supply of the city. Crossing the centre of the territory 15 miles south of the site is a range of mountains 4,000–5,000 feet high, which mark the old divide between the Snowy River and Murrumbidgee River systems. The old head-waters of the Snowy, captured by the Northern River, now flow north through the Tharwa Gap after an abrupt reversal in the direction of their valleys. The city site is 1,900 feet above sea-level, and has an average rainfall of about 20 inches. Some thirty miles to the south the rainfall is 50 inches, so that a good water-supply is assured from the Upper Cotter.

Mount Kosciusko.

The two mountain masses we have now to consider are relics of a uniform topography which has been cut in two by a system of rifts and fault-basins (*Senkungsfelder*). The main depression is occupied by the Murrumbidgee and the middle Snowy River. There is a low gap near Cooma connecting the two valleys which has every appearance of having originally been the outlet of the Upper Murrumbidgee. The eastern Tindery block has its flanks washed by the Pacific. There is practically no coastal plain here, but flourishing dairying and mining settlements occur at the numerous river mouths. Milton, Ulladulla, Moruya, Eden, and Bega are towns of this character. No railways have yet been built, and the coach road climbs some 2,000 feet to reach the country to the west. The southern half of this faulted region is called the Monaro and is chiefly used for cattle-rearing. Many sheep-stations are found, however, in the faulted depressions between the blocks. Some mining is carried on, chiefly at Kiandra and Araluen. The Monaro culminates in the summit of Australia, Mount Kosciusko (7,340 ft.) in the south-west. This is easily reached by a good motor road from Cooma, but on the west its slopes descend almost precipitously to the waters of the Upper Murray. Moreover, the complications ensuing on the late Tertiary

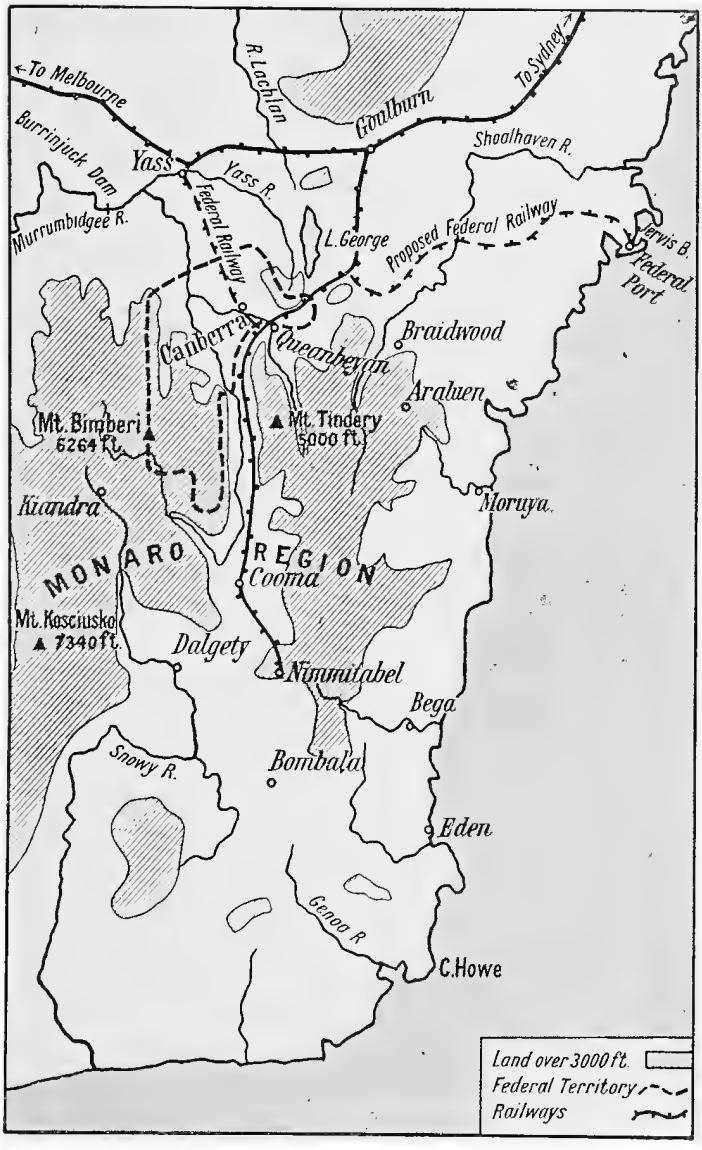

FIG. 10. Federal Territory.

block-faulting in this area have led to many deep gorges in the valleys of the Snowy and its tributaries on the eastern side also.

The Victorian Highlands and their Coast Plains

Physical features.

Nowhere is the artificial nature of the State boundaries better shown than in the south-east corner of the continent. The massif of Kosciusko continues uninterruptedly across the border into Victoria, forming a large high-level plateau whose summit is second only to Kosciusko. This massif, largely composed of granite, is traversed by similar north-south faults, of which a very striking example near Omeo appears to have cut off the head-waters of the Tambo River and grafted them on to the Mitta Mitta. A favourite tourist resort is Mount Buffalo, another flat-topped granite block between tributaries of the Ovens. Westward of the Omeo Gap the plateaus are more dissected, and indeed become real ridges which dwindle to a level of about 1,200 feet at Kilmore Junction. Beyond this to the west there are more or less isolated mountain elements such as the Pyrenees, a series of granite bosses, and the north-south sandstone ridges of the Grampians. The main divide near Ballarat is an almost level water-parting of which Professor Gregory says 'it is a level basalt plain, and if several men were sent across it independently to put a mark upon the highest point, they would probably differ in their positions by about a quarter of a mile'.

A mountain range of greater uniformity than the Great Divide would seem to have once run along the present Victorian coast in the form of uplifted Trias-Jura sediments of the Wannon Hills, Cape Otway Ranges, and Gippsland Hills. Between these and the main divide lies the Great Valley of Victoria, which has been subjected to varying warps and stresses which have broken the continuity of its southern bulwark and have led to the formation of Port Phillip. The buckling of the crust has been accompanied by one of the largest outflows of basalt in Australia. These flows have enriched the soil

and indirectly given rise to one of the most flourishing farming regions in the continent.

Towns and industries.

The rugged east-central portion of Victoria is practically uninhabited. There are a few small mining townships (Omeo, Bright, &c.) and one or two tourist resorts such as Buffalo; but for the rest it is more profitable to settle in the coastal plains south in Gippsland or in lower valleys of the Murray tributaries to the north.

The Gippsland Lakes are lagoons formed by dunes drifting across the mouths of the rivers. They are favourite resorts of tourists and fishermen. Bairnsdale, on the Mitchell River, is an important town and railway terminus. Sale, nearer Melbourne at the western end of the Lake District, is the chief town in Gippsland. Farming, dairying, and pastoral occupations support the people, while the foothills (as at Walhalla) have yielded a considerable quantity of gold in the past.

The high rainfall (45 ins.) of south-west Gippsland is accountable for the growth of the giant eucalypts. These are the largest hardwood trees in the world and heights of over 360 feet have been measured.

North of the mountains are small townships which in the east are chiefly devoted to mining (Beechworth and Yackandandah). Wangaratta, Benalla, and Seymour on the Inter-State Railway are flourishing towns devoted to farming and pastoral industries. The rough country to the south of Benalla was the haunt of numerous bush-rangers, of whom Kelly was perhaps the most notorious.

When the Kilmore Gate is passed in our traverse to the west, the character of the country changes considerably. A network of railways crosses the divide without difficulty and sends out to the north-west the six parallel tentacles which have helped so greatly in developing the Wimmera and Mallee Plains. Ballarat, Bendigo, Castlemaine, Ararat, Stawell, all owe their origin to gold-mining, and their present prosperity in no small degree to the less fluctuating profits of agriculture and sheep-farming.

Port Phillip.

Port Phillip is a large, shallow, and somewhat exposed sheet of water. It is probably due to subsidence accom-

panied by faults which appear to extend north from Sorrento to Kilmore Gap. Moreover, the western portion of the Yarra River has been affected by a fault-trough developed around the west of Mount Dandenong.

Melbourne.

Melbourne has grown up around the mouth of the Yarra and has spread southward along the flat tea-tree covered shores of Port Phillip for 15 miles or so. The suburbs run north and east, but not in any great degree to the west. Williamstown and the large town of Geelong have been settled in suitable sheltered spots on the western shores of the Bay.

South-west Victoria.

West of Port Phillip is a lowland area studded with ancient craters, of which that at Tower Hill may well have been the last active volcano in Australia. The numerous small lakes in this region, such as Corangamite, are due, in Professor Gregory's opinion, to local subsidences consequent on the outflow of lava. The resulting soils, rich in lime and phosphates, and the good rainfall have made this the most prosperous region in the State, where steady and lucrative returns accrue from comparatively small areas of land. In the south-west region are several centres of closer settlement, served by the ports of Warrnambool and Portland. Railways connect these ports to Melbourne, but it is hoped that the capital city, which is twelve times larger than any other Victorian town, will be saved from further congestion by their greater independence.

The basalt country.

The newer basalts (late Tertiary) extend from Melbourne west to Glenelg River. They form an almost continuous sheet about 150 miles from east to west and some 50 miles broad, with long tongues extending down the Campaspe and Loddon Rivers to the north. Many craters form conspicuous features, especially near Ballarat (Mount Warrenheip), Daylesford (Mount Franklin), and Terang (Mount Noorat). It seems more probable that this vast sheet of lava has developed from many independent volcanic outlets rather than that it is a fissure flow such as we know of in Iceland. Hamilton in the west is the chief town on these basalt plains; Penshurst and Terang are less important.

Tasmania

Separated from Australia by the late subsidence of Bass Straits, Tasmania forms a unit of Australia which has not foundered like much of Tertiary Australia. Two important trend lines associated with granite bosses running down each side of the island would seem to have buttressed and preserved the central sediments. The central plateau consists of coal measures capped largely by basic lavas. These huge mesa-like massifs are known as 'Tiers'. Though they may have been isolated by block faults, yet the protection from erosion by the hard cap of lava may account for their characteristic structure. Cradle Mountain (5,069 ft.) is at the north-west of the plateau and presents a huge scarp to the sea which is probably due to an extensive north-west to south-east fault plane. Large lakes occur on the plateau, drained by rivers which have cut deep gorges in the edges of the Tiers. The island is described in detail in Chapter IX. Physiography.

The Lowland Belt of Australia

Between the Eastern Highlands and the Western Tableland lie the Central Lowlands. This area is conveniently divided into the Murray-Darling Lowland in the south, and the artesian lowlands in the centre and north. Physical history of the lowland.

In Permian times there was a long and rather narrow depression extending from Cooktown (Queensland) to Cape Howe (New South Wales), while the central portion of Tasmania was also occupied by the Permian Sea. In these seas were deposited sediments conformable with our chief coal-measures. Since the coal seams in the latter are of freshwater origin the sea was occasionally shut off from the ocean and presumably restricted in area. In Triassic times the region further to the west was sunk and the main axis of submergence moved west. In Cretaceous times, a further depression took place, still to the west. The deposits then laid down constitute the greater part of the lowlands. Most of the inland rivers, e.g. Upper Lachlan, Castlereagh, Macquarie, Condamine, and

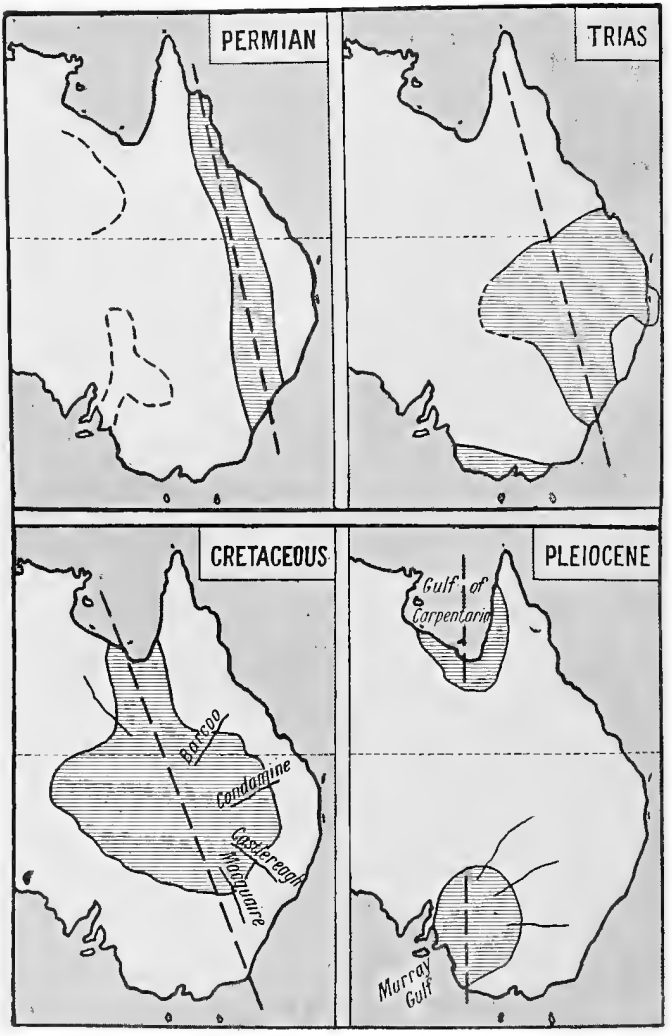

FIG. 11. Evolution of Australian Lowlands.

Barcoo, are heading for this ancient sea. An elevation *en masse* turned the Cretaceous sea into dry land, and also raised the Eastern Highlands higher. In later Tertiary times the gulfs which were relics of the Cretaceous sea (at Murray mouth and south of Carpentaria) were also elevated, and Australia arrived at its present shape.

In contrast to the Eastern Highlands, largely composed of folded slates, granites, and basalts, these lowlands are formed for the most part of level-bedded marine sediments. In the north they are of Cretaceous age, and will be considered in the section on the artesian area.

In the southern portion the Mesozoic marine sediments (here largely Triassic) have been covered by an extensive deposit of river silts and estuarine gravels. In the far south occur the upraised Tertiary marine beds which were deposited in the Murray Gulf at a time when the tributaries of the Murray River entered the sea by separate mouths.

The Murray-Darling Lowlands

Southern portion of the lowland belt.

The southern portion constitutes the Murray-Darling Lowlands, an approximately square area some 400 miles wide, chiefly in New South Wales. The boundaries are fairly well defined on the south by the Victorian Highlands. On the west it is flanked by the inliers of very ancient slates and quartzites (of Cambrian age or earlier) of the Flinders and Barrier Ranges. On the east it rises gradually to the Highlands. The foothills (below 2,000 feet) may be classed with the lowlands. On the north the boundary between it and the great artesian basin is not apparent at the surface, but has been mapped from borings. It runs along the Rivers Bogan and Darling to Bourke, and thence in a general westerly direction until the Cambrian Highlands are met with beyond White Cliffs.

Division I. Cobar-Wagga peneplain.

If we accept the 2,000-foot contour as a natural limit of the dry lowlands (which view is supported to some extent by the distribution of rainfall and of the plains' vegetation), then considerable areas of folded Palaeozoic rocks are included in them. They may be grouped in one division, which Professor David has named the

Cobar-Wagga peneplain.[1] Unlike the Eastern Highlands, it has not been much uplifted, and so it closely represents early Tertiary Australia. It is rich in minerals, especially gold and copper, and elsewhere has been named the 'Gold-Copper Slope' for this reason.

Towns and industries.

The area is of an hour-glass pattern, the valley of the Lachlan almost separating the two inliers of ancient mineralized rock. In the Cobar moiety mining and sheep-growing are universal, the chief towns on this 'Palaeozoic island' being Cobar, Nymagee, Nyngan, Narromine. In the southern and eastern portion the rainfall is greater (15–25 inches), and it includes an important part of the wheat belt. Wagga, Young, Albury, and in the north, Parkes and Forbes, are wheat centres, and, with dry farming and suitable seed, wheat-growing is spreading to the west. Wyalong, Forbes, Parkes, Adelong, and Young are centres of gold- and copper-fields, and since sheep also graze here in large numbers it is seen that these southern foothills in New South Wales are unusually rich in pastoral, mining, and agricultural resources.

Division II. The Western plains and the Riverina.

These plains lie along the Darling (south of Bourke) and penetrate into the Cobar-Wagga peneplain. Their greatest breadth (200 miles) is in the Riverina—a name given to the Mesopotamia of the Lower Lachlan, Murrumbidgee, and Murray Rivers. For several hundred miles no hill is to be seen; indeed no rock crops out to break the monotony of the plains. The soils are of two kinds: (i) reddish disintegrated desert sandstones, rich in plant foods, cover extensive areas in the north, and with suitable tillage they will produce large quantities of wheat; (ii) richer still are the *black-soil* belts which represent old silted-up river channels, many of them still filled with river-water in flood time.[2] They lie for the most part in the outer portions of the plains.

Communication during the rains is extremely difficult,

[1] A 'peneplain' is an old land surface planed down by river and other erosive action nearly to sea-level.

[2] David, Introduction to *Geography of New South Wales*, by Jose, Taylor and Woolnough.

the heavy soils clogging the wheels of the great wagons. Single-line railways, however, are rapidly being pushed into this lowland belt, and are of the utmost value in transferring stock in time of drought.

The plains are not quite horizontal, but have an extremely gradual slope, amounting on an average to eighteen inches in a mile. The soil contains a large amount of sodium chloride and gypsum, the two salts most abundant in sea-water. It shows every evidence of having been deposited in a shallow sea or salt marsh. The plain is therefore one of accumulation.

Rivers.

The great rivers for the most part flow in rather deep gullies through these plains. In times of drought the Darling and Lachlan degenerate to a string of waterholes, but the Murrumbidgee rarely ceases to flow and the Murray never. During the floods, which occasionally occur, the rivers spread for miles over the plains and reoccupy ancient channels. Later these are left as serpentine 'billabongs', and large lakes may originate thus. There are said to be seventy of these lakes along the Lower Darling.

More or less permanent distributaries are also common on the Lower Darling and Murrumbidgee, and are locally known as 'anabranches'.

Towns and industries.

The plains country is devoted to the merino sheep. The rainfall is too low for wheat except in the eastern Riverina, where it is 20 inches. Large holdings of land are necessary in the western plains. In the west there are only one or two towns of any importance, which distribute stores to the sheep stations and receive wool for transport via rail or steamer to Melbourne or Sydney. Among these may be mentioned Deniliquin, Hay, Moulamein, Condobolin, Jerilderie, and Narrandera.

An area of great economic interest is found on the Lower Murrumbidgee near Narrandera. Two hundred miles up the river is the Burrinjuck Dam, just below the junction with the Goodradigbee River. The dam is to be 240 feet high, and will hold back the water for 40 miles up the main stream, with important additions in the Yass

and Goodradigbee Valleys. From the dam the water flows at first by the river channel and later by an artificial cut to the Yanco Irrigation Area. A weir diverts the water at Berembed into the Yanco Cut, and thence it will be led by canals into the irrigable areas north and north-west of Narrandera. The best land lies on the north of the river along the foothills extending from the Yanco siding to Gunbar.

It is expected that about 200,000 acres of first-class land and 360,000 acres of second-class land can be subdivided near Yanco for intense cultivation. It is possible that a further area south of the river will be irrigated by the surplus water impounded in the Burrinjuck Dam. It is estimated that the growth of fruits for drying (raisins, apricots, &c.), ordinary fruits, vegetables, and fodder will occupy some 50,000 people in the near future.

The Murray system.

The special feature of this region is the important river system of the River Murray and its tributaries. With its main tributary the Darling, no less than 2,500 miles are navigable in favourable seasons, but internal navigation is decreasing in importance. With the exception of a lock at Bourke very little has been done to extend the period when these streams are capable of being utilized as a channel of trade to the interior. With a high river the Murray is practically navigable to Albury ; but there is very little traffic beyond Echuca (which is 666 miles from the South Australian border). On the Darling steamers trade as far as Walgett, a distance of 1,180 miles from Wentworth. The Murray is navigable for about seven months (July to January inclusive) in the year. The Darling may be blocked for several years in a series of dry seasons. Moreover, the river-towns are now served by railways at Murray Bridge and Morgan in South Australia ; and in New South Wales and Victoria the railways reach the Murray at Mildura, Swan Hill, Koondrook, Echuca, Cobram, Yarrawonga, Corowa, and Albury. The Darling is linked to Sydney by railways at Bourke, Brewarrina, Walgett, and Collarendabri. Along the Murrumbidgee and Lachlan the railways run almost

parallel for the most important part of their courses in the plains.

Division III. The ancient Murray estuary.

An approximately circular area in the south of the Australian lowlands occupies an old bay or estuary into which the Darling, Murrumbidgee, and Murray probably entered by separate mouths. It extends from Menindie on the Darling to Glenelg River (Western Victoria), and is about 300 miles broad, its limits being Swan Hill (on the Murray) on the east, and the Mount Lofty Ranges (S.A.) in the west. In this region the rocks consist of marine sediments of late Tertiary age, largely sandstones, which near the coast are often covered by wind-blown sand cemented by lime into a fairly hard rock. Elsewhere the surface is coated with a recently formed calcareous layer (travertine) which is due to a natural concentration of lime-compounds at the surface. The rainfall is rather low (10–20 inches), the country being sheltered by hills from rain-bearing winds; but large areas, which were formerly deemed worthless, are progressing rapidly, since it has been discovered that wheat can be profitably grown here. The natural vegetation, especially in the southern portion, consists of a low shrub-like eucalypt, called the 'mallee', which forms very thick copse-like masses. This is being cleared to make way for the wheat. The Lower Murray passes through the middle of this tract, in which it receives no tributaries except in time of flood.

In the south-east the rainfall increases, and the 'Wimmera' district is supplied by the head-waters of several streams which rarely reach the Murray. Here there are extensive irrigation and water-supply works, as at Glenorchy, Dooen, and Boort. Some of these enable large crops to be grown, others only supply water for stock in the drier periods of the year.

The irrigation centres of Renmark and Mildura on the Murray (near the Darling confluence) are of great interest. Here large crops are obtained, in a region with only a 10-inch rainfall, by water pumped from the Murray. At Renmark (S.A.) 4,000 acres (chiefly devoted to grapes

and apricots) are cultivated, and in 1907 supported a population of over 1,000.

The Lower Murray, after entering South Australia, has an extremely slight gradient, its summer level at Morgan being only $5\frac{1}{2}$ feet above the sea, though this town is 120 miles inland. It has long since reached base-level, an easy matter in these soft marine strata, and flows for the most part along a wide gorge with steep cliffs often 200 feet high. At its mouth recent elevation has led to the formation of shallow basins and lakes in the old delta, of which one, Lake Alexandrina, is about 25 miles long. The drainage of the whole Murray Basin enters the sea by an insignificant outlet, so shallow that none but the smallest steamers can cross its bar. Mailboats, however, run regularly from Milang across the lakes and from Goolwa to Morgan, and, when depth permits, to stations higher up the river.[1]

The south-east of South Australia.

The part of this elevated Tertiary estuary which has been most successfully settled lies in the south-east corner of South Australia. It is just west of the Victorian boundary, the latter being an artificial line whose demarcation (to the extent of a mile of longitude) caused great litigation in the past. The Mount Gambier region is dotted with old craters and crater lakes. The basic lavas burst through late Tertiary limestones and have flowed over the surface in some examples, as at Mount Schank. But no basalt plains such as occur in Western Victoria were developed here. Usually the cones are isolated and contain small lakes, due in part to the subsidence of unsupported strata, as at south-east Mount Gambier.

With a good rainfall of 30 inches this corner of the State is noted for its crops and fruit, and it enjoys the most favourable climate of any part of the State of South Australia. This is largely due to the fact that it extends sufficiently far south to be influenced by the dominant rain-bearing westerly winds for a large part of the year. There is here, however, a sub-artesian water-supply which is really deleterious. A large area between the Mount

[1] See *Geography of South Australia*, by Howchin and Gregory, 1909.

Gambier Railway and the coast was originally a sour swampland, being flooded by the outflow from the more elevated porous beds of Western Victoria. The crater lakes owe their water-supply to this. A large drainage scheme is being carried out which will improve 2,000,000 acres of agricultural land.

The Great Artesian Basin

This includes about 570,000 square miles, comprising more than half of Queensland and important portions of New South Wales and South Australia.

The Mesozoic gulf.

During Mesozoic times a large gulf extended from the Gulf of Carpentaria to Lake Eyre. This covered much the same ground as the artesian basin, to which indeed it gave rise. In this basin were deposited thick beds of sand which ultimately became a permeable sandstone. Over these were laid down clays of an impermeable nature (blue clays, shales, &c.). Later, earth movements elevated this area, and the underlying peripheral porous sandstones were exposed by erosion.

Water-supply and bores.

Rain falling on the upturned porous beds, which are perhaps Triassic in New South Wales and Cretaceous in Queensland, is rapidly absorbed and flows underground toward the lower portion of the basin, which probably occurs in the north. There is probably an outlet for this underground flow into the Gulf of Carpentaria. Many mound-springs, to the west of Lake Eyre along the railway line, also represent a natural outlet to this basin. In New South Wales there are nearly a hundred Government bores and about two hundred and fifty private bores. At Dolgelly (near Moree) a bore was sunk 4,806 feet and gave 682,000 gallons per day. In Queensland there are about six hundred flowing bores and one hundred and sixty-eight sub-artesian, where the water does not reach the surface without pumping. The average depth per bore is about 1,200 feet in Queensland. In South Australia the artesian basin is far distant from settled areas. The most important bores are situated on stock routes, of

which the chief runs from Hegott to Cooper's Creek (Queensland).

The artesian region may be divided into two parts, (i) the western, or Lake Eyre division, and (ii) the Eastern Division, which comprises Western Queensland. The dividing line is somewhat arbitrary, but is not far from the 10-inch isohyet; so that the west is practically desert country and the east is a very important pastoral region.

The eastern or pastoral artesian region.

This belt lies to the west of the Eastern Highlands, and gradually changes from uplands, through rolling downs to the monotonous levels of the region around Lake Eyre. It extends about 1,200 miles from the Gulf of Carpentaria to Dubbo on the Macquarie River (N.S.W.), and is about 300 miles wide.

The northern portion around the gulf consists of a low-lying country, probably the elevated bed of the gulf, with a rainfall of 20 to 40 inches. It is watered by numerous rivers. Normanton, the chief town, is partly supplied with water by an artesian bore. Behind the mangrove swamps of the northern margin is an important cattle-grazing district. The chief industries are, however, connected with mining, much gold being obtained at Croydon, and copper at Cloncurry. These ore-deposits occur in islands of older rock, projecting through the artesian water-bearing strata.

To the south of this gulf country the land rises considerably, and a strip of about a thousand feet above the sea extends south to the head-waters of the Paroo and other northern tributaries of the Murray, whence it gradually slopes down to 500 feet along the southern boundary of the artesian basin. It is important to note that this portion of the artesian basin lies in the 10–20-inch rainfall area, so that except in the extreme south, where some wheat is grown, there is nothing to compete with the pastoral industry. Hughenden, Winton, Barcaldine, Charleville, and Cunnamulla are all centres of sheep and cattle districts connected by railways to one of the ports Townsville, Rockhampton, or Brisbane.

The remaining division comprises the lowlands drained by the rivers Diamentina, Barcoo, &c. The lowest portion of the area constitutes Lake Eyre. The southern arm of this lake usually contains salt water, while the remainder is a vast salty plain formed from alluvium carried down by the large rivers which now enter it only in flood time. It is situated within the 10-inch isohyet, yet many pastoral areas have been occupied, especially along the beds of the Diamentina and Barcoo. In droughts this country labours under great disabilities. The artesian water will not prevent shortage of food, and conservation of flood waters on any large scale is almost an impossibility in this level area. The geological formation is late Mesozoic, so that there is no likelihood of valuable mineral deposits being discovered. Opal (which originated in a different way from gold or copper) is found, however, at Opalton and White Cliffs. A more detailed account of the mining within the limits of the artesian basin appears in Chapter VI.

The Lake Eyre Basin or desert artesian region.

The South Australian Highlands and the Associated Trough-Faults

This isolated region of elevation extends from Cape Jervis in a north-south line to Hergott Springs near Lake Eyre. It consists of 'numerous local ranges which in places reach an elevation of over 3,000 feet. The ranges are usually separated from each other by undulating or nearly level plains ; and as a result of these longitudinal valleys the Northern Railway has been carried through the hill country, reaching an elevation near Petersburg of over 2,000 feet, without the necessity of cutting a single tunnel.' [1]

Relief.

These highlands form one of the most interesting geological regions in the world. They are built up largely of folded Cambrian strata (with a north-south strike) consisting of slates, sandstones, conglomerates, and limestones. Although these strata are among the most ancient that exist, yet they preserve to us very clearly

Geological history.

[1] *South Australia*, 1909, p. 82 (Howchin and Gregory).

near Beltana and Wirrialpa a great fossil 'coral-reef which must have rivalled the Great Barrier Reef in extent'. This Cambrian reef was composed of *Archaeocyathinae*, which were organisms apparently resembling both sponges and corals.[1] Somewhat earlier than this the region must

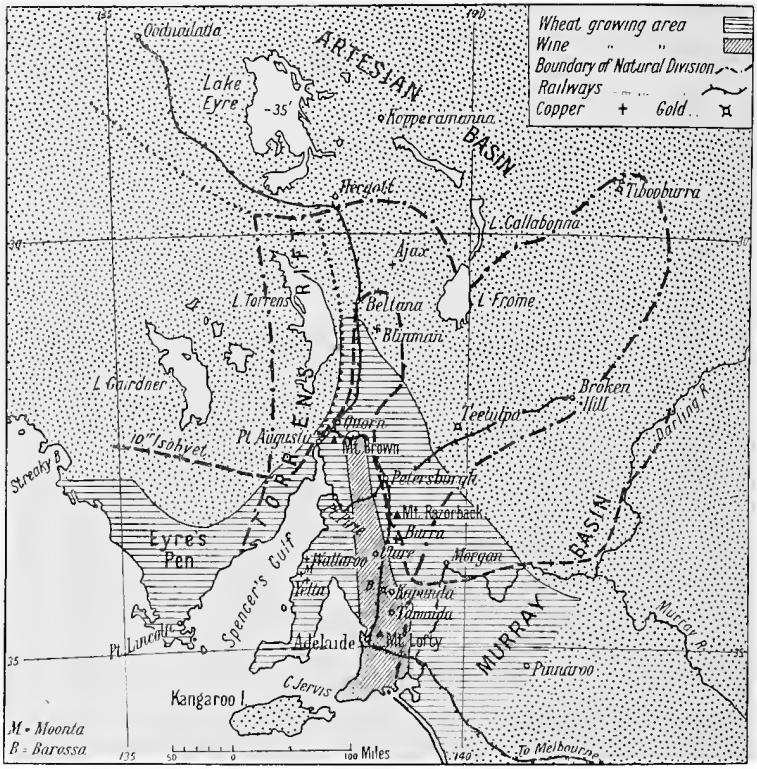

FIG. 12. South Australia.

have had an antarctic environment, for we find striated boulders and glacial 'tills' in the older beds (e.g. Sturt River).

None of this highland area appears to have ever sunk beneath the sea again, though in Permo-Carboniferous times it was apparently a mountainous region covered

[1] They have also been described from the Beardmore Glacier near the South Pole.

with an ice-sheet in many places. The present topography of the highland is determined chiefly by a series of faults on the western side of the Cambrian Highlands. These run meridionally and appear to have taken place in almost every geological epoch. Running parallel to the highlands is a subsidence area which Professor Gregory has termed the ' Rift Valley of Australia ', which constitutes St. Vincent Gulf and Spencer Gulf—Yorke's Peninsula being a block between two rifts. The Rift Valley extends north through Lake Torrens, and has probably helped to make Lake Eyre. The scarp faces on the west of the Mount Lofty ranges are not yet in equilibrium, and slips on a large scale along the old fault lines make this perhaps the most active seismological region in Australia.

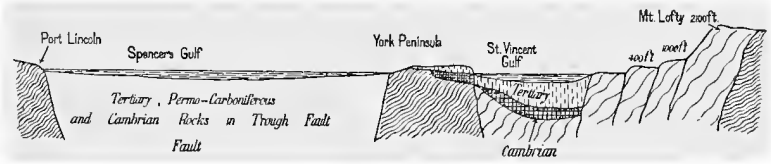

Fig. 13. Section across the Rift Valley of South Australia.

To the east the ancient Cambrian and Pre-Cambrian rocks diminish in height and gradually merge in a low level peneplain of old rock, which is bounded and in part covered by the Tertiary sediments of the lowlands already described. This peneplain is rich in metalliferous deposits, but is otherwise not of great economic importance. The Broken Hill mines account for practically all settlement.

Surface features.

The main divide of these highlands lies somewhat to the west, culminating in Mount Lofty (near Adelaide, 2,334 feet), Mount Razorback (near Burra, 2,834 feet), and Mount Brown (near Quorn, 3,100 feet). None of the rivers is of importance, and in the north water is obtained chiefly from wells sunk in the beds of the intermittent rivers. The lakes are all shallow sheets of salt water and worthless industrially. After heavy rains Lake Frome is joined to Lake Eyre, forming a temporary cordon of

water, which led to the delineation of a vast horseshoe-shaped lake in old maps. In Lake Callabonna are found the skeletons of Pleiocene giant marsupials buried in the lake muds. Many have been dug out, varnished carefully, and transported by camel-back to the Adelaide Museum.

Towns and industries.

The geological factors mentioned above have led to an industrial isolation from the surrounding regions. The Cambrian Highlands (including the Mount Lofty and Flinders Ranges) lie in the course of strong westerly winds in winter. They have at that season a good rainfall which is found to be eminently suited to the needs of the wheat plant. In fact, many districts with only ten inches per year can grow an excellent hard wheat because practically the whole precipitation takes place from April to October (inclusive).

The main settlement in South Australia is therefore confined to a triangle included between Streaky Bay (west), Beltana (north), and Morgan (south-east). Mount Gambier and the Pinnaroo wheat area have already been described as likely to become areas of close settlement.

The heaviest rainfall occurs near Adelaide on the slopes of the Mount Lofty Ranges. Here are planted the vineyards, whose wines are favourably known. Clare and Tanunda, to the north-east of Adelaide, are two of the most famous cellars.

It is to wheat, however, that South Australia chiefly owes her prosperity. The wheat line coincides, for reasons stated, with the 10-inch (winter) isohyet. The three peninsulas, Eyre's, Yorke's, and Mount Lofty, are included in this area, and six counties around St. Vincent Gulf each produced more than 1,000,000 bushels for the season 1906–7.

The ports around the gulfs chiefly export wheat, though Wallaroo and Port Pirie ship ore and metals also. Their importance in the wheat trade is in the following order: Port Adelaide, Port Wallaroo, Port Pirie, Port Augusta, Port Germein, and Port Victoria. Port Lincoln, further west, is the outlet from Eyre's Peninsula.

Wool is grown throughout the State where the annual

rainfall exceeds 9 or 10 inches, which includes all the Cambrian Highlands. But a large area in the north-west beyond a line joining Eucla to Oodnadatta is still No Man's Land. As pastoral industries have paid their way in the dry regions of Hergott and Oodnadatta, where railway transport is available in time of need, we may hope that the new trans-continental railway from Port Augusta to Kalgoorlie will lead to the settlement of the region in question.

The Western Plateau

Relief and geological history.

To the west of the Australian Lowlands, i. e. beyond a line joining the two gulfs of Spencer and Carpentaria, lies a vast country forming the largest geographical element of Australia. Two-thirds of the continent consists of an ancient peneplain composed chiefly of Palaeozoic or older rocks, which have been planed down to a more or less uniform level. This now stands from 1,000 to 1,500 feet above the sea, and for the most part does not seem to have been submerged since middle Palaeozoic times. Fringing this plateau on the west are coastal lowlands of Tertiary age ; while there is a fairly continuous hinterland of Mesozoic and late Palaeozoic rocks which resembles the larger belt on the east of the continent. This obviously indicates that the margins of the Western Australian massif have oscillated above and below sea-level many times in post-Cambrian times.

Only in the south at the head of the bight is there any large area of younger rocks, where there appears to be a Cretaceous basin extending for a radius of 300 miles round Eucla. The Cretaceous rocks are capped by 600 feet of Eocene limestone, and appear to be equivalent to the 'rolling downs' formation of Queensland. The relation of the latter to the great artesian water-supply gives this Western Australia area an especial interest in view of the fact that the Trans-continental Railway will traverse this otherwise almost waterless route.

The whole of Western Australia and most of the Northern Territory and South Australia occupy this plateau. It is

by no means so important economically as the Central Lowlands, and only supports about 6 per cent. of the Australian population (250,000 out of 4,000,000).

Natural divisions.

There are no dominating physical features to assist subdivision of this large area, except it be the Central Highlands in the east, which form one subdivision. Since

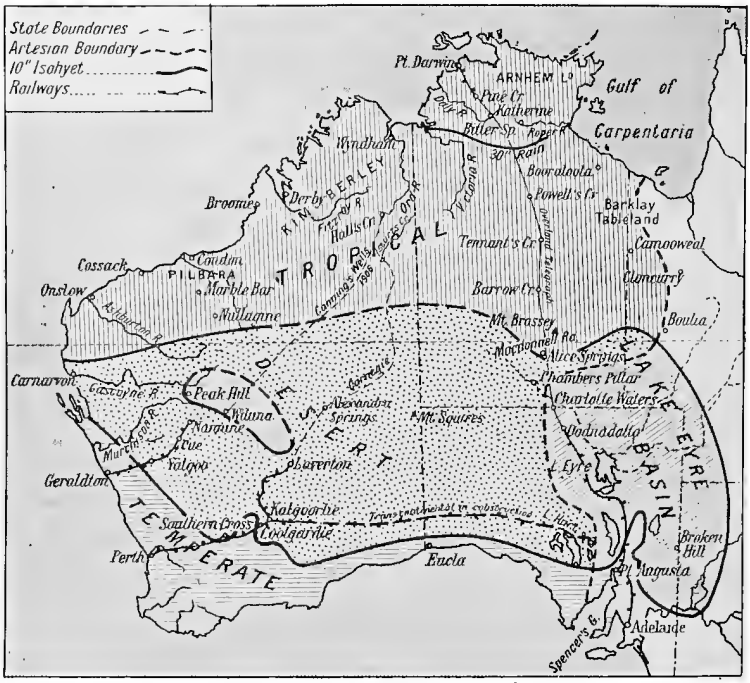

FIG. 14. The Western Plateau.

this tableland extends through almost 25° of latitude, it is obvious that it is subjected to very different meteorological conditions. Accordingly the most satisfactory primary divisions are : (i) the southern temperate region, (ii) the northern tropical region, and (iii) the central desert with the Central Highlands. These and their subdivisions may be defined as follows :

(*a*) *The tropical region,* consisting of a broad coastal strip from Sharks Bay to the Gulf of Carpentaria. In this

region the rainfall occurs in summer, and increases in amount as the equator is approached. It is bounded on the south and east by the desert region. Unfortunately there are no rain stations between Nullagine and Barrow Creek, so that the division line (approximately the 10-inch isohyet) is only tentative.

It will be described under the heads: (1) Northern Territory Lowlands; (2) Northern Territory Uplands; (3) The north-west coast comprising the regions around (*a*) Kimberley, (*b*) Pilbarra, (*c*) Sharks Bay and the Murchison.

(*b*) *The desert region* includes most of the areas with less than 10 inches of rainfall. It will be described under the heads: (1) The Desert Proper; (2) The Gold-fields Region; (3) The Macdonnell Ranges.

(*c*) *The south-west temperate region*, a belt extending from Geraldton to Eucla. It has more than 10 inches of rainfall falling mainly in winter and increasing to the south-west.

It will be described under the heads: (1) The Eastern Pastoral Belt; (2) The Central Wheat Belt; (3) The Western Timber Belt.

(*a*) *The Northern Tropical Region*

(1) Northern Territory lowlands.

Northern Territory consists of two different divisions—lowland and highland. The coastal portion is low-lying and is still practically unknown except along the railway, which rises only 300 feet in 100 miles from the coast. It does not appear to be very good cattle country, and though the rainfall is heavy in summer the soil is poor in plant food, and the vegetation on the whole is scanty except along the rivers. The hinterland, including Arnhem Land to the east, appears to be a dissected peneplain about 1,000 feet above sea-level. It is trenched by numerous rivers which have reached base-level a long way up the valleys, so that the railway follows a series of broad mature valleys separated by insignificant divides (see Woolnough; Bull. 4, 1912).

Surface features: Roper River.

The coastal inlets indicate the drowning of fairly youthful river valleys. The accompanying downward movement of the land, by decreasing the gradient of the streams, caused them to fill up their valleys, forming large alluvial plains. The river and creeks are in many cases dry gullies during the dry season, but they become considerable streams in the wet season (December to March). There are notable exceptions to this, for the Edith, Catherine, and Roper are large rivers which flow at a constant rate through the dry weather. The Roper rises near Bitter Springs, to which place it is proposed to transfer the capital of Northern Territory, and flows perennially thence. It is a noble stream 100 yards wide and occasionally 25 feet deep; and though crossed by quartzite bars, some of the reaches on the river are said to be 40 miles long. Large boats do not usually proceed more than 25 miles, but small launches and ship's boats can reach Leichhardt's Bay, 100 miles from the sea. However, a steamer landed telegraph supplies at Omeo Landing near this point during the building of the Overland line. The river is about 100 yards wide here.

The coast-line east of Port Darwin is low and beset with shoals. Almost every bay is memorable for some murderous attack by blacks on sailors or traders seeking water or trepang. Junction Bay (134°) separates the semi-civilized western aborigines from the still hostile eastern tribes.

McArthur.

At the McArthur estuary the coast is low and fringed by mangroves. A steamer periodically ascends 12 miles to Palmerston Landing, and from here the goods are forwarded in a punt some 39 miles to Borroloola. The latter 'town', the most important in the Territory off the telegraph line, consists of court-house, police station, store, hotel, and Chinamen's gardens. The McArthur River Station is 40 miles higher in well-grassed country. Small lead and copper mines have been worked in the vicinity. The river flows continuously and floods 40 feet high are known. The Roper River exhibits similar features.

The capital is at Port Darwin, a small township chiefly consisting of Government buildings. From the capital a narrow-gauge railway runs to Pine Creek, 145 miles inland, and will be extended to the Katherine. A British line of steamers maintains a monthly service, and there is a small local trade, a steamship running between Port Darwin, Port McArthur, Daly River, Victoria River, and Wyndham (Western Australia). Towns and trade.

The population of the Territory in 1911 comprised about 3,300 whites and Chinamen, and some 20,000 aboriginals. Pearl-shell realized £10,000 in 1910, tin £34,308, and gold £21,632. The mines are briefly described elsewhere.

The uplands extend southward from the Roper River and include the most promising portion of the Territory. Though the rainfall is less, gradually decreasing from 40 inches to 6 inches, yet the climate is more healthy, and the strip of country southward to Tennant's Creek is well adapted for cattle. The railway traverses fair pastoral country as far as Pine Creek, though it is practically not stocked with cattle. Then the area decreases in value to the head-waters of the Roper, where it improves considerably. (2) Northern Territory uplands.

For 210 miles along the telegraph to the south there is no dwelling, and this stretch of land is at best second-class pastoral country. A few telegraph clerks and police serve to keep open the line of communication. To the east of Newcastle Waters black-soil plains occur, well grassed with Mitchell grass, but unfortunately they are very badly watered except in the rainy (summer) season. Water can generally be obtained by sinking a bore, but the average cost is about £1,500. There are many cattle stations on the low eastern plateau known as Barklay Tableland. These are linked to the more populous regions by a mail route via Camooweal just within the Queensland borders.

This is wholly included in Western Australia and consists of a strip of country between the desert and the sea about 400 miles wide, extending from the Ord River in the north to the Murchison River in the west. The (3) The north-west region.

rainfall decreases from 30 inches in the north to about 6 inches per annum on the Murchison. The towns in this vast territory of 500,000 square miles number about a dozen, being with very few exceptions either settlements around stamp batteries on a gold-field, or ports leading to them. The country, however, contains numerous sheep and cattle stations.

(*a*) Kimberley.

The Kimberley region contains a one-time important gold-field with its centre at Hall's Creek, on the divide between the Ord and Fitzroy Rivers. Numerous cattle stations have been occupied along both these rivers, but the rugged land between them is almost entirely uninhabited by white settlers. Wyndham at the mouth of the Ord River, Derby on the estuary of the Fitzroy, and Broome, are the only towns. The cable to Java starts from the latter, which is an important pearling centre and cattle port.

Pearling extends northwards from Sharks Bay, where the pearl-shell is of a smaller and less valuable kind, to Broome, the commercial centre of the industry. While the industry is financed and managed by whites, the fleets are manned very largely by Japanese and Malays, about 1,500 in all. White labour, however, must displace the aliens in accordance with the political ideal of a white Australia. The industry supports a population of 5,000 at Broome. In 1910 there were in East Kimberley 200,000 cattle, 4,500 horses, and in West Kimberley 300,000 sheep, 10,000 cattle, and 3,150 horses.

(*b*) Pilbarra.

The next centre of settlement is the Pilbarra Region. It is noted for its pearls, mining, heat, and cyclones. Hereabouts the average rainfall is 15 inches per annum, yet there are many records of 20 inches falling in a few hours. Cossack and Condon are situated where the tropical tornadoes recurve and strike the coast. The hinterland also holds an uneviable record for heat.

The Pilbarra gold-fields with centres at Marble Bar and Nullagine and the Whim Creek Copper mines have led to the development of the country. A railway is being built from Port Hedland to Nullagine. Large areas can be

supplied with water for stock by putting down shallow bores. Sheep are the principal stock. Many of the stations are worked almost entirely by aboriginal labour, so that the wages bill is small.

(c) Sharks Bay and Murchison.

The southern portion of this belt, comprising the basins of the Ashburton, Gascoyne, and Murchison, should logically be considered with the desert region, for the greater part of it has a rainfall of less than 10 inches per year. Numerous sheep and cattle stations, however, have been taken up, the stock being shipped from Onslow and Carnarvon.

Off the coast at Sharks Bay are three large islands, Dirk Hartog, Dorré, and Bernier. The former is a sheep station and the latter are isolation hospitals for the aborigines. Some of the smaller islands, such as Dampier and Abrolhos, are sources of guano. Far inland from Geraldton are the goldfields of Yalgoo, Murchison, and Peak Hill. A railway runs through Yalgoo, Mount Magnet, Cue, and Nannine to Meekatherra. The Fenian Mine at Meekatherra has paid approximately £80,000 in dividends.

(b) *The Central or Desert Tableland*

Extent of the desert.

This is rectangular in shape, about 1,200 miles from west to east and 650 from north to south. The desert extends beyond it into the Lake Eyre Basin and so occupies the rectangle between Condon and Cloncurry on the north and Southern Cross and Broken Hill on the south. The proposed trans-continental railways from Southern Cross to Port Augusta and from Camooweal to Bourke form two of its boundaries.

This region, with an area of 800,000 square miles, comprises more than one quarter of the whole continent. It therefore merits study in spite of the fact that there are probably not a thousand white folk in it, excluding the miners in the south-west corner between Kanowna and Laverton. Our knowledge is derived from explorers' records such as those of Giles and Carnegie, and from later Government expeditions such as that of Canning in 1906. The Macdonnell Ranges have been well described by the

Horn scientific expedition and these highlands are now sparsely settled, but the region from Oodnadatta to the Westralian goldfields is still desolate.

The arid north-west interior.

The most interesting account of the western portion is that recently published by Talbot, who made a geological traverse along the stock route opened up by Canning in 1906–7. This 700 mile route connects Hall's Creek (Kimberley) with Wiluna and the Murchison goldfields. A series of 50 wells about 15 miles apart have been sunk along the route. In many cases native wells were cleaned out and deepened.

Geology.

By far the larger part consists of sedimentary rocks, the oldest being metamorphic of undetermined age. These are unconformably overlaid by two series of strata which Mr. Talbot describes as being of Devonian and Carboniferous age respectively. No fossils, however, were found by this officer, and the evidence is based on stratigraphical grounds. So that contrary to expectation the greater part of the country traversed to the north of latitude 25° is probably not a portion of the great coign of Archaean rocks.

Leaving Wiluna (26° 30′), for a hundred miles the track crosses diabase, granite, and then metamorphic rocks. These are covered by sand ridges, but there was no difficulty in obtaining water in shallow wells 50 feet deep. The slates dip steeply and have an east-west strike, but at Mount Davis (25°) the level-bedded quartzites and conglomerates are first met with. They are put down as Devonian by Mr. Talbot. There are some rich patches of red soil with a heavy growth of mulga and gidgie. To the north-east are patches of diabase near Weld Spring (25°), but thence for 150 miles all the country consists of Devonian sediments. Although the rainfall is less than 10 inches, yet a well only $8\frac{3}{4}$ feet deep may yield 4,300 gallons per hour, as at the Goodwin Soak (24° 40′).

Surface features.

The prevailing south-east winds have banked the sand ridges against the southern slopes of all the low ranges, but on the lee sides they are flanked by a strip of flat country which in some places grows good food for stock. Right through the desert these conditions recur. These flats

grow saltbush, and after good rains the clay pans are full of water and covered with waterfowl, and are often surrounded by luscious grass. In 23° 30′ are picturesque gorges cut in the Devonian sandstones with large rock holes. To the north-east very poor country fringes Lake Disappointment. In the dry creeks a layer of salt two inches thick was collected and used to preserve meat.

The sandstones are folded into anticlines near Well 23 on latitude 23°. North of this region a new series of horizontally bedded sandstones is reached which extends nearly 400 miles to Hall's Creek. This is probably Carboniferous. Hereabouts there are wide belts of sand ridges which are broken by patches of good grazing country. At Majingerra (22½°) is a curious subterranean tunnel-well, 150 feet long and 4 feet deep, formed of travertine. There is fair grass at Lake Tobin (21½°), and near it is an excellent native well, 7 feet deep, in which the water rises so close to the surface that it can be dipped out with a tin.

At 20½° white gums occur, but there are numerous sand ridges to the north. Gregory's salt sea marks the southern limit of good natural water-supply. Thence occupied pastoral country is traversed along Sturt's Creek to Hall's Creek township. At the latter mining township the metamorphic auriferous rocks again crop out.

Although at some future time the lower valley of the Sturt may become settled, the country along the stock route south of that point, owing to its inhospitable character, is never likely to become occupied by pastoralists.

The region farther east has been described by Carnegie. In 1896 he left Coolgardie to strike NNE. across the continent in the hopes of finding gold-bearing or pastoral country in the desert. Travelling over a long stretch of dry country where the camels were without water for 13½ days, they reached a soakage near Alexander Spring. Beyond this a few low sandstone ranges and hills were found, and occasionally in the valleys belts of bloodwood and a few shrubs edible by camels, but most of the country was a continuous waste of sand ridges. They reached

The central arid region.

Hall's Creek, and returned south along the South Australian border. He thinks that a stock route from the Macdonnell Highlands to the Coolgardie Railway is possible in winter. The route from these highlands to the south-west is excellent as far as the border. From there it would be necessary to strike the small oases near Mount Squires, Warburton Ranges, Blyth Creek, and Alexander Spring. In conclusion he says of the area traversed (see Fig. 14): 'We have demonstrated the uselessness of any persons (either pastoralists or miners) wasting their time and money in further investigation of that desolate region.'

The Macdonnell Ranges.

The Macdonnell Ranges lie in the middle of the continent, and, owing to the Horn expedition of 1894, are better known than many more accessible regions. The Cretaceous region between Lake Eyre and the southern ranges of the group consists of stony (gibber) plains and arid loamy tracts which support a sparse saltbush. Professor Spencer calls these the Lower Steppes.

Geological history and surface features.

As soon as the northern boundary of the Cretaceous area is passed (near Chamber's Pillar) there is a striking difference in the configuration. The rocks are sandstones and limestones folded at some ancient period into ridges and furrows running east and west. These, after being worn down to a level surface, were elevated in quite recent geological times, and the rivers have cut out extraordinary gorges and lateral valleys. To these the region owes the permanency of its water-supply, for the water is protected from rapid evaporation in the deep gullies and gorges (some of which, though 200 feet deep, are only a few feet wide), while in the surrounding plains the rain evaporates almost as soon as it falls. Permanent pasture, however, is rare, and the chief cattle areas are near Alice Springs and Tempe Downs.

The northern portion of the Macdonnell area consists of much older rocks, such as gneisses and schists, probably allied to those covering a large part of Western Australia. Associated with them are certain 'dykes' of granite, with white mica (muscovite), the chief mines being near Mount

Brassey in the north-east of the ranges, where plates of mica 6 feet across have been obtained. They are sent by camel to Oodnadatta and are exported for use in electrical works. In the same region is Arltunga, a goldfield which promised well some years ago, but it is heavily handicapped by its situation and surroundings.

Country west of the ranges.

To the west, as soon as the ranges are left behind, the monotonous sandhill, mulga, and spinifex country begins, and extends through Western Australia to Coolgardie. The so-called Lake Amadeus is usually a sheet of salt, about half an inch thick, and is obviously quite valueless for water-supply.

It is to be feared that neither the cattle, mica, nor gold will lead to the prosperous settlement of Central Australia. The low rainfall (averaging only 6 inches per year over a considerable portion of the area) makes extensive pastoral occupation impossible, while 200 miles of transport to the railway at Oodnadatta—and thence 600 miles to Adelaide—will prevent the working of any but very rich mineral fields.

The Coolgardie goldfields region.

From an annual output of £1,148 of gold in Western Australia in 1886 the yield leapt to over £8,770,000 in 1903. Since then it has decreased, being £5,823,000 in 1911. The great wealth is very largely derived from a region which was unexplored until 1892. Though a comparatively small field of an area of approximately 600 square miles, East Coolgardie has within its boundaries the majority of the best gold-mines of the State.

Here have arisen the twin towns of Kalgoorlie and Boulder, equipped with electric light and electric tramways, a daily train service to the coast, a population of some 26,000, and a water-supply pumped nearly 400 miles from the coastal ranges. Early in 1903 the present supply line was completed, connecting a reservoir near Perth with Kanowna, 387 miles east of that town. On the Darling Ranges near Perth there is a rainfall of over 20 inches, and a weir across the Helena River (at Mundaring) impounds 400,000,000 gallons. Nine pumping stations elevate the water 1,313 feet to the Coolgardie

distributing reservoir. The pipe line (33 inches diameter) is laid on the surface close to the railway, and at each of the pumping stations, roughly 40 miles apart, the water is elevated about 140 feet, whence it flows by gravity to the next station.

In 1894 the railway to Southern Cross was completed, and gradually extended as the value of the goldfields became assured to Kalgoorlie in 1897, Menzies 1899, and since then to Laverton (586 miles) in the north, and to Norseman in the south.

The region of the trans-continental railway.

The trans-continental railway from Kalgoorlie to Port Augusta (1,100 miles) was under construction in 1913. The gauge is the standard 4 ft. 8½ ins., and the other links, Fremantle to Kalgoorlie and Port Augusta to Albury, will be altered to suit this gauge. The estimated cost of construction is £3,988,000.

The railway will serve an area of about 90,000 square miles which can be considered favourable for pastoral development, but the main advantage is the saving of time between Europe and Eastern Australia. The military aspect is also of importance.

Surface features.

The physiography of the region traversed has been described by Gibson, from whose bulletin the following account is taken.

The country is undulating or flat east from Kalgoorlie, with a general elevation of 1,200 feet. The auriferous belt of greenstones extends some 65 miles and then a granite region is reached near Cardinia. Beyond this place there is no mineral country on the line in its Western Australian section. For another 100 miles the country is formed of granite with scattered salmon gums and bluebush. To the north of the line toward Queen Victoria Spring there are numerous sandhills covered with spinifex, desert gums, and pines, with occasional patches of dense mallee gum.

East of the 167-mile peg the mallee and spinifex give place to 'oaks' and bluebush with scattered saltbush, whilst the sand plains are replaced by light-coloured loam flats. This change marks the junction between the

granite and the Tertiary limestones. The whole of the limestone area is a level treeless plain, with grass and saltbush along the railway, but somewhat timbered nearer the coast. The only surface water is obtained from small rock holes which are few and far between and of limited capacity.

Water-supply.

The first 150 miles from Kalgoorlie is practically waterless, nor is it probable that boring will procure water except in the limestone country. Salt water is procurable at shallow depths along any of the salt lakes. In the limestone plains, which are about 500 feet above sea-level, water can be obtained by deep boring, but the quality is not good and it will have to be pumped several hundred feet. The water-bearing sandstones seem to be at sea-level both along the line and at the coast, where they crop out below 250 feet cliffs composed of limestone. At Twilight Cove the water rises in surface springs.

The South Australian part of the railway.

Within the South Australian border (461 miles) similar limestone country is traversed until the ancient rocks around Tarcoola are reached. Here are valuable gold deposits. Outlying sheep stations are situated near the proposed line at Wilgena and Coondambo. Lake Hart promises to become an important source of salt. Near Oakden Hills station the line descends from the tableland into the Torrens Rift and crosses the head of Spencer Gulf at Yorkey's Crossing, which is only five miles from Port Augusta.

(c) *The South-West Temperate Region*

Physical features.

The coastal plain is formed mostly of shallow-water deposits, sandstones, and shales. It has a width of 60 or 70 miles in places on the west coast, though in the country at the head of the Great Australian Bight the plain, devoid of rivers, extends some 200 miles into the interior. The inner margin of the coastal plain reaches an altitude of 600 feet above sea-level in certain localities and is separated from the interior by a belt of hills.

These hills form the escarpment of the interior plateaus and plains. They have an average elevation of about

1,200 feet, though isolated ranges reach 4,000 feet. The escarpment has a short steep slope down to the edge of the coastal plain, into which it gradually merges. This belt of country is mainly formed of granitic and metamorphic rocks, the decay of which produces excellent soil,

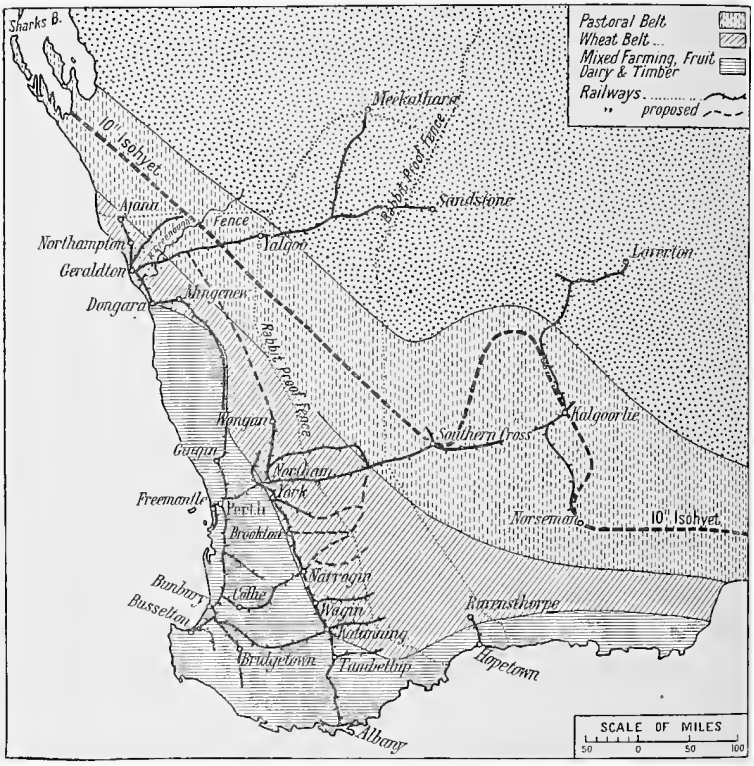

Fig. 15. South-west Temperate Region of Western Australia.

and owing to its rainfall it is the principal agricultural region.

The plateaus and plains of the interior consist of a broken tableland from which rise isolated hills and ridges of metamorphic rock, often separated by sand-plains of considerable extent with depressions occupied by saline marshes, clay flats, brine lakes, or deposits of salt. There are no rivers and the rainfall is slight. This plateau,

which forms the chief mineral region of the State, is mantled by superficial deposits concealing the underlying rocks over very wide areas.

This south-west portion of Western Australia contains the whole of the agricultural land in the State, and it is estimated that 60,000,000 acres are suitable for agriculture. It contains, and will always contain, the bulk of the population of Western Australia.

The south-west region may be subdivided into three belts, which are controlled by the rainfall. These are: (1) the Eastern Pastoral Belt, (2) the Central Wheat Belt, (3) the Western Timber Belt.

(1) The eastern pastoral belt.

The Eastern Pastoral Belt extending from Sharks Bay through Southern Cross and Norseman to the Bight lies approximately between the 8-inch and 13-inch isohyets. It is eminently suited for sheep and cattle. Two rabbit-proof fences cross this area. One starting from the coast about 50 miles north of Geraldton runs east through Yalgoo and then due south to the coast about 100 miles east of Albany. The other is farther east and extends from Hopetown north to Sandstone, and thence to the coast north of Pilbarra. These fences are kept in order by government, and enable the squatter to cope successfully with the rabbit invasion from the east.

(2) The central wheat belt.

The wheat belt lies between the 13-inch and 20-inch isohyets. It extends from Ajana to Hopetown. A strip of country to the east of Hopetown will be found as suitable for wheat as Eyre's Peninsula in South Australia, but is not yet developed. In the north are some rich river-flats along the Greenough, and here are the Northampton copper-mines. The belt of York gum (*Eucalyptus Roxophleba*) and of white gum (*E. redunca*) is coincident with the wheat belt, though the timber is lighter in the north.

Geraldton and Dongara are the chief settlements in the north. Thence the Midland Railway through Mingenew and Gingin traverses the belt to Perth, while further east a new line through Woregan is under construction. The country south of Northam has developed rapidly in recent

years. The Great South Railway to Albany runs along the west of the wheat belt through York, Brookton, Narrogin, Wagin, Katanning, and Tambellup. From each of these centres branch lines running east are completed or in progress; so that this portion of the wheat belt is served by one of the best railway systems in Australia.

(3) The south-west timber region.

West of the trunk line the rainfall increases as the south-west coast is approached; the timber becomes heavier and forms dense forests of commercial hardwoods. Because of this the wheat area does not extend very far westward, but the soil and rainfall are particularly well suited for oats, in parts for growing potatoes and root crops, and practically everywhere for fruit. This country is still comparatively unoccupied, for farming in the wheat belt has yielded quicker returns than in the heavily timbered districts. It is stated, however, that a farm of 160 acres in the west, if wisely chosen and improved, will provide as good a living as a 1,000 acre farm in the wheat belt.

All this country is or can be brought within convenient reach of the ports of Albany, Bunbury, or Busselton. Railways already cross it from Bunbury to Narrogin, through the coalfield of Collie. Another links Busselton to Katanning. A third passes through the tinfield of Greenbushes and the karri forests of Bridgetown.

This western corner is clothed either in jarrah or karri timber, the latter occurring chiefly in a coastal belt 30 miles wide from Bridgetown to Albany. There are said to be 20,000,000 acres of good timber in West Australia (nearly 17,500,000 acres are specially reserved), distributed as follows: jarrah 8,000,000, karri 1,200,000, white gum 7,000,000, York gum 4,000,000.

Perth and Fremantle.

Perth, the capital of Western Australia (36,000 inhabitants), lies in the north of this belt, where the timber is chiefly tuart (*E. Gomphocephala*) and red gum (*E. Calophylla*). It is situated on the estuary of the Swan River, and the hilly slopes on its western bank have been reserved as the King's Park. The Darling Scarp, produced by the faulting of the coastal strip, is about 20 miles to the east.

Fremantle lies at the mouth of the Swan, and in the vicinity of these two towns it is estimated that there are 108,000 people.

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'Topographical maps in the strict sense hardly exist, and . . . there is no developed scheme of survey, geodetic, cadastral, and topographical. On the other hand . . . the land surveys are highly specialized and adequate for their main objects' (see chapter on 'Mapping of British Territories', in the volume of this series on general imperial topics, where particulars of the maps of the various states are given).]

CHAPTER III

CLIMATE AND WEATHER

By H. A. Hunt and Griffith Taylor

Size of continent and effect on climatic variation.

Australia extends from 10° S. to 45° S., but the greater portion lies south of the Tropic and has a generally temperate climate. Port Darwin in the north has a climate resembling that of Trinidad, while Tasmania in the south has a typically cool moist climate like that of England.

In addition to contrasts due to difference of latitude,

there are diversities due to the great breadth (2,400 miles) of the continent along the Tropic, so that a great portion of its surface lies remote from the influences of the sea. In this Australia differs from the other southern land-masses.

Australia has a uniform outline and a lower average elevation than any other continent. These make for

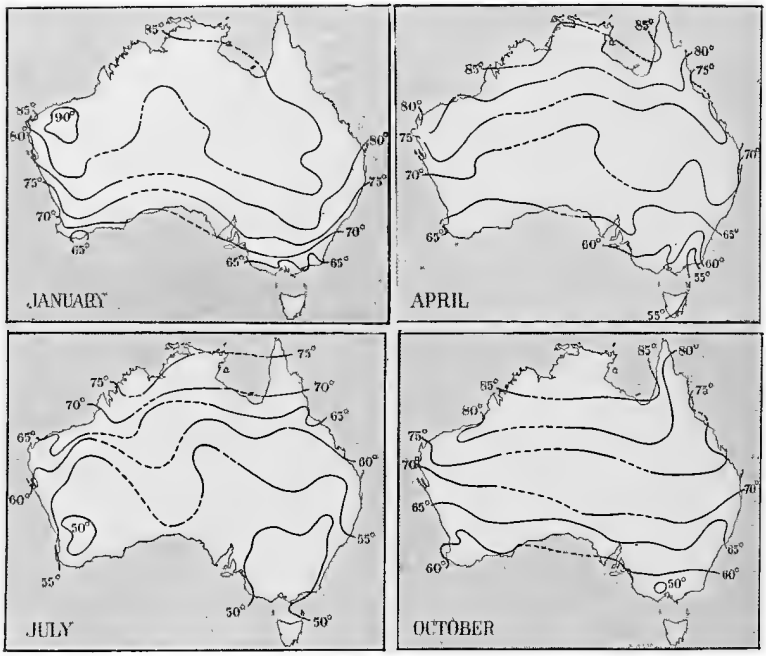


Fig. 16. Mean Monthly Temperatures.

simplicity in climate, for there are no tongues of water penetrating far into the interior to modify the climate, like the Mediterranean, nor any large freshwater areas. The salty lakes of Southern Australia do not appear to affect the climate of the surrounding area.

The average elevation of Australia is probably somewhat under 1,000 feet. Although, as will be seen later, the more important highlands have a great effect on the *local* distribution of rain, they do not determine the

primary climatic divisions. It may, however, be mentioned that the two chief breaks in the oval outline of the continent, the Gulf of Carpentaria and the Great Australian Bight, appear to control the movement of the cyclonic disturbances to some extent.

The Seasons and the March of Temperature

The seasons.

Northern Australia comes under the influence of equatorial conditions, where there are two seasons, the wet and the dry. There is a difference of 10° between the mean temperatures of January and July, and there is a great difference between the muggy conditions in January (when practically all the rain for the year falls) and the dry heat of July.

In the south the division of the year into four seasons is well marked, though definite wet and dry periods are still noticeable.

The march of temperature.[1]

A study of the mean monthly temperature charts shows a marked control of temperature by latitude—modified, however, by well-defined variations. These latter may be classed as Alpine Cool Gulf and the Northern Hot Gulf. In August the isotherms run almost due east and west, the hottest region being the north-west coast. A cold gulf under 50° covers the south-east corner of Australia nearly to Dubbo in the south-east highlands of New South Wales. In September this high region is warming and the gulf has disappeared, but two northern hot gulfs (70°) have formed in the north, one on the west coast behind the Pearling Coast (Cossack and Condon), and the other along the North-East Queensland coast as far south as Rockhampton. As the months advance, the north-west gulf becomes a closed heated area over the Pilbarra Goldfield with a mean temperature of over 90°.

The north-east gulf moves gradually westward and southward during spring and summer until it forms a broad hot gulf extending to South-West Queensland, largely due to the monsoon winds in front of the cyclonic

[1] Degrees Fahrenheit throughout.

system usually dominating North-West Australia in summer.

In April and later the Queensland gulf shrinks as the land areas cool, while the southern cold gulf increases and is largest in July.

Across Central and South-Western Australia the isotherms move equatorwards in winter and retreat in summer without losing their east-west direction. The 75° isotherm moves about 1,200 miles north (as winter approaches) from January to July, the cooling being quickest in April and May.[1]

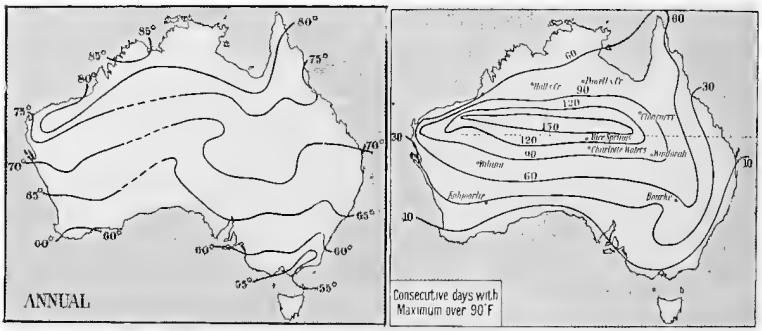


Fig. 17. (*a*) Mean Annual Temperature. (*b*) Number of Days on which Temperature exceeds 90° F.

Extremes of temperature.

The highest temperatures are recorded over the north-western portion of Western Australia (see Fig. 17), where the maximum shade temperatures exceed 100° on 64 consecutive days and 90° on 150 consecutive days, the mean temperature of the hottest month being 90° and the mean temperature of the coldest 65°. The coldest portion of Australia is over the Australian Alps, where the mean shade temperatures range from 65° in January to 40° in July. During exceptionally dry summers the temperatures in the interior reach and occasionally

[1] It must be noticed that in the west centre of the continent our meteorological knowledge is very meagre, and more complete data may indicate looped isotherms in the remaining quadrant of the continent, though the topography would not seem to favour such a condition.

exceed 120°, and the same areas during the winter months are subject to ground-frosts.

Taking Australia as a whole, the extremes of temperature annually, seasonally, and daily are less than those experienced in any of the other continents, and the mean temperatures prevailing are generally lower than for corresponding latitudes in the other continental land areas of the globe. These features are due mainly to the surrounding ocean and the absence of lofty mountains.

Pressure[1]

Seasonal march of pressure.

In January (midsummer) a monsoonal depression (under 29·7 in.) occupies North-West Australia. The Antarctic low-pressure belt reaches south of Tasmania. The warm highland in the south-east appears to give rise to a col of low pressure separating the higher pressures over the Bight and over the North Tasman Sea. In February the conditions remain much the same. In March the northern depression has almost left the continent and the south-eastern low-pressure col is disappearing. In April a high-pressure system is forming over the south-east and elsewhere the isobars run from west to east.

During winter (May, June, July, and August) there is a well-marked area of high pressure centring in Western New South Wales with an axis running approximately from Brisbane to Perth. The isobars of 29·90 run parallel to this direction, through Port Darwin in the north and through Tasmania in the south.

With the spring the monsoonal low pressure begins to move in and split the high-pressure region into two—one area lying over Perth and the other over Brisbane, and in November and December the cyclonic area dominates North and West Australia, gradually concentrating over

[1] At only a few important stations in each state are complete barometric data available for any length of time. These have, unfortunately, been recorded for different times of the day, and the pressure maps are only approximations.

the intensely hot region around Pilbarra, Western Australia.

Local variation in pressure.

Full data for pressure are available for 1910 only, but the isobars for 1910 follow the direction of the isotherms, and show the influence of the hot and cold gulfs. In January 1910 there was a low-pressure area (29·6) situated just south of the Gulf of Carpentaria (within

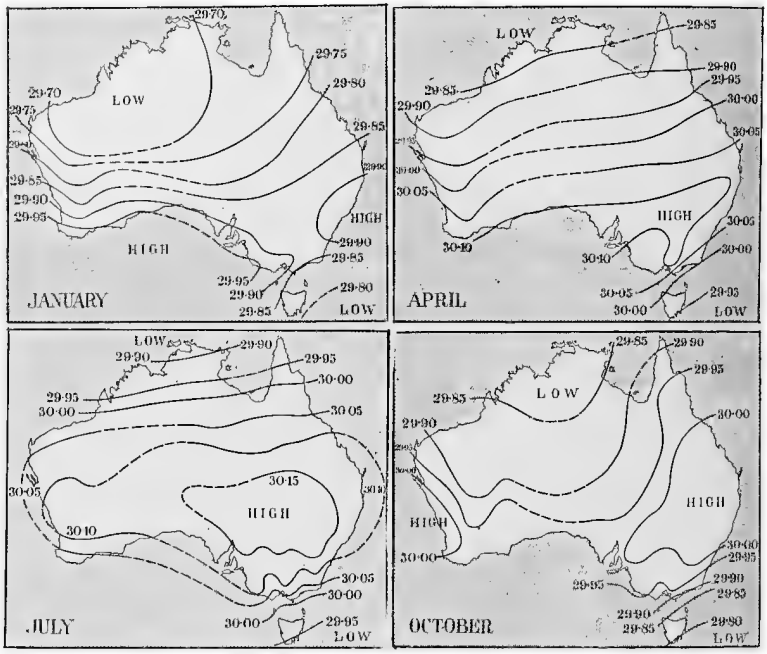


Fig. 18. Mean Monthly Pressure.

the Queensland hot gulf) and another just off the Pearling Coast (29·6). The remaining isobars ran east and west with a definite tendency to follow the double curve of the south coast, and the maximum (30·0) appears in the extreme south of Tasmania.

As the winter approaches, the high pressures tended to centre themselves around Kosciusko, the lower isobars forming around that elevated area. This was especially true in May and June. Then the high-pressure area

spreads westward right across the continent, in July (midwinter) forming a broad belt between the Tropic and the Bight with an average over 30·0 inches.

Australian weather is controlled by three belts of atmospheric eddies. The paths of the highs and lows.[1]

(i) In the north, moving (generally) from west to east, along the tropic of Capricorn, is a procession of low-pressure systems which may be termed Tropical Lows.

(ii) South of 40° S. is another series of cyclonic eddies, probably secondaries from the low-pressure belt of the Southern Ocean. These are called Antarctic cyclones.

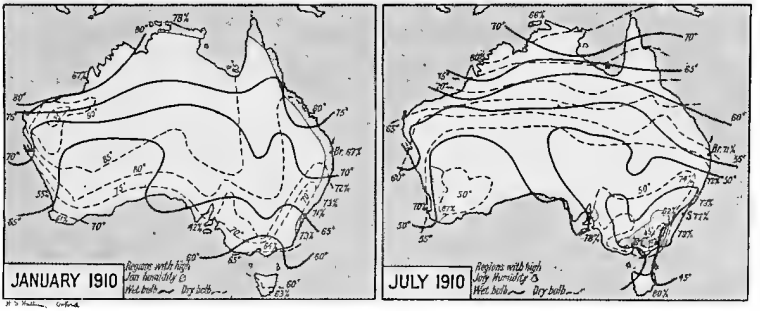


Fig. 19. Typical Climate of Hottest and Coolest Month.

(iii) Between the two lies the belt of anticyclones, whose path swings between latitude 30° and 42° as the sun moves south and back again.

The general tracks of the disturbances are shown on Fig. 20 (tracks of lows for 1910), when three facts may be noted in their characteristics. The tropical belt is much more irregular, the paths being often recurved. This series is never well developed in winter, for the months of April, May, June, July, and August are practically free from these disturbances.

The anticyclones are most numerous in winter and least numerous at midsummer. The tropical depressions

[1] Here also data are very incomplete, except for 1910, but the main features can be deduced from a study of the tracks of the disturbances in that year.

are unimportant in winter and increase in number as the sun moves south to a position over the continent. The Antarctic disturbances are somewhat less in evidence at midsummer. At this period the southern low-pressure belt has moved southward and its accompanying eddies (the Antarctic V's and lows) do not so often influence Australian weather.

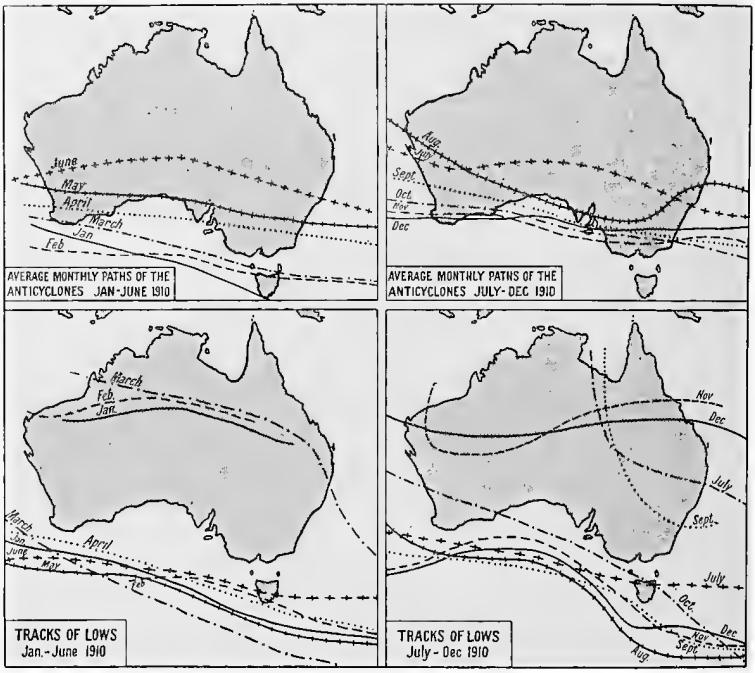


FIG. 20. Tracks of High and Low Pressure Systems.

Speed of the disturbances.

Sufficient data is not yet available for very accurate determinations of the speed of the disturbances. But one or two points of interest are obvious in any set of charts.

The tropical lows show a marked tendency to 'hang' about certain localities, such as the Pilbarra heated area or the region south of the Gulf of Carpentaria. A focus for the southern type of low is off the south of Tasmania. The velocity of the highs and lows across Southern

Australia is very irregular. Their rate across the Australian Bight is greater than over South-West Australia or Bass Strait, probably because the frictional resistance is less over water. These velocities vary with the months. Thus in June 1910 the lows off the Leeuwin averaged about 360 miles per day; over the Bight about 550 miles, and over Tasmania about 600 miles per day. In November of the same year the velocity of the lows showed an average of 830 miles across the Bight and 500 to the south of Tasmania.[1]

Dominant Winds

The south-east trade winds.

The whole coast of Australia from Perth round the north to Brisbane is at times influenced by the south-east trade winds.

In April the coastal winds are practically all south-south-east or east-south-east over this immense stretch of coast-line (the only marked deviation being the occurrence of some south-west winds (20 per cent. only) off Kimberley). In May the belt has moved north to Geraldton, but is otherwise unchanged. In June it does not extend south of North-West Cape, but is stronger off Kimberley. In July, August, September, and October it is practically continuous from North-West Cape to Rockhampton. In November, as the sun moves south, the belt extends down to Geraldton. In December the Australian monsoon causes a break from North-West Cape to the Gulf of Carpentaria (dominated by west winds) and the south-east trade forms a fringe on each side. This hiatus lasts through January and February, and in the last month the south-east trade is hardly distinguishable on the west coast. In March the intervening region of south-west winds is confined to the north-west coast and the trades are again in evidence south to Perth. In April the whole north-west, north, and north-east coasts are controlled by the trade winds.

[1] It must also be noted that it is difficult to fix the position and velocity of these southern eddies. Their centres often lie over water areas and can only be deduced approximately from the lie of their northern isobars.

Land and sea breezes.

Since so large a portion of the population of Australia lives on the seaboard, these winds are of great importance. Data is lacking, except at the capitals, but type examples

LAND AND SEA BREEZES

PERTH

Land ← (years to end of 1911) → Sea

Month	Average	Mid^{nt}	3 a.m.	6 a.m	9 a.m	Noon	3 p.m.	6 p.m	9 p.m
South Winds									
January	S	S	SE	ESE	ESE	S	SSW	SSW	S
South East Winds									
February	SSE	SSE	SE	ESE	ESE	SSE	SSW	SSW	S
March	SSE	SSE	SE	ESE	E	SSE	SSW	SSW	S
April	SE	SE	ESE	E	E	SE	SSW	SSW	S
North East Winds									
May	ENE	E	ENE	NE	NE	NNE	WSW	SW	SE
June	NNE	NE	NNE	NNE	NNE	N	WNW	WSW	E
July	NNE	NE	NNE	NNE	NNE	NNE	W	WSW	SSE
South West Winds									
August	WSW	SE	SSE	NE	NE	NW	WSW	SW	SSW
September	SW	S	SSE	ENE	NE	SW	WSW	SW	SW
South Winds									
October	SSW	S	SSE	ESE	SE	SW	SW	SW	SSW
November	S	S	SSE	SE	SE	SSW	SW	SSW	SSW
December	S	S	SSE	SE	SE	SSW	SW	SSW	S

FIG. 21.

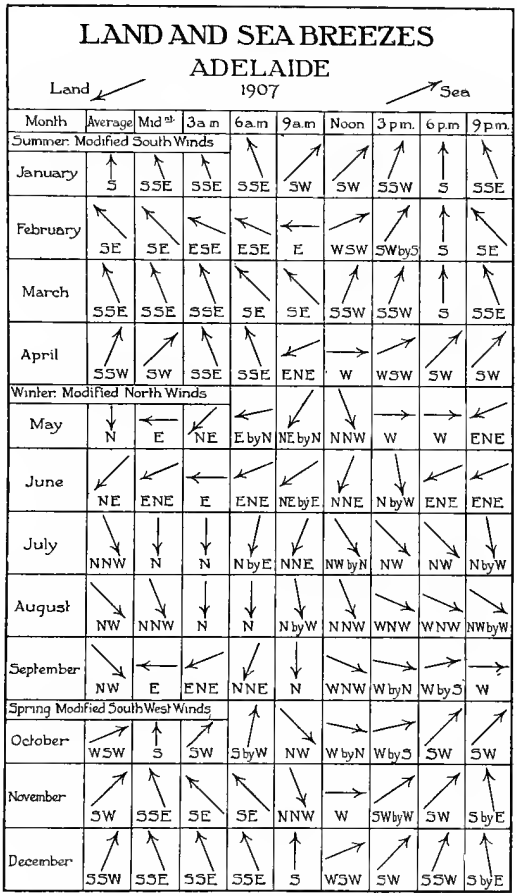
from Perth and Adelaide will serve to indicate the effect of the diurnal change.

Regional winds at Perth.

At Perth the average winds are:

South wind in October, November, December, and January (summer).
South-east wind in February, March, and April (autumn).
North-east wind in May, June, and July (winter).
South-west in August, September (spring).

In this locality the invigorating sea breeze—called the 'doctor'—blows from the west-south-west during the afternoon, while a land wind (east-north-east) sets in



LAND AND SEA BREEZES

ADELAIDE

1907

Land ← → Sea

Month	Average	Midnt.	3a.m	6a.m	9a.m	Noon	3p.m.	6p.m	9p.m.
Summer: Modified South Winds									
January	S	SSE	SSE	SSE	SW	SW	SSW	S	SSE
February	SE	SE	ESE	ESE	E	WSW	SWbyS	S	SE
March	SSE	SSE	SSE	SE	SE	SSW	SSW	S	SSE
April	SSW	SW	SSE	SSE	ENE	W	WSW	SW	SW
Winter: Modified North Winds									
May	N	E	NE	EbyN	NEbyN	NNW	W	W	ENE
June	NE	ENE	E	ENE	NEbyE	NNE	NbyW	ENE	ENE
July	NNW	N	N	NbyE	NNE	NWbyN	NW	NW	NbyW
August	NW	NNW	N	N	NbyW	NNW	WNW	WNW	NWbyW
September	NW	E	ENE	NNE	N	WNW	WbyN	WbyS	W
Spring Modified South West Winds									
October	WSW	S	SW	SbyW	NW	WbyN	WbyS	SW	SW
November	SW	SSE	SE	SE	NNW	W	SWbyW	SW	SbyE
December	SSW	SSE	SSE	SSE	S	WSW	SW	SSW	SbyE

FIG. 22.

when the land has cooled below sea temperatures in the early morning.

The sea breeze is most active when the land is much warmer than the sea, i.e. in the summer. The land breeze is most active for similar reasons in winter.

Thus we see that in winter the two factors (the normal

north-east wind and the land breeze) are assisting each other. Hence the constant north-east winds every morning during this season. For the rest of the year the morning winds are from the south-east, the resultant of the southerly regional wind and the north-east land breeze.

The sea breeze absolutely controls the wind direction at Perth in the afternoon, even in winter, and in the summer not much deflexion of the normal south wind is necessary to bring it into line. In conclusion it may be noted that there is each day a noteworthy change in wind direction near noon. During the first half of the year (February to July) this occurs just *after* noon ; in the latter half of the year (August to January) just *before* noon.

Regional winds at Adelaide.

At Adelaide the average winds are :

South winds in summer (January, February, March, April).
North winds in winter (May, June, July, August, September).
South-west winds in spring (October, November, December).

Here the coast-line has much the same direction as at Perth, so that the land breeze is east-north-east, and the sea breeze west-south-west as before.

It will be noticed that the land wind is very strong in the months of May and June. It also deflects the normal wind appreciably, but not very greatly in other months. The sea breeze is not strong in winter, but all the rest of the year is very important in the afternoon, exercising a strong deflexion in January, February, and March.

Rainfall

Areas of rainfall.

Australia and Tasmania cover 2,974,581 square miles. Of this total area 1,045,073 square miles have less than 10 inches per annum on the average ; 651,961 square miles have from 10 to 15 inches ; 416,135 square miles from 15 to 20 inches ; 502,929 square miles from 20 to 30 inches ; 198,608 square miles from 30 to 40 inches ; and 159,875 square miles have an annual average rainfall of over 40 inches.

Chief sources and seasons of rain.

The rains of Australia are derived mainly from two sources, tropical depressions and Antarctic depressions.

Tropical depressions affect over two-thirds of the

continent, lying to the north of a line from Cossack on the north-west coast to Sydney on the south-east coast, the rainy season being from December to March inclusive, and the wettest month January. The remaining third receives rain from the southern depressions in the autumn, winter, and spring, with the heaviest rains in June.

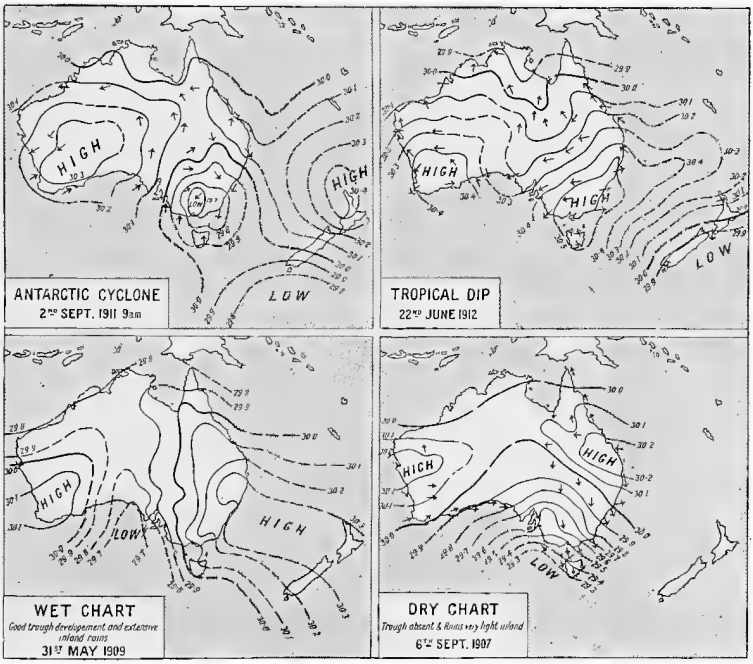


FIG. 23. Types of Pressure Systems producing Wet (1911, 1912, 1909) or Dry (1907) Conditions.

Minor sources of rain.

Anticyclonic rain falls over the eastern coastal districts at all seasons, when the high pressures are situated to the west of Tasmania.

Convectional rains may occur at any season in the interior, and cyclonic rains visit the east coast in northern parts during the summer months, and in the winter and spring months on the southern or New South Wales coastal regions.

Annual rainfall.

The annual isohyets form approximately concentric ovals around the arid centre of the continent. This arrangement does not, however, mean that the coastal regions are always wet; although unfortunately it is true that the interior is nearly always dry. In each month the region with over 1 inch of rainfall covers a somewhat crescent-shaped area, whose concavity lies toward the

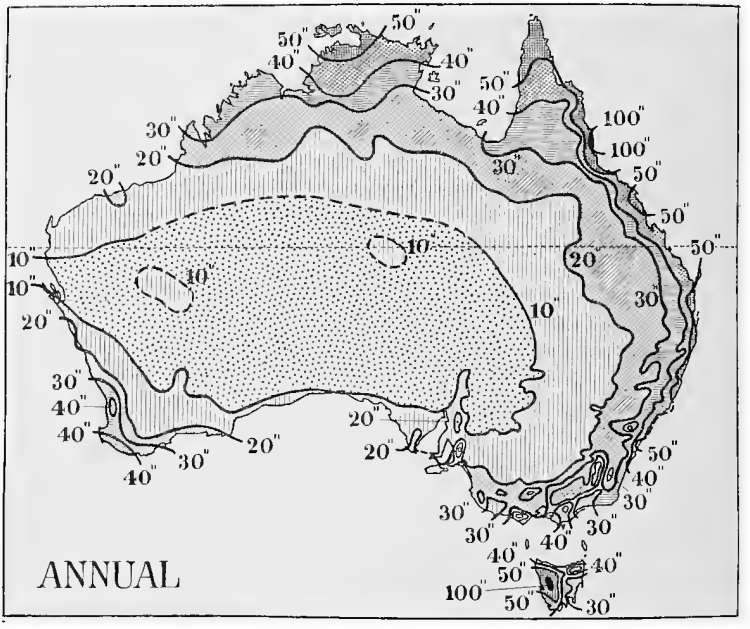


Fig. 24. Mean Annual Rainfall.

centre. These rain crescents slowly swing round from north through east to south and back during the year.

Monthly rainfall.

Let us now consider the months in some detail. In January the monsoon is at its height and hence an average of half an inch of rain falls each day at Port Darwin, gradually decreasing towards the south. Alice Springs (in the centre) gets about 1 inch in the month, while South and South-West Australia receive practically no rain. In February the rain belt is less intense, at Port

Darwin the monthly fall being 10 inches instead of 15 inches, but otherwise the distribution over the continent is much the same. In March the summer rains have retreated still further north, and the southern limb of the crescent is beginning to cover the south-west coast. The south-east trades have given the Queensland coast near Cairns over 20 inches during each of these three months.

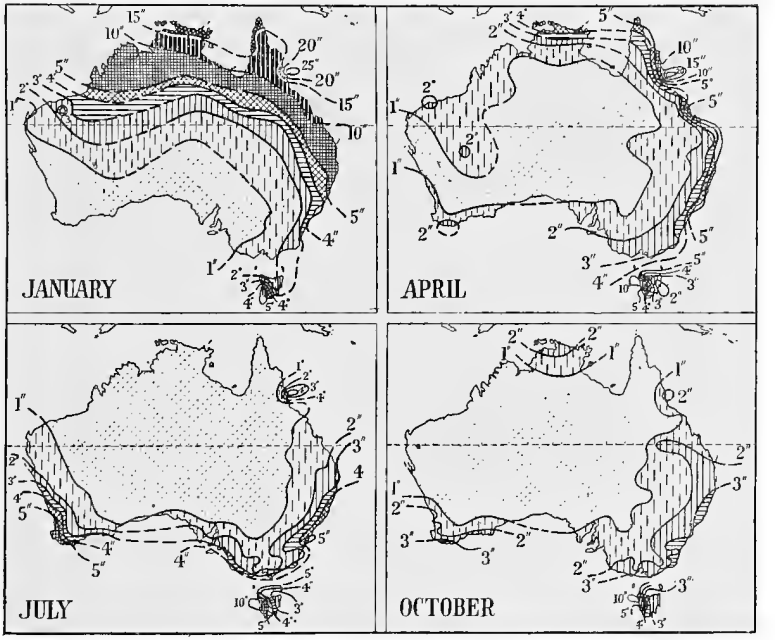


Fig. 25. Seasonal Rainfall.

In April the winter rains are beginning to be felt along the whole south coast. In May the south receives rainfall and no rain falls in the north. The crescent has now tilted round to face the south and its two limbs cover the east and west coastal areas. This is the condition in June, July, and August.

September is perhaps the driest month in the year, if we consider Australia as a whole. Only the extreme south-west

corner of Tasmania and the south-east highlands have a rainfall of over 2 inches. The southern rains are now moving south as the sun retraces his path from his northern limit.

In October there can hardly be said to be a rain *belt*, for the rain region is divided into three isolated areas. The northward bulge of the Southern Ocean in the Bight has severed the winter rain area in two, while in Northern Territory the summer rains are again creeping southward and are giving that settlement over 2 inches. For six months (since April) the north-west coast and York Peninsula have had practically no rain.

In November the winter rains are over. The crescent faces toward the north-east again and the monsoonal rains are dominating the north of the continent. In December the summer rain has reached Alice Springs in the centre of the continent and over an inch has fallen in that region.

Variation in maximum rainfall.

Fig. 26 shows the month of maximum rainfall and the boundary between the winter and summer rain areas. It will be seen that the four wettest months are January and February in the north, and May and June in the south.[1]

The line dividing summer and winter rain areas runs almost directly from North-West Cape to Sydney, though the actual line of demarcation, especially at the eastern end, cannot be drawn exactly.

In New South Wales the rainfall is remarkably uniform on either side of it throughout the year ; e.g. at Dubbo the monthly rainfall in inches is :

1·97 ; 1·92 ; 1·83 ; 1·92 ; 1·94 ; 2·00 ; 1·53 ; 1·86 ; 1·92 ; 1·58 ; 1·82 ; 1·99.

The highlands south of Bathurst cause summer rains considerably further south than elsewhere. Along the New

[1] The cause of the local variations is sometimes not easily explained. Why should Longreach, for instance, apparently receive twice as much rain in February as in January (see Fig. 26) when all the neighbouring stations have maxima in January ? In February 1898 no less than 15 inches of rain fell in Longreach instead of the normal 1–2 inches ; and the one extraordinary fall vitiates the whole record : for in the other years February and January are nearly equal. Many cases of a similar nature occur in the tropical moiety of the continent, which can only be rectified as the years of record lengthen.

South Wales coast, south of the Manning River, the maximum rainfall takes place in autumn, March being usually the wettest month. On the far south coast, however, the maximum is in July.

Relative humidity.

The relative humidity is highest at Sydney, while Hobart, Melbourne, Brisbane, Perth, and Adelaide follow in the order stated, Adelaide being the driest. The

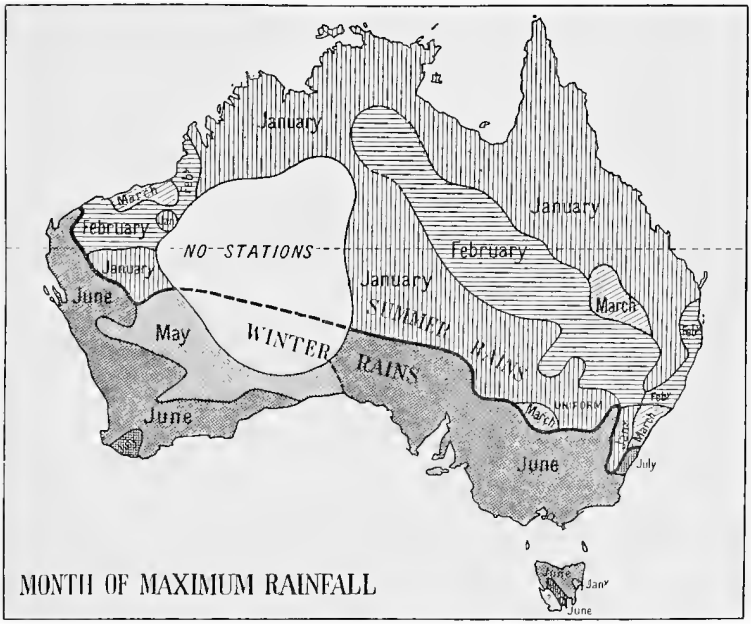


FIG. 26.

relative humidity is ordinarily but not invariably great when the temperature is low.

Effect of topography on rainfall.

Surrounding the central dry area of Australia, the isohyets describe almost concentric curves, any modifications being almost entirely due to variations in elevation. Thus the Darling Ranges to a great degree account for the excellent rainfall of the south-west corner of Australia. The Flinders Range (South Australia) and Australian Alps in the south-east have heavier rainfalls than the surrounding tracts owing to their cooling effect on the air currents.

Along the eastern highlands every ridge between large river valleys has a somewhat greater rainfall. Where the Bellenden Ker Mountains (5,000 feet) obstruct the south-east trade winds there occurs the heaviest rainfall (140 inches) in Australia. In Western Tasmania there is a superfluity of rain for similar reasons, though here the constant stormy westerlies play the part of water-bearers.

South-eastern Australia.

A brief notice may be devoted to the south-east corner of Australia, where in only 15 per cent. of the total area no less than 85 per cent. of the population of the continent dwell. Here the contours have been very approximately mapped. The so-called dividing 'range' consists of five or six isolated 'massifs'—the New England Plateau, separated by the broad low Cassilis gap from the Blue Mountain massif. The Lake George gap is the northern boundary of the Snowy-Bowen and Tindery Ranges, which are separated by the long Cooma Rift Valley; and by the Omeo gap from the westernmost massif, the Barry Mountains. At Kilmore the highland practically ends, though a well-marked low plateau near Ballarat prolongs the main divide to the west.

The following table shows how the distribution of rainfall is related to this alternation of a massif and gap:

	Name.	*Height in feet.*	*Rainfall in inches.*
Wet.	New England Plateau	3,000–5,000	30–40
Dry.	Cassilis gap	1,000–2,000	20–30
Wet.	Blue Mountain area	3,000–4,000	30–40
Dry.	Lake George gap	2,000	20–25
Wet.	Tindery Range	3,000–5,000	25–30
Dry.	Cooma Rift	2,000–3,000	Under 20
Wet.	Snowy Ranges	3,000–7,000	Over 50
Dry.	Omeo gap	2,000–3,000	20–30
Wet.	Barry Mountains	3,000–5,000	Over 50
Dry.	Kilmore gap	1,200	25
Wet.	Ballarat uplands	2,000	30

Other special areas.

One or two other isolated areas deserve brief mention. The noticeable effect (in the far west) of the comparatively low Grampians and Cape Otway Ranges on the rainfall is very evident. The latter, though little over 1,000 feet high, have a precipitation of over 50 inches annually. Near Geelong is one of the peculiar *locally dry* areas, due

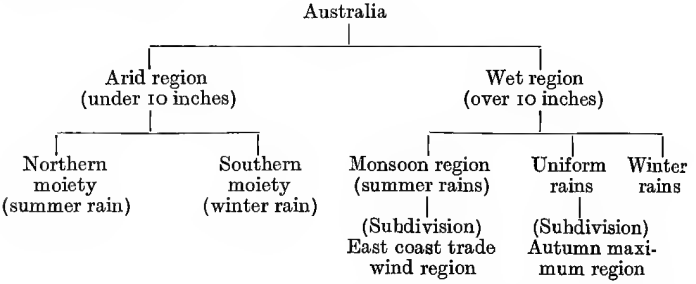
to its low-lying and sheltered situation. Similarly, there is heavy rainfall (50 inches) on the insignificant Gippsland Hills (1,000–2,000 feet), and a drier area in their lee around Sale. The latter has 5 inches less rainfall than the rest of Eastern Victoria.

Fig. 27. The Influence of Orographical Conditions on Rainfall.

Behind Sydney in the lee of the Blue Mountains is a patch around Picton with less than 30 inches, probably due in part to the drying (föhn) action of westerly winds sinking down to sea-level after crossing the elevated land (3,000–5,000 feet). In other regions these contrasts must occur, but no data for contours are available.

Chief Climatic Regions

Our study of the chief weather elements has shown us that Australia has not one general climate. The types of climate may be best classified in Australia according to quantity and season of rainfall. Other factors determine secondary subdivisions, and we may tabulate them thus (see Fig. 28):



The monsoon region.

This comprises Australia north of the tropic of Capricorn, together with Southern Queensland and the north of New South Wales. The heaviest rains are in January and February. They are directly due to the indraught caused by the heating of the centre of the continent. This leads to the formation of a low-pressure system (monsoonal depression) in Northern Australia. The ascending winds are cooled and deposit their water vapour in heavy rain-storms and thunder showers.

Over the greater portion of the area the winter is quite dry, and the whole of the rainfall falls in three or four months. In the east, however, the rain is much more abundant and uniform. Along the Queensland coast the land rises to considerable heights, and there is a permanent on-shore wind, the south-east trade, which gives a rainfall of over an inch in each winter month. It seems worth while to make this eastern fringe a subdivision of the summer rain (or monsoon) region.

The arid region.

This is bounded somewhat arbitrarily by the 10-inch annual isohyet. Two small areas with more than 10 inches are shown in the highlands of the Macdonnell Ranges

and in the Peak Hill Goldfield. These two slightly less arid areas may be related to the two commoner paths of the tropical lows, which often curve southward and south-eastward over Pilbarra and Alice Springs respectively.

Owing to lack of information the northern boundary of the arid region cannot be accurately plotted, so that the line given—from Winning Pool to Barrow Creek—

Fig. 28.

will no doubt need considerable revision later. Although the scattered rains of the north fall chiefly in January, and of the south in May and June, this variation does not determine the type of vegetation, which is almost wholly controlled by absence or insufficiency of rain (xerophilous) and not by the season when it falls. The arid region consists essentially of an undulating tableland, 1,000–3,000 feet high.

If the isohyets for 0·5 inches are plotted in each month,

the Macdonnell Ranges are seen to form an oasis in the arid region. In May, June, October, and November, when the districts not only south, but east (Sturt's Desert, &c.), are receiving less than half an inch, this region of uplands (3,000 feet) is favoured by more rainfall. Possibly the Musgrave Ranges, which are said to reach 5,000 feet (Mount Woodroffe, 5,230 feet), are also wetter, but no data are available. The driest region with a rain gauge is in the east and north-east of Lake Eyre, with less than 5 inches in the average year.

In the northern portion of the arid region the temperatures are much higher (the hottest part of Australia lies between the Peak Hill and Pilbarra Goldfields) and the evaporation is much greater here than in the southern goldfields—an important matter for the water-supply of these centres. (Compare Wiluna and Coolgardie in the following table.)

Evaporation Data

	Yrs.	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May.*	*June.*	*July.*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Total Evap.*	*Annual Rainfall*
Carnarvon	4	14·6	11·9	10·8	8·3	5·3	4·3	5·0	6·4	7·5	10·0	11·8	13·4	109·3	9·17
Wiluna	6	21·5	17·7	16·0	10·5	7·4	4·7	5·1	6·7	9·1	13·4	17·4	21·3	151·1	9·94
Coolgardie	11	12·9	10·4	9·3	6·3	3·7	2·5	2·5	3·5	5·2	7·4	10·3	13·1	87·4	9·08

Note.—Coolgardie, 36-inch tank with water-jacket; Carnarvon, 8-inch dishes with small water-jacket; Wiluna, 8-inch dishes with small water-jacket.

Intermediate region of uniform rains.

In our description of the monthly rainfall we saw that the distribution areas were shaped like crescents. The summer rain crescent includes Northern Australia and South-East Australia; the winter rain crescent includes South-West Australia and South-East Australia. In other words, the two crescents do not meet in the north-west—so far as any but light rains are concerned—but they overlap in the south-east. Hence the coastal *aridity* in Western Australia and the region of *uniform* rainfall in Eastern Australia.

Region of uniform rainfall

The latter region is a roughly triangular area reaching from Wilcannia east to the coast at Port Macquarie and

south-east to Albury and thence to Melbourne. A reference to the tables shows that Dubbo is a typical station, for it has just under two inches of rainfall in each month of the year. Cobar and Wilcannia to the north-west and Goulburn and Delegate to the south-east are also on the axis of uniform rainfall. To the north-east the summer rains grow proportionately greater, though a considerable amount of rain falls all the winter. To the south-west the June maximum becomes very evident, and over the border, in the Wimmera and Mallee regions, the winter rainfall is much more than double that of the summer. in East Australia.

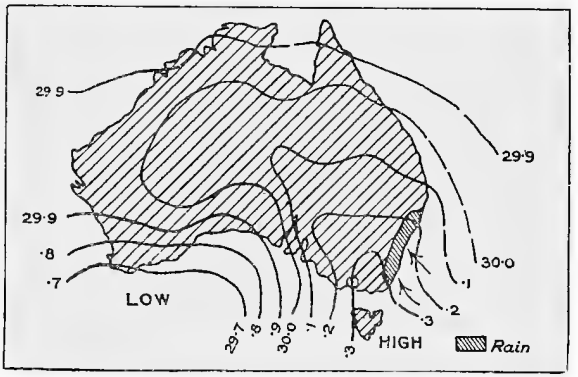


Fig. 29. Pressure Conditions with Autumn Rains (Sidney, &c.).

Furthermore, along the coast from Port Stephens to Ulladulla is an enclave of autumn rains. This includes Sydney, and forms a narrow coastal strip with heavy rains in February, March, April, May, and June, and moderate rains in the remaining months. An explanation of this is suggested in the following sentences, based on the conditions in 1912. During these autumn months the anticyclones move along latitude 35° S. In midwinter their path is along 28° and in midsummer along 42°. In spring the paths are much the same as in autumn. About once a week during the autumn months of 1912 this coastal strip experienced rains, while the rest of New South Wales was dry. This rain generally accompanied south-east on-shore winds in the front and north of Autumn rains in Sydney coastal district.

a high as shown in the figure. Out of nineteen examples of this type of rain distribution in autumn, 1912, no less than fifteen occurred when the centre of the high was about Bass Strait (roughly between Mount Gambier and Gabo). In September, October, November, and December, 1911, there were only three of these local rains near Sydney. It would appear, therefore, that some other factor than the path of the atmospheric eddies was involved, for in spring (September, October, November) the highs occupied somewhat similar positions to those in autumn. Since these rains do not penetrate beyond the coast to the highlands, they are obviously due to differential temperatures of coast and ocean. Perhaps the more rapid heating of the land than the sea in spring militates against similar rains in this season.

The winter rain region.

The winter rain region consists of a belt along the south coasts of Australia. It may be subdivided into four sections on geographical grounds, though the meteorology does not differ so much as might be expected.

1. The south-west corner, or Westralia Felix.
2. The Bight Littoral.
3. South Australian gulfs, western Victoria, and the Riverina, New South Wales.
4. Tasmania (except the south-east).

In these areas there is a marked maximum rainfall in June, especially in the west. Along the Australian Bight, the area receiving more than 10 inches is extremely narrow. The effect of the Flinders Range, which lies athwart the westerly winds, in improving the rainfall of South Australia is very strikingly shown, and probably the long rift of Spencer Gulf, immediately to the west, also tends to increase the rainfall. In Victoria, the rainfall becomes more towards the north-east. Along the west coast of Tasmania is a region, unique in Australia, where a superabundance of rain has undoubtedly retarded settlement. There are practically no inhabitants in the south-west region, which is very rugged country consisting of bare granite, barren heath, or covered with an almost impenetrable scrub. The rainfall reaches 110 inches a year

on the highlands behind Macquarie Harbour, and is, therefore, only exceeded by the town of Geraldton in North Queensland. Around Hobart (Tasmania) is a small region having a much more uniform rainfall with a spring maximum.

Each of the four or five main divisions of Australia which have been described in the foregoing can be paralleled by similar regions in other parts of the world. These are briefly summarized in the following table (based on Herbertson and Koeppen): Comparison of climatic regions.

Australian.	*Extra-Australian.*
1. Summer rain region.	Sudan, Brazil (like the wetter north portion); and South Siberia and Argentine (like the drier south-east portion).
1*a*. North-east coast (trade wind region).	Florida, South China coast.
2. Arid region.	Kalahari, Atacama, Sahara, Arizona.
3. Uniform rain region.	Uruguay, Cape Colony (south-east).
3*a*. Autumn maximum.	Eastern U.S.A., Natal, South-east Brazil.
4. Winter rain region.	Cape Colony (west), Chile, California, and Mediterranean lands.

Characteristics of Drought Years in Australia[1]

As would naturally be expected, years drier than normal in Australia are, in general, years with air-pressure above normal, and vice versa. Confining attention to the period since 1880, the information for previous years being rather too scanty, the principal dry years were 1881, 1884, 1885, 1895, 1896, 1897, 1899, 1902, 1907, and 1911. In considering drought years, attention is directed to the failure of the rains during the critical periods for grass and crops, which may be taken as extending from April 1 to October 31. The low rainfall for the year for all but one of these constituted them drought years in any case. The exception is 1911, which was one of the wettest years on record for Victoria, owing to two tremendous rainfalls in February and March, but from July onward it was extremely dry, as were also the first five months of 1912. The years 1884 and 1885 were not universally bad, the former being very dry only in the east and the latter in South Australia.

[1] This section has been contributed by E. T. Quayle, B.A., Assistant Meteorologist.

Pressure and temperature in drought years.

In tables showing for Melbourne and Adelaide the mean pressure and temperature departures from the mean for each month of these years, it may be seen that for Melbourne 8 out of the 11 years are above normal pressure and a similar proportion below normal temperature. The Adelaide records agree as regards pressure, but disagree altogether as regards temperature, only 4 out of the 11 being years colder than the average. The Melbourne temperature figures for the first three months are interesting and suggest the possibility of using them to forecast the character of the following nine, no less than 25 out of 33 being below the average. The Adelaide temperatures suggest a similar possibility, though not so strongly, only 20 of them being below and 13 above normal. As regards pressure, Melbourne suggests nothing, but Adelaide shows 23 above to 10 below normal for the first three months. Similar data for Alice Springs show that, as at Adelaide, pressure and temperature are generally above normal for the drought years as a whole.

Drought of 1888.

As the years 1888 and 1902 stand out beyond all others as drought years, a comparison between the two may be instructive. It is worth noting that the former was sandwiched between years of excessive rainfall, but that the latter was the culmination of a long stretch of years with low average rainfall which began in 1895. The year 1888 was characterized by no unusual weather type. Pressures were higher than normal throughout the year in Melbourne and Adelaide, except in July, and especially so in spring. These pressure systems were almost entirely of anticyclonic type, there being few inland rains of tropical origin, even in summer, and during the seven winter months, April to October, practically no rains due to tropical incursions of low-pressure systems. Cyclonic developments from antarctic low pressures were absolutely wanting during the whole year, and there was a succession of high-pressure systems on the mainland and of low-pressure systems with centres far to southward passing along the south coast. For the year as a whole, the departure from the average mean pressure was very

large thoughout Australia, averaging $\frac{4}{100}$ of an inch at the six capital cities.

Drought of 1902.

The year 1902 was also marked by pressures much above normal, but in other respects it differed very strikingly from 1888. In 1888 the depressions followed one another over the southern waters without making many inroads upon the high-pressure systems upon their equatorial sides. In 1902, during the five critical months, April to August, high-pressure systems were continually being built up over Tasmania and South-eastern Australia, apparently through the agency of large cyclonic depressions operating over Tasman Sea or New Zealand, many of which were of tropical origin. The result upon storm systems approaching from the west was generally disastrous. Some were deflected too far south to affect Eastern Australia, some seemed to die out before reaching it, and some were converted into feeble cyclonic eddies, which had little rain-producing effect. The last two months in both years were, however, a good deal alike, in that depressions of tropical origin became frequent, possibly owing to the approach of improved conditions.

Dry-weather types.

This would suggest two main dry-weather types: (*a*) High- and low-pressure belts maintaining their respective latitudes with little tendency to departure from the usual position, but the high-pressure greater than usual, probably the result of a general lack of humidity in the atmosphere. Of this, 1888 is most typical. (*b*) Unfavourable location of high-pressure systems over South-eastern Australia and Tasmania, coincident with the operation of great storm systems over Tasman Sea and New Zealand, and a tendency to the formation of slow-moving feeble cyclonic circulations advancing from the west. This was characteristic of 1902.

Conditions in other drought years.

Examination of the weather charts of other drought years show more or less of the characteristics just defined. For example, the winter months of 1899 showed a very decided tendency to the pressure distribution of 1902, though tropical cyclonic storm systems off the east coast of New South Wales were much more pronounced, with

the result that the coastal rains there were well above the average for that year. 1895 resembled 1888, but the antarctic lines were stronger; 1896 favoured the 1902 type, but the tendency to cyclonic development was much greater. 1897 also tended to resemble 1902, but with occasional departures to the other type. The years 1907 and 1911 do not show any special likeness to any drought

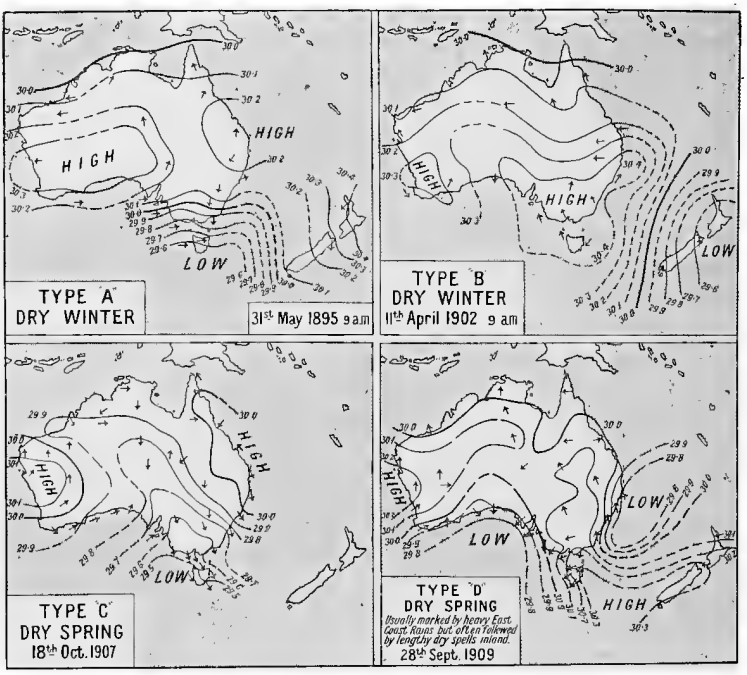


FIG. 30. Types of Pressure and Wind Systems which bring Drought.

years, and seem to have been dry from various causes. 1907 can hardly be taken as a typical drought year, inasmuch as true drought conditions were limited to the eastern states in area, and to the spring months in time. The great deficiency was in September and October, the previous shortage not being very serious. A study of the weather charts for these two months reveals two tendencies, one of which, at all events, tends to relate their pressure distribution to that of 1888, the southern

circulation being of pronounced westerly type. This is shown by a decided tendency to flattened V depressions, so that winds in front of a storm would be more from north-west than north-east, and in rear from the west than from the south. This was probably due to the exceptional rapidity of the storm movement eastward, in higher latitudes, an idea suggested by the frequency with which monsoonal troughs in connexion with antarctic storms were given a north-west to south-east axis. The chart of October 18 (Fig. 30) is typical of these conditions and is a distinct dry spring type. It shows a high-pressure system pressing eastward over the head of the Bight. This is a very unfavourable sign for rain over the southern parts, as it has the apparent effect of cutting off any trough connexion with the tropical low-pressure belt, and, in addition, means the establishment of anticyclonic conditions over the south coastal areas. It brings persistent westerly winds over southern waters. The spring of 1909 is another good example and was similarly dry. The type exemplified in the chart for October 18, 1907, may be regarded as a special one characteristic of dry weather in spring, as it most frequently occurs between August and December.

Association of dry periods with moderate humidity of atmosphere.

Another special type, which does not seem inconsistent with a moderately humid condition of the atmosphere, and yet often causes prolonged dry spells over the inland portions of South-eastern Australia, is one which frequently occurred in 1899. Here high pressures tend to centre over Tasmania, or to form an elongated system extending from Southern New Zealand to Tasmania, and thence towards Central Australia. The apparent cause of this arrangement seems to be a cyclonic storm, usually of tropical origin located on its northern side, and often off the New South Wales coast-line, along which the rainfall is generally very heavy, owing to the upthrust given by seaward slopes to the strong south-easterly winds in the south-westerly quadrant of the cyclone. Inland areas do not benefit appreciably, and as these systems tend to persist for several days and seem not only to prevent the advance of rain-bearing storms from the west, but to

destroy their energy, the occurrence of a number of them during the rainy season may have a very appreciable effect in lessening the inland rainfall (see chart for September 28, 1909). The tendency to this distribution was very pronounced during the seven winter months of 1899, and in particular during the months of July and August, when the inland rains were very scanty.

Classification of drought years by types.

In the following table the years are arranged in two sections, (*a*) and (*b*) representing the two most distinct drought types, and the barometric departures from the normal for the whole year at the various capital cities are also given to show how far these support the classification. As will be seen, they do this fairly well.

TYPE (*a*)

Departure from Normal Annual Air-pressure.

	Hobart.	*Melbourne.*	*Sydney.*	*Brisbane.*	*Adelaide.*
1888	+·029	+·060	+·053	+·039	+·051
1895	—	−·004	+·010	−·001	+·009
1907	−·035	−·017	+·007	−·013	−·015
		TYPE (*b*)			
1902	+·058	+·029	+·032	+·020	+·033
1896	+·021	+·016	+·017	+·009	+·018
1897	+·032	+·007	+·015	+·007	+·015
1899	+·041	+·020	+·020	+·010	+·023
1911	+·022	−·009	−·008	−·012	−·001

Effect of air-flow from tropical belt.

A very common feature of good winters is the formation of trough-like depressions lying north and south and connecting with the tropical low-pressure belt. These cause extensive rains, falling mostly in front of this trough and extending sometimes right across the continent. They frequently end by producing a strongly cyclonic circulation over South Australia, New South Wales, or Victoria, or all three, and when this happens the tropical influence seems to come to an end with the cessation of trough rains and the production only of those due to the cyclonic system itself. A tongue of high pressure usually now presses from the westward along the northern boundary of the cyclone, destroying the tropical connexion, and this is followed by the lessening intensity of the cyclone itself, as if its main supply of energy had been cut off. Nineteen times out of 25 the rule holds that winter rains are above

or below normal according as the number of days occupied by decided troughs passing over Alice Springs is above or below normal. Eight selected dry years give a mean only two-thirds as large as that given by twelve wet years.

Evaporation and rainfall.

Evaporation means for the drought years are in general slightly below those for all years of record for the coastal stations, and above for Alice Springs, the one inland station given. The lower evaporation, as well as the lower summer temperatures at coastal stations, in drought years may be explained by assuming that the greater insolation over the interior produces greater and more frequent indraughts of moist, cool sea air. Choosing ten typical stations in the northern wheat-areas of Victoria and a similar number from the northern areas of Southern Australia, it is found that the mean annual rainfall for the Victorian stations is 17·82 inches, of which 12·33 fall in the seven months April to October. The wettest year since 1880 was the year 1889, when 26 inches fell, and the driest 1902, when the total was only 10·94 inches, of which only 5·11 fell during the critical seven months. For the South Australian stations the mean annual fall is 15·0 inches and for the seven winter months 11·25. The wettest year in this area was also 1889, with 25·35 inches, and the driest 1888, with 9·21 inches, of which 7·93 fell during the growing period. In 1902 the year's total was 10·70 inches, and that for April to October, 6·60 inches.

Drought, agriculture, and stock.

It will thus be seen that even in the worst years the rainfall is sufficient, when aided by modern agricultural methods, to ensure at least moderate yields of cereals from extensive inland areas. That an occasional drought is not an wholly unmixed evil is seen in the unusually abundant crops harvested in the first good season, owing probably to an improved condition of the soil. The most serious effects of prolonged drought are the losses of stock, due to an almost entire dependence upon natural grasses. That these are easily preventable will be proved by future experience.

Rainfall in the West Australian Goldfields

In the arid region of Western Australia, for the most part with a rainfall of less than 10 inches a year, are three important centres of settlement. In the north is the Pilbarra Goldfield, in the centre the Murchison Goldfield, and in the south the Coolgardie Goldfield. Kalgoorlie has a population of over 17,000 inhabitants, while some £85,000,000 have been won by the miners from the goldfields of Western Australia.

Rain-storms in Coolgardie, Murchison, and Pilbarra areas.

A special study of the rainfall of this area is justified by its economic importance and by its interest as a region which has been settled in defiance of physical control. An analysis has been made of the conditions governing the rainfall in the inland portion of Western Australia during the period July 1909–July 1912. The rain-storms are classified in three groups: Coolgardie (Southern Goldfield), Peak Hill (Central Goldfield), Pilbarra (North-west Goldfield). In most cases Coolgardie participated in rains from the north which affected the other two, but rains moving from the south rarely reached Peak Hill and never Pilbarra. The number of rain-storms affecting the districts in this period is shown in the following table (for three years):

	Summer. Dec., Jan., Feb.	*Autumn. Mar., Apl., May.*	*Winter. June, July, Aug.*	*Spring. Sept., Oct., Nov.*	*Total.*
Pilbarra . .	10	9	7	1	27
Peak Hill . .	13	9	18	8	48
Coolgardie . .	12	17	35	18	82
Individual storms[1]	21	24	39	26	

Coolgardie lies in the winter rain region, Peak Hill gets its infrequent rains both in winter and summer, while Pilbarra, so far as frequency is concerned, has a slight

[1] Many of these 'individual storms' affected two centres.

summer maximum and a more characteristic spring minimum.

The wind directions tabulated refer to the dominant winds over the whole rain area ('smear' is used for such local rain) due to one particular storm or set of controls. Winds.

The rain winds affecting the arid interior are chiefly from the north to north-east octant, veering to the north-west in part in the colder months. But the south-west and south winds also exercise a beneficial effect, especially in the colder months.

Summer.		*Autumn.*	
North-east = 8	10	North-west = 7	16
North = 2		North = 3	
		North-east = 6	
South = 6	8		
South-west = 2		South-west = 5	5
Others	3	Others	3

Winter.		*Spring.*	
North = 15	23	North-east = 10	
North-west = 4			
North-east = 4		South-west = 10	14
		South = 4	
South-west = 11			
Others	4	Others	3

The pressure conditions leading to the fall of rain in the interior of Western Australia are by no means always of the same type. The most striking feature shown by the analysis of the pressure systems is the persistence of one type throughout a season in one year which may not occur in the same season next year. Pressure systems.

There is perhaps no need to emphasize the fact that in an immense area like Australia each climatological division exhibits as diverse features as does for instance the whole of the British Isles.

In *January*, *February*, and *March* the rain smears extend usually over the three goldfields. They occur Monthly distribution.

nearly always when a low lies off North-West Cape—the high being to the south-east, either over the Bight or further east. The wind is generally from the north-east, but if the southern high is rather to the west then south winds also bring rain to the Fields.

In *April* the second type of rain-bringer is prevalent, i. e. a low south of Leeuwin and a high approaching Geraldton. Winds are northerly first and then southerly as the low advances. Coolgardie rains are due usually to the latter winds.

In *May* and *June* the favourable condition for rain appears to be when two highs lie rather near together (one over South-Eastern Australia and one off Geraldton) with a low just south of Cape Leeuwin. The winds are northerly and the rain smear chiefly in the south.

In these months increased gradient (implying stronger winds) is apparently the most favourable factor in supplying Coolgardie with rain: for the velocity and path varied without effect.

In *July* and *August* the lows are slightly further north than in June, and the preceding high covers Central and Eastern Australia, and the rains were generally due to northerly winds in front of a low.

In *September* a tendency for the low to run up between the two highs is noticeable. If the latter are close together so that the gradient is steep there would seem to be better chances for rain. Thus in 1911 in this month there were six high-pressure systems in evidence, but only three with somewhat steeper gradients led to rain.

In *October*, *November*, and *December*, rains are rare in the goldfields region, and there seems to be no very favourable arrangement of the pressure conditions. Thunderstorms may occur over the goldfields.

Flood Rains in Australia

South-Eastern Australia (August, 1909).

During the month of August 1909 every station in South-Eastern Australia recorded above the normal fall, except the coastal fringe from the Gippsland Lakes northward. In South Australia, where the mean fall in

the settled districts ranged up to more than double the normal, and in Victoria, where the greater part of the state had over twice the normal amount, this month will rank as one of the wettest on record (see Fig. 31).

The rains were not only abnormally heavy but well distributed through the month, though the rain-producing cyclonic systems were actually few in number (only four). They moved slowly, developed well inland, and the path

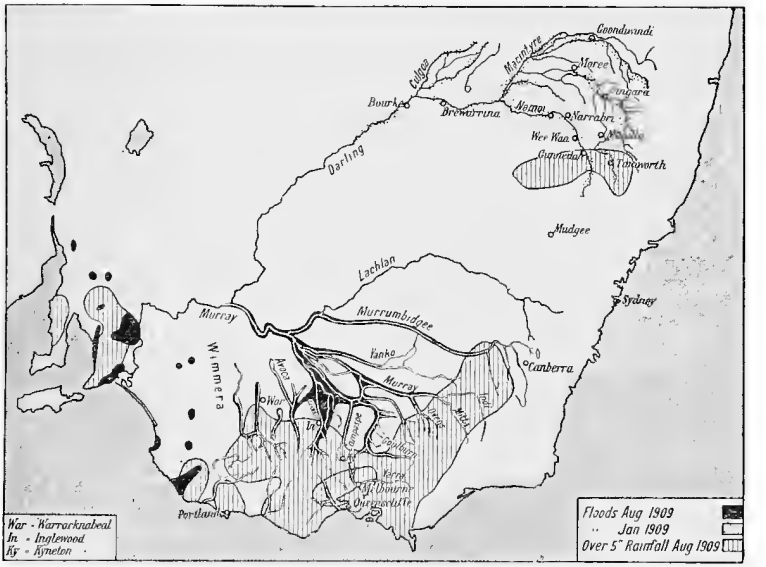


FIG. 31.

followed by their centres was further north than usual, all passing over or very little south of Tasmania. Each of these disturbances was marked by cold, wet, and stormy weather, but the storm tendencies of the month culminated on the 19th in torrential rains and fierce thunderstorms, which caused one of the most disastrous floods Victoria has ever experienced.

The cyclonic storm of August 16–21, 1909.

The map of the 16th shows the advent of the chief cyclonic disturbance, which had rapidly advanced from the southern Indian Ocean during the previous twenty-four hours, in the extreme west of the continent.

On the 18th the gradient had still further declined, but the low area had assumed a definite V shape with its apex

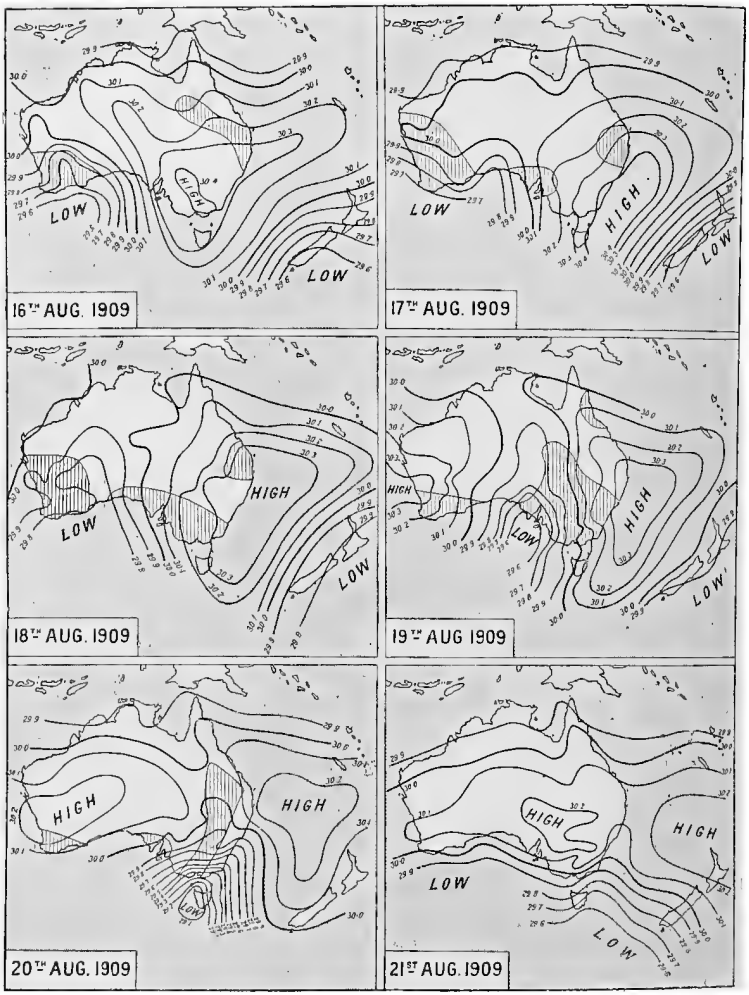


FIG. 32.

intruding well inland to much lower latitudes than on the previous day.

On the 19th greatly disturbed weather was anticipated, as this type of chart, showing a deep cyclonic V area,

wedged in between two energetic anticyclones with isobars running approximately north and south, is a very favourable forerunner of widespread rains on the Australian continent; and the subsequent conditions more than realized these anticipations.

On the 20th the storm reached its greatest intensity, its cyclonic centre being clearly shown to the south of Victoria and near the north-west corner of Tasmania (barometer at Stanley, 28·96 inches) with exceptionally steep gradients. Along the south-east coast of South Australia the previous night the weather was extremely wild, with winds of hurricane violence and exceptionally low barometer, and rain fell throughout the whole of South Australia, Victoria, Tasmania, and New South Wales, and over the south-west and south of Queensland.

Records of floods in rivers.

A reference to the rain smears plotted (with the isobars) on Fig. 32 shows that it was in Victoria that the greatest overlap of the daily falls occurred. Hence, the floods were greatest in the rivers draining the Victorian highlands (see Fig. 31).

The heaviest totals, about 4 inches, were received along a narrow strip of high country following the crest of the dividing range westward from Kyneton, and probably including the Pyrenees.

A brief summary of the heights reached in the various rivers affected is appended.

River.	*Town.*	*Height on Staff, &c.*	*Remarks.*
Murray	Echuca	32 ft. 2 in.	Twice exceeded (1867 and 1870).
Goulburn	Shepparton	33 ft.	Only twice exceeded (by a few inches) since 1881.
Wimmera	Jeparit	16 ft.	
Avoca	Charlton	—	6 ft. above 1870 flood, and 4 ft. above others.
Loddon	Laanecoorie	36 ft.	
Campaspe	Rochester	28 ft. 11 in.	
Murrumbidgee	Narrandera	26 ft. 6 in.	Below the great flood of 1853.

The floods in the Darling tributaries, January 1910.

The disastrous flood in the Upper Darling tributaries, consequent on the abnormally heavy rains on the north-western plains and slopes of New South Wales as well as those on the Darling Downs of Queensland, is from a meteorological standpoint one of the most interesting

events during 1910 (see Fig. 33). It was caused by the joint action of an anticyclonic area over the southern half and the monsoonal depression operating in the northern half of the continent. Between the 11th and 14th the tongue had expanded considerably (see Fig. 33), stretching as far south as Deniliquin, and on the 15th had intensified to such an extent as to form what is technically known as a closed curve depression. It was

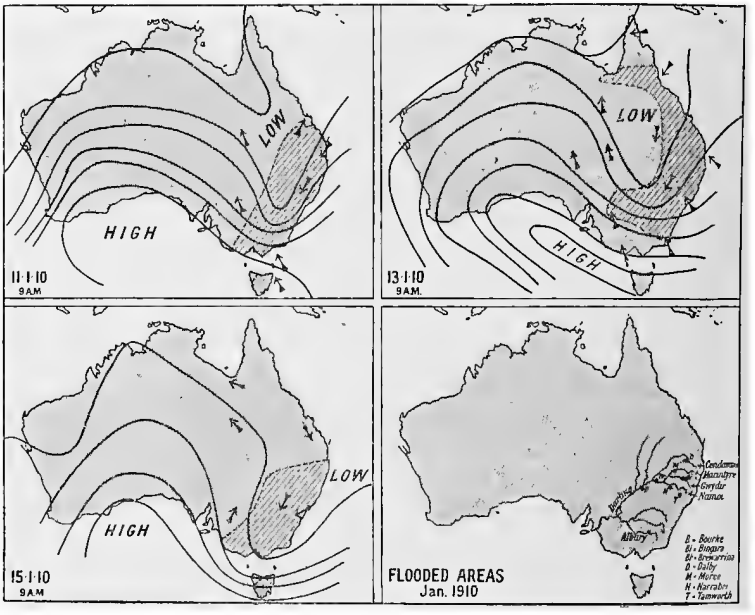


Fig. 33.

during this period that the heaviest falls were recorded. The Namoi Basin experienced particularly heavy falls on the 14th and 15th, and the average total rainfall for fifteen stations in that area from the 11th to the 15th inclusive was 8·63 inches, several places recording more than 12 inches of rain for that period. Copious falls occurred in the catchment area of the Condamine River in Queensland. Cambooya and Dalby, both in this area, registered 10·17 and 9·68 respectively. The MacIntyre Basin was also unusually favoured, the average total for

six stations, from the 10th to the 17th, being 7·13 inches—Goondiwindi, 9·11, Umbercollie, 9·90, and Bingarra, 19·44, being the heaviest falls recorded. The enormous amount of water which fell over these districts, covering approximately 86,000 square miles, may be roughly estimated at 22,263,981,688 tons, or 7,060,421,120,000 gallons, when we realize that the average total fall for seventy-seven stations, from the 11th to the 15th inclusive, was 5·7 inches. The water spread itself over the country for miles in every direction, devastating the surrounding districts and

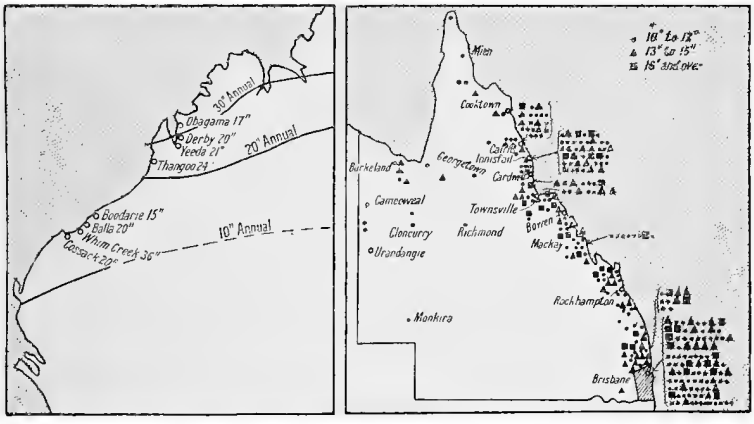


Fig. 34. Heavy Rains in (*a*) the North-west; (*b*) Queensland.

causing incalculable destruction of property, as well as small loss of life. Almost all the towns along its banks were inundated, Tamworth, Gunnedah, Manilla, Boggabri, Narrabri, and Wee Waa suffering particularly.

Heavy rains of Queensland.

The Queensland coast is characterized by occasional very heavy downpours. These are almost entirely confined to the summer months, as the following table (for storms giving over 10 inches during 23 years, 1887–1909) clearly indicates :

Month.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Number	104	42	92	24	1	9	1	1	2	0	2	26
Per cent.	33	14	31	8	—	3	—	—	1	—	1	9

The following downpours in twenty-four hours have been recorded in Queensland : Crohamhurst (45 miles

from Brisbane), 35·7 inches; Buderim (near Brisbane), 26·2 inches; The Hollow, Mackay, 25·1 inches; and eight other falls of over 20 inches in a day have been returned since 1893. These excessive rains are most abundant between Cairns and Cardwell.

Storms

West Australian hurricanes.

Undoubtedly the most striking feature of the climate of Western Australia is the visitation of the north-west coast by hurricanes in the summer months.

The passage of areas of low pressure across Western Australia is of weekly occurrence, but occasionally these lows develop immense energy and bring about great loss of life and property. The hurricane, or 'Willy Willy', seems to differ in degree but not in kind from the monsoonal low which traverses Australia at all seasons.

'These storms sometimes give the first indication of their approach in the extreme north-eastern corner of the state, and occasionally it is believed at Port Darwin. They travel at first in a south-westerly direction, the centre keeping well out to sea, and their pressure and movement are shown by an easterly wind gradually veering north and west, accompanied by heavy rainfall. When they reach latitude 20° or thereabouts, their course alters and they recurve and commence to travel in a southerly or south-easterly direction, striking the coast generally between Condon and The Fortescue, and frequently bring a "Willy Willy" to wreck whatever happens to be in the way. They now travel inland, passing as a rule either over or to the east of the goldfields, and bringing more or less rain according to their intensity. Thence they travel to the Southern Ocean.'

The path of a typical Willy Willy disturbance is shown in Fig. 35.

Relation between hurricanes, temperature, and pressure.

The hurricanes are most numerous in the hottest months. Of the seventeen recorded, January has four, March four, February three, April three, December two, November one. In these months a hot region is situated between Nullagine and Winning Pool, Western Australia. This area of high temperature means also an area of low

pressure, and this is no doubt a factor in swinging the hurricane to the south-east. The cold Westralian current may act as a buffer to the passage of these cyclones along the coast beyond Onslow; the general easterly drift of the upper air also undoubtedly helps to swing them inland from Cossack. Moreover, their destructive violence rarely penetrates far beyond the coast, for this can only be maintained by large supplies of ascending moist air. This can only take place over the ocean, so that though an individual cyclone can be traced to Coolgardie, to

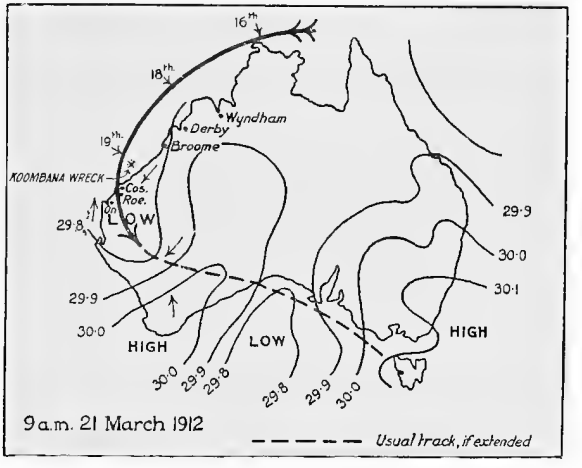


FIG. 35. Track of the Koombana Hurricane, March 1912.

Eucla, and even to Tasmania, it rarely inflicts much damage inland, but rather brings beneficial heavy rains.

Hurricanes in the South-West Pacific.

In the warm, moist, and calm region of the north-east coast of Queensland, hurricanes develop just as in the similar area north of Western Australia. As their parabolic paths do not approach the land so closely as in Western Australia, we have very little data of their behaviour. They originate generally between Fiji and New Guinea, and move westward to Queensland. They usually hit the coast-line near Cairns and then 'rebound' to the south-east—being carried thither by the dominant upper currents, as in the western examples. Occasionally their paths can be traced from shipping reports, but very often it is not

possible to obtain mainland data, for the telegraphic and postal services are nearly always greatly disorganized for some time after the disaster.

The North Queensland hurricane of March 1911.

On the North Queensland coast March is perhaps the month most visited by tropical hurricanes. In 1911 (March 16) a disastrous storm struck Port Douglas, killing several people and almost destroying the town. Until the 13th a tongue-shaped shallow depression remained persistently over the north-western quarter of

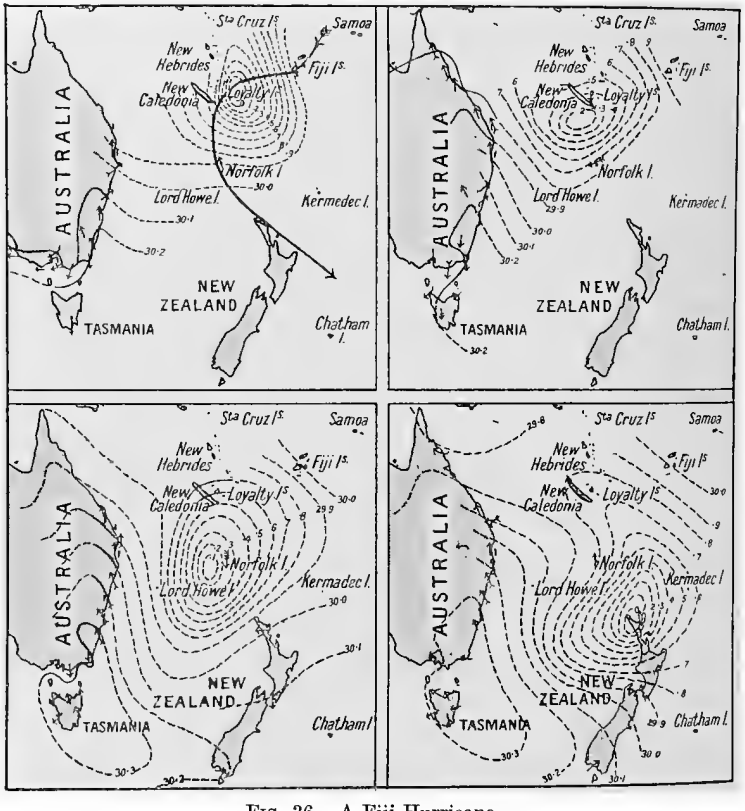


Fig. 36. A Fiji Hurricane.

the state and the Gulf of Carpentaria without developing unsettled characteristics of any definite kind. On the 14th, data showed that the trough was undergoing a deepening process, and, under the impetus of vigorous

high-pressure waves from the westward, was moving slowly across the peninsula (see Fig. 37). This deepening was maintained, and on the 16th a disturbance was evolved with its centre approximately a little to the north-east of Cairns. It suddenly moved towards the coast, between Cooktown and Cardwell, and its worst effects were experienced in the Port Douglas District, which it swept with disastrous results to property and life. During this hurricane the fine steamer *Yongala* was lost with all on board. The storm subsequently moved on a westerly course, rapidly decreasing in intensity, and remained over the Gulf of Carpentaria until the 21st, causing unsettled conditions in the north-western interior.

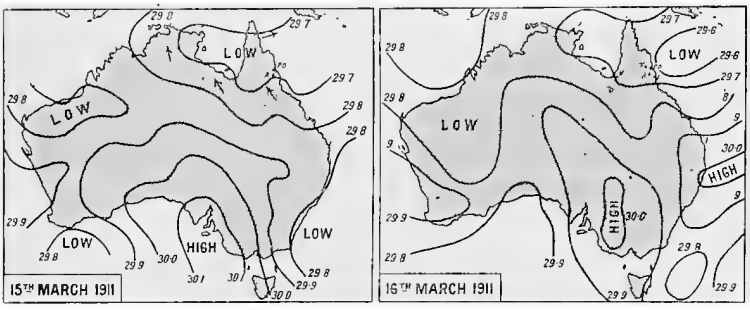


FIG. 37. A Queensland Hurricane. A=Atherton; D=Donor's Hill; I=Innisfail; P D=Port Douglas.

This storm obviously did not follow the parabolic path characteristic of the more typical tropical hurricanes. It, however, caused very heavy precipitation all along its track, as the following twenty-four hours' totals show:

		Points.
16th and 17th,	Innisfail	605
	Atherton	620
	Thornborough	428
17th and 18th,	Normanton	405
	Donor's Hill	308

Southerly bursters.

The southerly bursters have been described as perhaps the most remarkable of the 'squall' winds which characterize various parts of the earth. They are cold winds, succeeding a period of hot weather. They blow from the south, usually arriving as a sudden squall after calms

or northerly winds. Although not unknown along the southern shores of Australia, it is the coast of New South Wales, from Port Macquarie to Cape Howe, where they are especially noteworthy. Here the topographical conditions are peculiar, and are undoubtedly contributing causes to the local intensity of the burster.

Some 50 or 80 miles from the coast extends a belt of highlands from 3,000 to 7,000 feet high. They are parallel to the coast and therefore at right angles to the general easterly drift of the atmospheric drift. Between this cooler belt of highlands and the ocean is a 'hinterland' which is considerably warmer than the ocean or the mountains during the summer months, when these winds chiefly occur.

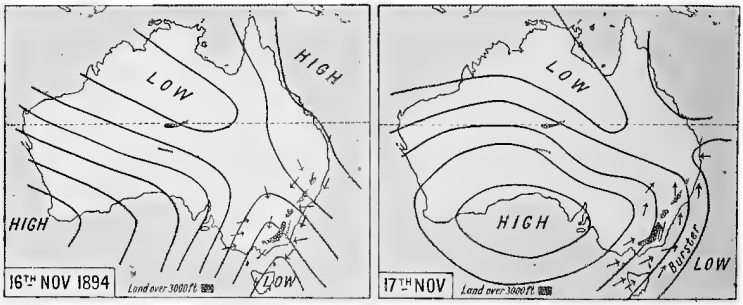


FIG. 38. Conditions accompanying a Southerly Burster (pressure and wind direction).

The monthly averages for the bursters are as follows:

	Per cent.		*Per cent.*		*Per cent.*
December	18·3	August	·5	March	9·1
November	16·8	January	17·3	April	4·1
October	14·0	February	13·2	May	·4
September	6·3				

The spring and summer half-year therefore accounts for 86 per cent. of the bursters. The average of their maximum velocities is 42·7 miles per hour, though 153 miles was recorded in 1877. The maximum velocity usually occurs twelve hours after the burst.

Accompanying weather conditions.

The weather preceding the burster may be summarized as follows: For a period varying from three hours to three days before, high temperatures prevail. Northerly winds, with a tendency to east in summer and to west in early and late summer, are the rule.

PLATE V. THE ROLL OF CLOUD WHICH SOMETIMES HERALDS A SOUTHERLY BURSTER (LOOKING EAST OVER SYDNEY)

(Phot. Mr. Griffith Taylor)

PLATE VI. 'BUSH' AT HEALESVILLE, VICTORIA

(High Commissioner for Australia)

The clouds are characteristic. Usually cirro-cumulus and thunder-clouds appear in the south-west, then a long dark cumulus roll approaches with a front of thirty miles or more. As this nears the wind drops completely, and then a whirl of dust ushers in the 'burst'. The wind-vane flies round to the south, and the southerly in a few minutes may reach gale force.

Rain may accompany the burst, but it is generally due to the electrical disturbances. The warm antecedent north winds, however, are often accompanied by some rain. The southern swing in wind direction is accompanied by a cooling of the air through as much as 37° F., but 18° is about the average total fall, though on December 30, 1891, the thermometer dropped this amount in the first five minutes.

Origin of bursters.

There is no doubt that the burster is merely an intensification of the normal southerly wind ushering in an anti-cyclone in New South Wales. This intensification is due to the relation of topographic and temperature conditions noted previously.

Snow lies throughout the summer on the Kosciusko range, while the belt immediately behind Sydney (as we have seen in a previous section) is abnormally warm and dry. These conditions may tend to hold the high pressure (to the west) and low pressure (to the east) somewhat stationary for a time. Finally, the general easterly drift of the upper air overcomes the reluctance of the adjacent limbs (of the high and low) to leave congenial quarters—the low hurries to the east, leaving a clear smooth track for the frontal currents of the high along the coastal waters. There is also the barrier effect of the Kosciusko range to be considered. This has a height of over 5,000 feet for nearly 100 miles, and, no doubt, tends to bar the passage of the high, for these systems are usually confined to the lower layers of the atmosphere. The hot lowland and cold elevated areas in question, however, are too small to originate definite highs and lows themselves ; but these contributing factors no doubt largely account for the suddenness of the burst.

TYPICAL CLIMATIC CONDITIONS OF THE SUMMER RAIN REGION

Average Pressures in Inches

Station.	*Jan.*	*April.*	*July.*	*Oct.*	*Annual Average.*	*No. of Years.*
Broome .	29·714	29·840	29·960	29·854	29·840	13
Hall's Creek	29·722	29·887	30·022	29·849	29·869	10
Port Darwin . .	29·699	29·793	29·896	29·826	29·804	29
Cloncurry . .	29·710	29·942	30·084	29·933	29·923	11
Charleville .	29·813	30·067	30·168	30·044	30·026	8
Cairns . .	29·746	29·920	30·030	30·004	29·931	8
Brisbane .	29·898	30·083	30·110	30·045	30·036	25

Average Temperatures in F.°

Broome . .	85·8	83·2	70·4	80·9	79·9	14
Hall's Creek . .	86·6	77·9	64·6	83·2	78·0	12
Port Darwin .	84·0	84·2	77·2	85·5	82·7	29
Daly Waters .	86·8	80·4	68·6	86·1	80·4	25
Cloncurry .	86·9	77·6	61·3	82·5	76·9	11
Charleville . .	82·8	68·8	51·0	71·6	68·4	9
Geraldton .	78·9	74·6	65·9	72·9	73·0	6
Brisbane . . .	77·1	70·2	58·0	69·8	68·8	25

Average Rainfall in Inches

Station.	*Summer.*	*Spring.*	*Autumn.*	*Winter.*	*Total.*	*No. of Years.*
Broome . .	14·75	1·09	5·39	1·59	22·82	22
Hall's Creek . .	13·72	2·18	4·55	·64	21·09	21
Port Darwin . .	38·98	7·85	14·95	·34	62·12	41
Daly Waters .	17·25	3·21	6·20	·59	27·25	38
Cloncurry .	13·10	2·00	4·01	·90	20·01	22
Charleville . .	8·14	3·52	6·34	2·57	20·57	22
Geraldton (now Innisfail) . . .	59·80	13·03	61·06	16·30	150·19	25
Brisbane . . .	18·58	8·45	12·77	7·25	47·05	60

Broome, Western Australia. 63 ft. A coastal town subject to hurricanes.

Hall's Creek, Western Australia. 1,225 ft. An inland mining township (200 miles from coast).

Port Darwin, Northern Territory. Capital of Northern Territory (on the coast).

Daly Waters, Northern Territory. An inland settlement on overland telegraph (300 miles from coast).

Cloncurry, Queensland. 696 ft. An inland town (200 miles south from Gulf of Carpentaria).

Charleville, Queensland. 975 ft. A town in South Queensland (300 miles from Pacific Coast).

Geraldton, Queensland. A coastal town with heaviest rainfall in Australia (50 miles south of Cairns).

Brisbane, Queensland. 137 ft. Capital of Queensland, in the south-east. About ten miles up the estuary.

TYPICAL CLIMATIC CONDITIONS OF THE UNIFORM RAIN REGION

Average Pressures in Inches

Station.	*Jan.*	*April.*	*July.*	*Oct.*	*Annual Average.*	*No. of Years.*
Wilcannia	29·888	30·126	30·172	30·030	30·052	29
Dubbo	29·899	30·121	30·153	30·020	30·045	28
Newcastle	29·915	30·097	30·110	30·001	30·028	49
Sydney	29·901	30·073	30·079	29·966	30·004	53
Moruya	29·906	30·057	30·068	29·958	30·002	34
Sale	29·884	30·055	30·047	29·923	29·993	16
Melbourne	29·913	30·100	30·097	29·965	30·014	54
Hobart	29·839	29·977	29·955	29·805	29·890	40

Average Temperatures in F.°

Wilcannia	81·6	65·4	50·0	68·2	66·4	26
Dubbo	78·7	64·1	47·4	63·4	63·3	35
Newcastle	73·0	66·4	54·0	64·9	64·6	46
Sydney	71·6	64·5	52·3	63·4	63·0	53
Moruya	69·0	63·2	51·8	60·2	60·9	35
Sale	65·8	58·4	47·5	56·0	57·3	16
Melbourne	67·5	59·6	48·5	57·5	58·3	56
Hobart	62·0	55·4	45·7	54·0	54·3	28

Average Rainfall in Inches

Station.	*Summer.*	*Spring.*	*Autumn.*	*Winter.*	*Total.*	*No. of Years.*
Wilcannia	2·44	2·25	2·94	2·41	10·04	31
Dubbo	5·88	5·32	5·69	5·41	22·30	38
Port Macquarie	19·97	11·54	18·09	12·99	62·09	39
Sydney	10·96	8·62	15·26	13·15	47·99	53
Eden	8·92	7·57	9·60	8·26	34·35	38
Kiandra	10·84	18·32	13·89	20·87	63·92	31
Sale	5·69	6·64	5·69	6·22	24·24	24
Melbourne	5·91	7·21	6·69	5·79	25·60	56
Hobart	5·21	6·84	5·37	6·15	23·57	69

Wilcannia, New South Wales. 267 ft. 300 miles from coast. An inland town in the western plains.

Dubbo, New South Wales. 670 ft. 200 miles from coast. On the western slopes of the Divide.

Newcastle, New South Wales. Coastal town near boundary of uniform and autumn rain regions.

Sydney, New South Wales. 146 ft. Capital, on the coast, with autumn maximum.

Moruya, New South Wales. Coastal town in the south.

Eden, New South Wales. Coastal town in extreme south.

Kiandra, New South Wales. 4,640 ft. 100 miles from south coast. Highest town in Australia.

Sale, Victoria. Coastal town in drier region of Gippsland.

Melbourne, Victoria. 115 ft. Capital, at south-west corner of uniform region.

Hobart, Tasmania. 160 ft. Capital, at south-east of island.

TYPICAL CLIMATIC CONDITIONS OF THE WINTER RAIN REGION

Average Pressures in Inches

Station.	*Jan.*	*April.*	*July.*	*Oct.*	*Annual Average.*	*No. of Years.*
Perth	29·910	30·072	30·100	30·034	30·020	27
Esperance	29·966	30·100	30·070	29·984	30·024	14
Eucla	29·923	30·085	30·116	29·978	30·018	32
Port Augusta	29·872	30·100	30·154	29·980	30·020	31
Adelaide	29·913	30·117	30·133	29·995	30·034	54
Robe	29·929	30·093	30·049	29·958	30·015	21
Albury	29·883	30·084	30·097	29·969	30·010	43
Cape Otway	29·918	30·043	30·044	29·940	29·988	46

Average Temperatures in F.°

Perth	73·5	66·4	55·0	60·9	64·0	15
Esperance	68·3	63·2	53·4	59·4	61·2	14
Eucla	70·8	66·1	54·3	62·7	63·5	33
Port Augusta	77·5	66·4	52·6	66·8	66·0	22
Adelaide	74·2	54·0	51·5	61·9	62·9	54
Robe	64·7	58·9	51·0	56·8	57·9	19
Albury	76·2	60·4	45·9	60·1	60·7	43
Launceston	64·1	55·5	44·1	53·9	54·8	18

Average Rainfall in Inches

Station.	*Summer.*	*Spring.*	*Autumn.*	*Winter.*	*Total.*	*No. of Years.*
Perth	1·19	6·13	7·36	18·58	33·26	36
Esperance	2·12	5·90	5·51	11·91	25·44	28
Eucla	1·62	2·16	3·34	3·01	10·13	35
Port Augusta	1·53	2·48	2·76	2·71	9·48	51
Adelaide	2·22	4·62	5·80	7·98	20·62	54
Robe	2·38	4·91	6·10	11·39	24·78	50
Albury	4·73	7·33	6·86	9·05	27·97	46
Launceston	5·15	7·37	6·42	9·20	28·14	26

Perth, Western Australia. Capital; on Melville Water, ten miles from ocean.

Esperance, Western Australia. On the south coast.

Eucla, Western Australia. On the coast at the head of the Great Australian Bight.

Port Augusta, South Australia. On the coast, at the head of Spencer Gulf.

Adelaide, South Australia. Capital; on the east coast of Spencer Gulf.

Robe, South Australia. On the coast in the south-east corner of South Australia.

Albury, New South Wales. In the Eastern Riverina, 542 feet above sea-level.

Launceston, Tasmania. On the Tamar Estuary, and thirty miles from the sea.

TYPICAL CLIMATIC CONDITIONS OF THE ARID REGION

Average Pressures in Inches

Station.	*Jan.*	*April.*	*July.*	*Oct.*	*Annual Average.*	*No. of Years.*
Carnarvon	29·787	29·943	30·075	29·987	29·942	13
Nullagine	29·689	29·902	30·062	29·874	29·874	11
Peak Hill	29·701	29·926	30·088	29·900	29·897	12
Coolgardie	29·866	30·063	30·119	29·974	30·000	14
Alice Springs	29·707	29·983	30·127	29·887	29·920	28

Average Temperatures in F.°

Carnarvon	79·8	74·6	60·4	68·8	71·0	13
Nullagine	89·4	77·4	59·1	78·0	76·2	12
Peak Hill	87·2	73·6	54·3	71·4	72·0	12
Coolgardie	77·3	65·4	50·8	63·5	64·4	15
Alice Springs	84·0	68·1	52·4	73·5	69·7	29
Williams Creek	82·7	67·2	52·0	70·3	68·4	22
Broken Hill	78·6	64·0	49·2	65·9	64·7	21

Average Rainfall in Inches

Station.	*Summer.*	*Spring.*	*Autumn.*	*Winter.*	*Total.*	*No. of Years.*
Carnarvon	1·12	·38	2·27	5·40	9·17	29
Nullagine	5·72	·42	3·77	2·43	12·34	14
Peak Hill	2·99	·52	3·58	2·95	10·04	14
Coolgardie	1·74	1·86	2·58	3·02	9·20	19
Alice Springs	4·72	2·07	2·87	1·43	11·09	37
Williams Creek	1·28	1·22	1·72	1·23	5·45	37
Broken Hill	2·04	2·09	2·31	2·85	9·29	22

Carnarvon, Western Australia. The driest coastal town in Australia. Lat. 25° S.

Nullagine, Western Australia. Inland town (150 miles from coast). Characterized by intense summer heat. Lat 22° S.

Peak Hill, Western Australia, 1,930 ft. Inland town (300 miles from coast). Lat. 25° S.

Coolgardie, Western Australia. 1,389 ft. On the south-east boundary of the arid region (330 miles from coast). Lat. 30° S.

Alice Springs, Northern Territory. 2,000 ft. In the central highlands (600 miles from coast).

Williams Creek, South Australia. Near Lake Eyre (250 miles from coast).

Broken Hill, New South Wales. Near the south-west boundary (200 miles from coast).

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CHAPTER IV

ANIMALS AND PLANTS

By Geoffrey W. Smith

Limits and general features of the Australian Region

Extent of the region.

From a zoological and botanical standpoint the Australian region comprises more than Australia itself, as the island of Tasmania to the south differs but little in its inhabitants from the Victorian mainland, and New Guinea and some of the southern islands of the Malay Archipelago resemble closely the tropical northern and north-eastern coasts of Australia. Moreover, to the east the scattered islands of the Pacific, as far even as the Sandwich and Marquesas Islands, show sufficient relationship to Australia to be included in a common region, and New Zealand has probably at some period received a stream of immigrants from the Australian region by means of a land connexion. The Pacific Islands and New Zealand stand apart, however, from the Australian region in the narrower sense, primarily in the entire absence from them of any indigenous marsupials such as characterize Australia, Tasmania, and New Guinea, and there can be little doubt that the archipelagos in the Pacific have either never been connected with the Australian mainland or else, as in the case of New Zealand, New Caledonia, Norfolk Island, and a few others, have been connected with it at so distant a period and for so short a time as to have failed to acquire many of the most typical forms of life which now characterize Australia.

In this chapter we shall only deal incidentally with New Zealand and the Pacific, our chief concern being with Australia itself, and the closely-connected island of Tasmania.

Boundaries of the region: Wallace's Line.

To the south, east, and west, Australia is isolated by wide and deep expanses of ocean, but its northern coasts are in close proximity to New Guinea and the islands of

the Malay Archipelago, which stretches as a continuous chain to the Malay Peninsula and so to the mainland of the Oriental region. It might be expected, therefore, that as we passed northward from Australia through the Malay islands we should meet with a gradual transition taking place in the animals and plants from Australia to Oriental types; but this is not the case, and the discovery, first outlined by G. W. Earl and afterwards established by Alfred Russell Wallace, that a sharp line of division between the Oriental and Australian regions passes through the middle of the Malay Archipelago constitutes the most striking and outstanding feature of the whole science of geographical distribution. Wallace's Line, as this line of demarcation is called, passes from south-west to north-east through the narrow fifteen-mile wide straits between Bali and Lombok, through the Macassar Strait between Borneo and Celebes, and skirts to the south of the Philippine Islands, thus leaving Sumatra, Java, Bali, Borneo, and the Philippines to the Oriental Malay region, and giving Lombok, Timor, the Moluccas, and a host of smaller islands as well as New Guinea to the Australian region. The existence of Wallace's Line is remarkable not merely because it passes through the middle of an archipelago of islands in close proximity to one another, but because it separates two faunas more completely different from one another than those of any other two regions in the world. To quote from A. R. Wallace (*Malay Archipelago*, p. 11): 'The great contrast between the two divisions of the Archipelago is nowhere so abruptly exhibited as on passing from the island of Bali to that of Lombock, where the two regions are in closest proximity. In Bali we have barbets, fruit-thrushes, and woodpeckers; on passing over to Lombock these are seen no more, but we have abundance of cockatoos, honeysuckers, and brush-turkeys, which are equally unknown in Bali, or any island further west. The strait is here fifteen miles wide, so that we may pass in two hours from one great division of the earth to another, differing as essentially in their animal life as Europe does from

America. If we travel from Java or Borneo to Celebes or the Moluccas the difference is still more striking. In the first the forests abound in monkeys of many kinds, wild cats, deer, civets, and otters, and numerous varieties of squirrels are constantly met with. In the latter none of these occur, but the prehensile-tailed cuscus is almost the only terrestrial mammal seen, except wild pigs, which are found in all the islands, and deer (which have probably been recently introduced) in Celebes and the Moluccas. The birds which are most abundant in the western islands are woodpeckers, barbets, trogons, fruit-thrushes, and leaf-thrushes; they are seen daily and form the great ornithological features of the country. In the eastern islands these are absolutely unknown, honeysuckers and small lories being the most common birds, so that the naturalist feels himself in a new world and can hardly realize that he has passed from the one region to the other in a few days, without ever being out of sight of land.'

Contrast between Australian and Oriental regions: Mammals.

In order to illustrate more generally the great difference between the fauna and flora on the Australian side of Wallace's Line and the inhabitants of the Oriental region, we may mention a few of the most characteristic and noteworthy groups of animals, and plants, of either region. First and foremost the placental or eutherian mammals, including all those mammals which are nourished in the uterus of the mother for a prolonged period by means of a placenta, and are born in a well-developed state, occur under numerous forms in the Oriental and, indeed, in all other regions, but in the Australian region only a few types have penetrated, such as bats and small rodents which have peculiar facilities for distribution, and man accompanied by domesticated or semi-domesticated animals. Among the latter, the dingo has given rise to some controversy, but there seems little doubt that it was introduced into Australia by the natives, who were themselves immigrants from the Oriental mainland.

Marsupials.

In place of the placental mammals we find a great development of the marsupials in the Australian region,

unparalleled in any other region of the globe, and exhibiting a variety of forms which fill the places occupied by the placentals in the rest of the world. All these marsupials of Australia differ radically from ordinary mammals in the fact that they are born in a very undeveloped state, the newly-born young of a big kangaroo measuring less than an inch in length. The tiny creature is taken up after birth in its mother's lips and transferred to the pouch in which the nipples are situated, and here it is suckled for a long time until well-grown and able to look after itself. Besides this peculiarity in reproduction and in the presence of a pouch in the female, the marsupials also differ from ordinary mammals in a number of anatomical and osteological characters, so that the resemblances which they sometimes show to special forms of ordinary mammals, both in general appearance and in the form of the teeth, &c., are due to convergence and not to any real relationship. Owing probably to the absence of the higher mammalia, the marsupials in Australia have developed into many forms, some of which are closely parallel to the higher mammals of other countries. Thus the kangaroos and wallabies (*Macropus*) roam over grass plains and take the place of the herbivorous ungulates; the opossums (*Phalanger*) and native bears (*Phascolarctos*) live in trees and are something like sloths, and there is a flying phalanger (*Petaurus*), which resembles the flying squirrels; the wombats (*Phascolomys*) live on roots and resemble badgers, the bandicoots (*Perameles*) inhabit the under-scrub and partake something of the nature of rodents; there are marsupial mice, a marsupial mole (*Notoryctes*), a banded ant-eater (*Myrmecobius*), and the carnivores are paralleled by the small native cats (*Dasyurus*) and the larger Tasmanian tiger (*Thylacinus*) and devil (*Sarcophilus*). The mention of these principal genera of Australian marsupials will give some idea of the variety assumed by these creatures, a variety all the more remarkable when we consider that marsupials outside the Australian region are represented solely by the American opossum (*Didelphys*) and the South American bush-rat

(*Coenolestes*), a rare animal from the Peruvian Andes. The evidence of geology tells us that the marsupials are a very ancient group of mammals which in early times was better represented and more widely distributed on the earth than it is at present. Thus the Secondary rocks of Europe and North America have yielded several kinds of small rat-like animals which were probably related to the marsupials, and the South American Pliocene contains undoubted marsupials related to the existing American opossums and to the Tasmanian thylacine.

Monotremes.

Australia is not only remarkable for its wealth of marsupial life and its dearth of eutherian mammals, but also for its sole possession of the two egg-laying mammals or monotremes, animals of the greatest interest to the naturalist as affording a link between the mammals and the reptiles both in their anatomical characters and in their mode of reproduction and development. Of these two animals, the *Platypus* is amphibious, having webbed feet, otter-like fur, and a duck-like bill, and inhabits streams and lakes, making its burrow in the banks with one opening above the water-level and one below. In this burrow the female deposits and incubates its egg, and after hatching, the young is suckled with milk. The *Echidna*, or native porcupine, is a purely terrestrial creature, with sharp quills, long toothless jaws, and an extensile tongue, and it nourishes itself on ants and other insects. The female *Echidna* also lays an egg which is transferred to a temporary pouch where the young hatches and is suckled. These two extraordinary animals are unknown in any other part of the world, and as fossils they only occur in quite recent deposits in Australia, so that their place of origin and history is shrouded in mystery.

Birds.

Turning from this remarkable mammalian fauna, we may consider some of the characteristics of Australian bird-life. Here again we are confronted both with the absence of many families typical of the Oriental region and sometimes of the rest of the world, and the abundance of other families entirely or almost confined to the Australian region. As absentees we may note the true

finches, woodpeckers, vultures, pheasants, bulbuls, and barbets. Families confined to the Australian region are the birds of paradise (Paradiseidae), honeysuckers (Meliphagidae), lyre-birds (Menuridae), scrub-birds (Atrichidae), cockatoos (Cacatuidae), broad-tailed and grass paroquets (Platycercidae), brush-tongued paroquets (Trichoglossidae), mound-makers (Megapodiidae), and the emu and cassowaries (Casuariidae). The birds of paradise, which are confined to the New Guinea and North Queensland forests, and the cockatoos and paroquets, are the most striking for their colour and beauty ; the mound-makers, which heap vegetable rubbish over their eggs and leave them to incubate in the heat produced by the fermentative decay of the leaves, are the most interesting in their habits ; but the honeysuckers are the most typical Australian birds, being represented by hundreds of species, some of which are the commonest and most familiar birds in the Australian forests. Most of them are birds of small size and inconspicuous plumage, but the southern wattle-bird is remarkable for its size and succulence, for the fleshy pendants which hang from its head, and for emitting the most unearthly noises, which have been compared to a man drawing a cork out of a bottle and then being violently sick. The honeysuckers have the point of the tongue ending in a fine brush with which they extract the honey and insects from the innumerable flowering shrubs, eucalypts, &c., with which the Australian forests abound, and there can be no doubt that the variety and abundance of the honeysuckers have been developed in relation to the wonderful richness of Australia in flowering trees.

Besides these typically Australian groups there are some families which, without being confined to Australia, are yet peculiarly well represented there ; such are the pigeons, of which the large and handsome crested pigeon is an example, the flycatchers, of which the brilliant scarlet-breasted 'robin' (*Petroica phoenicea*) and the little metallic blue 'wren' (*Malurus longicaudatus*) are much admired, and the kingfishers, among which the laughing jackass is a familiar bird to the colonists.

Snakes. Of the lower forms of vertebrates some mention may be made of the poisonous snakes, because of their abundance and the abhorrence in which they are held. All the Australian poisonous snakes belong to the Elapidae, a group otherwise only occurring in South America. The proportion of poisonous to non-poisonous snakes in Australia is very large, culminating in Tasmania, where only three snakes occur and all of them are poisonous. The poison of these snakes is particularly deadly, but fortunately, though some of the species attain the large size of over six feet in length, the width of the gape is comparatively small, so that unless the creature can strike on to a bare surface or through thin clothes, it cannot inject its poison. Australians who spend much of their time in the bush always exercise some precautions against snakes, as for instance by wearing gaiters or putties, but death from snake-bite is rare.

Fishes. It is impossible to do more than touch upon other features of the fauna, and for this purpose we will choose some of the freshwater fish and crustacea because these creatures are of special interest in geographical distribution. The most interesting fish is the Australian lungfish (*Ceratodus forsteri*), which is confined to a few small streams in Queensland (Burnett River and its tributaries). This fish is intermediate in many of its characters between fish and amphibia; it is provided with lungs and can survive in poorly acrated water by coming to the surface and taking in gulps of air. Its only living relatives are the *Protopterus* of North Africa, and the *Lepidosiren* of the Gran Chaco in South America, but a large number of Palaeozoic fossil Dipnoi from the Old World are known very similar to the existing forms. The *Ceratodus*, in fact, thoroughly merits the name of 'living fossil'.

Australian fresh waters are poorly supplied with native fish, there being no Salmonidae save those that have been recently introduced, and none of the carp tribe. The black-fish (*Gadopsis marmoratus*), inhabiting the streams of Tasmania and Victoria which flow into Bass Strait, is the sole representative of its family: it may attain

a very large size and is excellent to eat. Of coastal or estuarine fishes used as food, mention may be made of the barracuda (*Thyrsites atun*) and of the Murray cod (*Oligorus macquariensis*), both of which attain a very large size.

No true lobsters occur in Australian waters, but a rock-lobster (*Panulirus*) is fished off the coast and supplies the markets. Some of the Australian rivers and streams are, however, stocked with freshwater crayfishes of the family Parastacidae, a family otherwise represented in New Zealand, South America, and Madagascar, and differing in many important features from the Astacine crayfishes of the northern hemisphere. In Australia some of the species attain to an enormous size (7 or 8 lb.) and exceeding succulence, as for instance the Murray River crayfish (*Astacopsis serratus*) and the Tasmanian crayfish (*A. franklinii*).

Of very great interest to the naturalist are the peculiar freshwater shrimps (Anaspidacea) which inhabit the mountain tarns and rivers of Tasmania, one small species being also found in Victoria. These creatures are unique among living shrimps, though very ancient Carboniferous fossils identical with them have been found in the northern hemisphere. These, again, are instances of living fossils.

Vegetation.

The vegetation of Australia is often accused of monotony and dullness, and this is true of the greater part of the continent where a low rainfall exists, but besides this xerophytic vegetation, which may be called typically Australian, there are two other intrusive elements, the tropical vegetation of the north of Queensland and the Antarctic flora in the highlands of Tasmania and Victoria. We shall have more to say of these latter elements in dealing with the sub-regions of Australia; here we may mention some of the more characteristic features of the typical Australian vegetation. The characteristic tree of Australia is the eucalypt, or gum tree, which exists in a protean variety of closely similar species, offering great difficulties to the systematist. The eucalypt has been

introduced for so long into the Mediterranean countries and America that it is unnecessary to describe its appearance ; its bluish waxy leaves turned edge-on to the sun, its tall straight trunk, which shoots up without branches to a considerable height and then spreads out into a mop, its beautiful yellow or red clusters of bottle-brush flowers, and its cup-like fruit. Typically adapted to a dry climate, the eucalypt under favourable conditions, such as the

Fig. 39.

Tasmanian and Victorian forests afford, may grow to a gigantic height (300 feet), and certain species (e.g. *E. globulus*, blue gum, and *E. regnans*, swamp gum) are of great value as hard-wood timber for piles and paving blocks.

Characteristics of forests.

The eucalypt forests of Australia are seldom dense, the trees generally standing some way apart from one another, and the underscrub is by no means impenetrable. Often, as in the open stations of the interior of New South Wales, there is little or no underscrub but only grass, and under these conditions the forest proper gives place to the

eucalypt savana. The other typical Australian shrubs and trees of these formations are also xerophytic in habit, with thin waxy leaves, as for instance the numerous myrtaceous shrubs, the acacias and casuarinas, the proteaceous shrubs, such as *Telopea* (the waratah), *Hakea*, and *Banksia*, and the heaths (Epacridaceae). Every single one of these trees and shrubs is evergreen and of a dark or greyish hue, so that were it not for the beautiful flowers with which so many of them are adorned—flowers famous in Australia are the waratah, the boronia, and the wattles (*Mimosa*)—the dullness of the colouring would be unrelieved. There is only one true deciduous tree, the *Fagus gunnii*, or beech of the Tasmanian mountains, and this is too small and insignificant to affect the landscape. Under the poor and almost desert conditions of parts of South and West Australia, the xerophytic nature of the scrub reaches its culmination, and Schomburgh writes: 'The monotonous and dismal look of an extensive scrub is depressing, especially when viewed from an eminence. The equal height of the vegetation, the dull glaucous colour of the foliage, look in the disance like a rolling sea reaching the horizon—at least the first sight of the Murray Scrub, extending hundreds of miles, produced this impression on my mind. Every one avoids the scrub as much as possible—many have lost their way there and perished for want of water.'

It must be admitted that vast tracts of Australia are of this dismal description and the desert is still more inhospitable, save for a short time after the very infrequent rains, when a lush vegetation springs up with extraordinary rapidity, only to disappear as quickly. We must not, however, paint too dark a picture, for in favourable situations the eucalyptus forests have a peculiar beauty of their own; the forests of Queensland are as luxuriant as those of other tropical countries, and the south-temperate forests of Victoria and Tasmania, with their variety of beech, conifer, tree-fern, and impenetrable undergrowth, are as fine examples of vegetable profusion as can be found anywhere in the world.

Isolation of Australian region.

If we cast a glance over the several features of the Australian flora and fauna we may be struck by the evidences of high antiquity and isolation from the rest of the world which they afford. Australia seems to have been an asylum in which many ancient and archaic types of life have been able to persist owing to the barriers which have prevented the higher products of the Tertiary epoch in other parts of the world from invading their area and exterminating them. With the advent of civilized man in the eighteenth century some of these higher forms of life were introduced, and it is not surprising that, finding themselves in a country which had, so to speak, lain fallow for so long a period, they proceeded to run riot and threaten to possess the land. It has been found easy to introduce many European animals and plants into favourable parts of Australia, where many of them have developed into formidable pests, e.g. the rabbit, the sweet-briar, graminivorous finches, &c., but the converse establishment of Australian forms in Europe as feral species is unknown. Such facts are readily explained by the circumstance that during the period when the rest of the world was undergoing the most rapid alterations and acquiring the main features which characterize it now, Australia lay isolated and unwitting of the momentous changes passing beyond Wallace's Line and the engirdling sea.

The Sub-regions of Australia

Three sub-regions can be clearly recognized (Fig. 40): (1) the Torresian, including New Guinea and the north and north-east coasts of Australia; (2) the Bassian, including Tasmania and the south-eastern corner of Australia; (3) the Eyrean (named after Lake Eyre, in Central Australia), including all the west, south-west, and central desert area.

Although these regions are characterized by special and well-marked features, it is not easy to fix their exact limits, as a good deal of intermixture occurs on their borders. Especially hard to fix are the limits between the Torresian and Bassian sub-regions on the east coast, while

the Bassian sub-region pushes westwards to include the Murray River and its tributaries, and only really stops short at the arid coast-line of the great Bight.

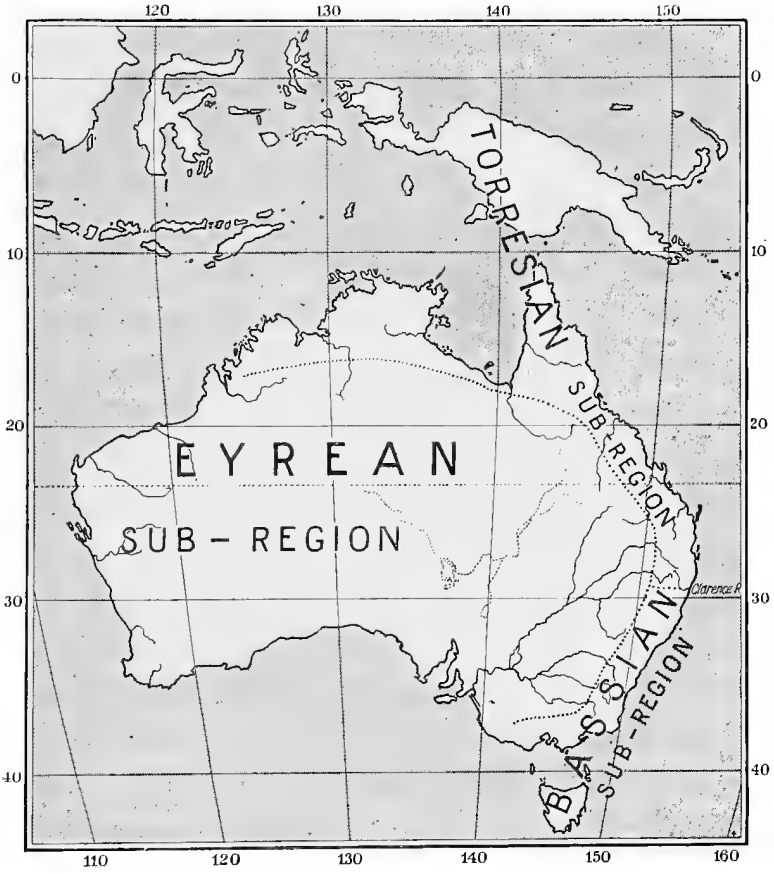

FIG. 40.

1. *The Torresian sub-region.* This region owes many of its peculiarities to the fact that it has been invaded in comparatively recent times by the tropical Oriental flora which has seized on the richer lands of the Queensland coast and ousted the native Australian vegetation, which, however, still occupies the poorer and drier inland portions

Torresian sub-region: vegetation.

of the region. Characteristic plants of the tropical vegetation of Queensland are the 'wild banana, orange, and mangosteen, the rhododendron, the epiphytic orchids, and the palms; so that in the heart of a great Queensland "scrub", a naturalist could scarcely answer, from his surroundings, whether he were in New Guinea or Australia' (Hedley). As we pass to the south of the Clarence River on the east coast, to the west of the Fitzroy River on the west coast, and into the interior of the continent, these tropical forms rapidly die away and are replaced by the more typical Australian forms.

Animals. Of the mammalia, we may note the entire absence from this sub-region of the *Platypus*, while the *Echidna* is replaced by *Proechidna*, the three-toed ant-eater, which is less spiny and more hairy than the southern form.

The marsupials are poorly represented in this region, and some of those that are present are rather highly specialized forms, such as the tree kangaroo (*Dendrolagus*), which, as its name suggests, is a kangaroo which has taken to living in trees and has lost the bounding agility of its ancestors.

The phalangers are represented by the cuscus, a very common animal in this region and in the Austral Malay Islands, *Phalanger orientalis* being the first Australian marsupial known to European naturalists. The above-mentioned forms belong to the diprodotont section of vegetable-eating marsupials, which are characterized by the possession of two enlarged incisors in the upper and lower jaws, used for cutting or gnawing vegetable food.

The other section of marsupials, the polyprodotonts, which are carnivorous or omnivorous in habit and have more numerous incisor teeth of an unspecialized pattern, are poorly represented by a single species of *Dasyurus* or native cat, several species of *Phascologale*, which are related to the dasyures, and several species of bandicoot (*Perameles*).

It must be remarked that the poverty of the Torresian sub-region in marsupials, and especially in the more generalized types, is an argument against the theory that

the marsupials entered the Australian continent from the north, and that their native home is the tropical forest.

Among reptiles, invading forms from the north are the crocodile, which does not penetrate beyond this region, and the frog *Rana*, which is entirely replaced by the cystignathous frogs in the southern parts of Australia. The birds of paradise have their centre of distribution in New Guinea and have colonized the north-eastern coasts of Australia from there, and the same is true of the mound-birds or Megapodiidae, which have, however, sent one form, *Leipoa ocellata*, far into the interior and to the west and east.

The cassowary is now confined to the Torresian region, and it seems probable that the struthious birds, as a whole, came from the north, though the emu is found far to the south and its bones occur in Tasmania.

Fresh-water crab and crayfish.

The streams in the Australian tropics are inhabited by the freshwater crab, *Telphusa transversa*, which belongs to a group of crustacea plentifully represented in the tropics of other countries; but in addition to this two species of parastacine crayfish are found in these streams, one, *Chaeraps quadricarinatus*, occurring in New Guinea, the Aru Islands, and on the Cape York peninsula, another, *Parachaeraps bicarinatus*, being fairly universally distributed all over the Australian continent and even penetrating into the central deserts, where it lives in small water-holes. Both these forms are related to the species of *Chaeraps* of Western Australia and are quite distinct from the genera *Astacopsis* and *Engaeus* which are characteristic of the Bassian sub-region, so that the distribution of these crayfish indicates a long-standing communication between the Western Australian and the Torresian sub-regions.

Bassian sub-region: vegetation.

2. *The Bassian sub-region.* Just as the Torresian sub-region has been influenced by the invasion of northern tropical forms, so the Bassian sub-region has received immigrants from the Antarctic continent which have left characteristic traces. In the rainy district of Gippsland, and especially on the mountainous west coast of Tasmania,

the eucalyptus savanas are replaced by thick forests of the evergreen beech, *Fagus Cunninghami*, which is identical with the beech of Tierra del Fuego and temperate South America. The deciduous beech of Tasmania, *F. gunnii*, is also an Antarctic form common to South America.

The horizontal scrub (*Anodopetalon*) forms a characteristic feature of the undergrowth in the Tasmanian beech forests. This impenetrable scrub is formed by the young saplings falling over with their own weight and giving rise to lateral shoots which again fall over, and by the repetition of this process and by the rotting away of the under-layers, a sort of platform is produced round the trunks of the forest trees, spanning the gullies often at a height of fifty feet from the ground. This and the luxuriant growth of tree-ferns, myrtaceous shrubs, and acacias, produce an impenetrable undergrowth which has hitherto been a severe check to explorers in search of the minerals which abound in this district.

There are several conifers confined to this region, e. g. the Huon and celery-topped pines, and the mountain-tops support a stunted alpine growth which contains several elements common to other Antarctic lands, e. g. *Donatia* and *Astelia*.

The open savanas of Tasmania, Victoria, and New South Wales are typical eucalyptus country, richer in individual growth though poorer in species than the corresponding country in Western Australia.

Animals. The Bassian sub-region is particularly rich in the mammalia characteristic of Australia. The *Echidna* and *Platypus* are both abundant here, and all the ordinary marsupials are well represented, with the addition of the two large carnivorous polyprotodonts, the Tasmanian tiger (*Thylacinus cynocephalus*) and the Tasmanian devil (*Sarcophilus ursinus*). These two animals, which are very destructive to sheep, are now confined to Tasmania, but their bones have been found in recent deposits on the mainland in company with those of the dingo, which is supposed to be responsible for their extinction there.

The vegetable-feeding diprotodonts, *Phascolarctos*, or native bear, and the wombat (*Phascolomys*), are also peculiar to the Bassian sub-region, while phalangers, kangaroos, wallabies, flying phalangers, opossum-mice, and bandicoots are well represented. Thus it may be said that the south-eastern portion of Australia contains all the characteristic forms of monotremes and marsupials, with the addition of several forms peculiar to it, and this fact has been used in favour of the argument that this is the original home of these animals in Australia, and that they arrived there from South America, via the Antarctic continent.

Fishes, &c.

Among the fish of this region the flat-head (*Aphritis*) and the freshwater herring (*Prototroctes*) may be mentioned as Antarctic forms found also in South America, while the black-fish (*Gadopsis*) is a peculiar isolated fish found only in the rivers flowing into Bass Strait. The little fishes known as native trout (*Galaxias*) have some purely freshwater representatives, but the majority of them go down to the sea to spawn, so that their distribution in the rivers of New Zealand, South Africa, and South America does not necessitate the view that all these lands were connected by an extension of the Antarctic continent, though on other grounds this connexion, at any rate between South Australia, South America, and New Zealand, is highly plausible.

The freshwater crustacea of the Bassian region are interesting owing to the presence of the peculiar shrimps belonging to the order Anaspidacea, which are now confined to this part of the world, though their marine ancestors are common in the Permian and Carboniferous deposits of Europe and North America. The streams of Tasmania and Victoria are also inhabited by a peculiar genus of isopods, *Phreatoicus*, which also occurs in New Zealand but nowhere else, and one of these forms, *Phreatoicopsis terricola*, in the forests of Gippsland has attained the very large size of several inches and lives on decaying vegetation, after the manner of an earthworm.

The crayfishes are represented by the genus *Astacopsis*, which is confined to this region, being represented by the gigantic Tasmanian form, *A. franklinii*, and the large and spiny *A. serratus* of the Murray and Paramatta Rivers. Derived from these crayfishes are the curious crayfish known as land-crabs (*Engaeus*) which burrow in damp soil in various parts of Victoria and Tasmania, and do a considerable amount of damage to water-courses in the mining districts.

Parachaeraps bicarnatus, which is universally distributed over the Australian mainland, does not occur in Tasmania, so that it presumably had not arrived in Victoria when the latter was connected with Tasmania across Bass Strait.

Eyrean sub-region.

3. *The Eyrean sub-region.* We have seen that the Torresian sub-region has been greatly influenced by the immigration of animals, and especially plants from the northern Oriental tropics, while the Bassian sub-region has received the imprint of an Antarctic fauna and flora; the keynote of the Eyrean sub-region is that it has been less influenced by any extraneous elements, but represents the typical Australian autochthones which have developed without the competition and intermixture with foreign immigrants. Hence the region has been named autochthonian. This name is better deserved by the flora than the fauna of this region, and in both cases it is apt to convey an erroneous impression. There is no real ground for supposing that the Australian fauna and flora originated in Western Australia and spread thence to the other parts of the continent. A sufficient explanation of the peculiarities of the region is given by the fact of its long-continued isolation, and the comparative absence of intruding invaders.

Whatever the true explanation may be, it is a noteworthy fact that Western Australia is much richer in species of the true Australian type than the rest of the Australian region, while there is a comparative absence of Antarctic and to a less extent of tropical forms. The richness of the Eyrean region in true Australian species is all the more remarkable as the conditions of life are

PLATE VII. CLIFFS BORDERING A SALT STREAM, LAKE EYRE REGION

(Phot. Professor J. W. Gregory)

PLATE VIII (*a*). GIBBER COUNTRY IN CENTRAL AUSTRALIA

PLATE VIII (*b*). INTERIOR PLATEAU OF QUEENSLAND, AND PEAK RANGE

(Phots. Professor J. W. Gregory)

uniformly arid, often entirely desert, while there are no extensive tracts of mountainous country or humid forests.

There is, of course, considerable variation in the degree of aridity in the different districts of the Eyrean region, and the vegetation differs correspondingly. Besides actual desert there are vast tracts, especially in South Australia, of dwarf eucalypt scrubs (mallee scrub), while the better-watered regions, for instance, in the hills of Western Australia, belong to the open savana type of eucalyptus country, and have been opened, especially during recent years, for pasturage and agriculture.

Since the whole of the deserts of Australia belong to the Eyrean sub-region it will be fitting to give here some account of the appearance and vegetation of these desolate expanses (see B. Spencer, *The Horn Expedition*).

Central desert, &c.: vegetation.

In the middle of central Australia there are considerable ranges of mountains, the Macdonnell and Hart ranges, but the greater part of the desert consists of Cretaceous sandstones which rise into low insignificant hills, or else of stony plains known as gibbers, or loamy plains which support rather more vegetation. Scattered at rare intervals in this desert are water-courses and holes which contain water only after the rains, but they are always marked by a belt of vegetation, among which trees, chiefly eucalypts and acacias (the mulga) are seen. On the loamy plains there grows a thin scrub of spiny plants, such as *Salsola kali* (the Roly-poly), cassias, eremophilas, hokeas, casuarinas, grevilleas, and dwarf eucalypts, but the gibber plains in the time of drought are generally without a vestige of vegetation, and may stretch away into the horizon without any break. The sandhills are often covered with spinifex grass and the characteristic porcupine grasses, *Triodia irritans* and *pungens*, which grow in dense masses and offer a serious obstacle to travelling, as their pointed leaves are sufficiently stiff to injure the legs of horses and camels passing through them.

In the mountain ranges of the interior sheltered gorges may be found in which palms and cycads grow, and these are instances of the intrusion of the tropical Oriental

flora into the Eyrean region, thus relating it more closely to the Torresian than to the Bassian sub-region.

Fauna.

The water-holes and claypans in the desert teem with varied life after the rains, most noticeable among the freshwater animals being various forms of brine-shrimp (*Estheria* and *Apus*), which lay resting eggs that can withstand prolonged desiccation. In the interior, the crayfish *Parachaeraps bicarinatus* inhabits these water-holes, and in the dry season burrows deep into the mud, forming a channel with a hole at the bottom in which there is always sufficient water to keep the animal alive. In the coastal rivers of Western Australia several species of *Chaeraps* occur, and this genus stretches northward into the Torresian region and New Guinea, thus affording another instance of the relationship between the Eyrean and Torresian sub-regions.

Of the monotremes only the *Echidna* occurs. The marsupial fauna is rather peculiar, and is rich in types which have been rather highly specialized in connexion with the dry and desert conditions prevalent in the region, e.g. various species of *Phascologale* and *Sminthopsis* or opossum mice, which burrow in the sandhills and frequent the grassy plains of the interior. The marsupial mole, *Notoryctes typhlops*, is also confined to the interior and is adapted to burrowing in loose sand.

We may also note the comparative absence of arboreal forms, e.g. *Dendrolagus*, *Petaurus*, and *Phascolarctos*, which require a richer arboreal vegetation than the country affords; but it must be remembered that the coastal ranges of Western Australia support large herds of kangaroo, and most of the ordinary marsupials are here well represented.

Extinct animals of the Eyrean region.

Although at the present time the Eyrean region, especially in the central parts, is excessively dry, there is abundant evidence that in the Pliocene times pluvial conditions reigned even in the interior, and that in place of the desert there were large lakes and swamps with a rich vegetation that supported gigantic herbivorous animals. Thus enormous kangaroos and wombat-like

creatures have for long been known from their fossilized bones, and at Lake Callabonna complete skeletons of the *Diprotodon*, an extinct wombat-like animal about the size of a rhinoceros, and bones of a very large struthious bird bear witness to the existence of abundant vegetation in districts now entirely desert.

Relationship of lower Eyrean and Torresian forms.

In the lower forms of animals of the Eyrean region we meet with the same kind of relationship with the Torresian region and isolation from the Bassian region which we found to be the case with the plants and the freshwater crayfish. Thus none of the fish of the Murray system are found; of the lizards, almost all those that are not peculiar to the region are related to the northern forms, while in connexion with the freshwater mollusca Mr. Hedley speaks of the 'impenetrable barrier which shut out Tasmanian types', e. g. the Rhytitidae. These facts point strongly to the great permanence of the barrier between the Eyrean and Bassian sub-regions afforded by Central Australia and the coast of the great Australian Bight, despite the existence of pluvial conditions in Central Australia during the Pliocene period.

Past History of the Continent

The foregoing examination of the distribution of animals and plants in the three sub-regions of Australia, taken in conjunction with our knowledge of the geology of the country, may form a secure basis for reconstructing the past history of Australia in its main features.

Separation of New Guinea and Tasmania from Australia.

Among comparatively recent events in this history has been the separation of New Guinea in the north and of Tasmania in the south from the mainland, which took place probably in the Pliocene or later Tertiary time. Torres Strait on the one hand, and Bass Strait on the other, divide a fauna and flora in which the individuals of a species have hardly had time to diverge into more than well-marked varieties. Bass Strait has, however, existed sufficiently long to prevent the immigration of Australian man with the dingo into Tasmania, and in the lower orders of creation the freshwater crayfish,

Astacopsis bicarinatus, which is universally distributed on the mainland, has not penetrated into either New Guinea or Tasmania.

Contrast between South-Eastern and Western Australia.

The most striking feature in the distribution of life on the mainland is the marked contrast between the inhabitants, both animal and vegetable, of South-Eastern and of Western Australia. A. R. Wallace has emphasized this great contrast, and he has accounted for it by the supposition that in Cretaceous times Australia was divided by the sea into a western and an eastern island, which

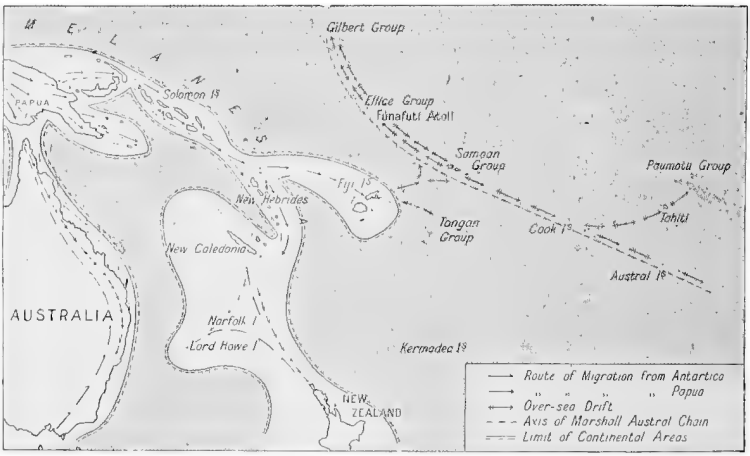

Fig. 41.

were completely isolated one from another, and in this isolated condition developed the characteristic differences in their inhabitants which is still to be observed. He also drew attention to the fact, first clearly brought out by Hooker, that while New Zealand possesses many forms of animals and plants common to Australia, it lacks many of the most characteristic Australian forms, such as eucalypts, and this he accounts for by the further supposition that the characteristic Australian fauna and flora originated in the western island of Australia and that New Zealand received its inhabitants from the eastern island when it was still separated from the

western, and hence only a partial sample of Australian types were handed on to New Zealand from the eastern island.

Division of the continent in Cretaceous times.

The evidence of geology establishes beyond doubt the correctness of Wallace's theory that a Cretaceous sea divided Australia into two main islands, a western and an eastern, though this sea may have been partially bridged by an archipelago of islands in the centre and by a continuous stretch of land along the north coast. The central desert sandstones are deposit from this Cretaceous sea, and bear infallible witness to the almost complete isolation which must have existed up to the approach of Tertiary time between Western and Eastern Australia.

The emergence of Central Australia from the Cretaceous sea, which took place at the beginning of Tertiary time, was succeeded by lacustrine and pluvial conditions which must have permitted considerable migrations between east and west, but the intermixture of forms can never have been anything but a very partial affair. After the lacustrine period, which persisted into Pliocene times, the central area underwent great desiccation and the desert period supervened which lasts to the present day, so that the barrier of the Cretaceous sea, after being partially broken down during a short lacustrine period, has been again replaced by the vast tracts of desert.

These events can be traced with some certainty, and they give a satisfactory explanation of the great differences which are to be observed between the eastern and western fauna and flora.

Connexion of Australia with Zealand,

Wallace's hypothesis that the characteristic Australian forms originated in Western Australia and subsequently passed over into Eastern Australia, after the latter had been separated from New Zealand, has not received much support from subsequent authorities. The origin of the Australian fauna and flora, excepting the immigrants from the northern tropics and from the Antarctic continent, is involved in great obscurity, but there is no evidence that it was ever confined to the western island

or absent from the eastern. The peculiar relation of New Zealand to Australia, which clearly indicates a land connexion at some period, probably at the end of the Cretaceous time, and yet is marked by the absence of all the most characteristic forms of Australian life, has been accounted for by Hedley on the hypothesis that a continental bridge ran out from New Guinea through the archipelago of islands in the Pacific, including the Solomons, Fiji, New Hebrides, New Caledonia, and Norfolk Island, to New Zealand (Fig. 41). Across this bridge a stream of Papuan life entered New Zealand on the one hand and Australia on the other, and hence the resemblances between these countries is due to their having received immigrants from a common source and not the one directly from the other. It was by this connexion that the struthious birds came to be so well represented in New Zealand by several species of the extinct moas, and in Australia by the emus and cassowaries. We must surmise that at this period the monotremes and marsupials had not penetrated into New Guinea, a supposition which is confirmed by the poverty of their representation there to-day, and by the probability that they entered Australia from the south by means of the Antarctic connexion with South America, and only gradually worked their way northwards into Papua.

with Malaysia and Antarctica.

We have still to consider the probable history of the connexion of Australia on the one hand with the Oriental tropics, and on the other with the Antarctic continent. It was shown in dealing with the Torresian sub-region that a considerable infiltration of Oriental forms, both animal and vegetable, but chiefly the latter, has taken place into Australia, but this does not necessarily imply a land connexion between the Oriental and Australian regions in recent geological epochs, because most, if not all, of these immigrants may have been distributed across the archipelago of islands stretching between the Malay Peninsula and the Australian coasts without any closer connexion. The sharpness with which Wallace's Line, passing through the middle of these islands, divides the

Oriental and Australian region, despite the fact that it has been overstepped by a certain number of Oriental forms, would seem to argue a long-standing separation between the two regions, because nowhere else in the whole world do we meet with so well marked a boundary between two neighbouring faunas and floras. The islands of the Malay Archipelago are mostly of volcanic origin, and it is more probable that they represent areas of upheaval than remnants of a once continuous continental bridge. There is no reason for supposing that any such direct land connexion has existed since the beginning of Tertiary or even of late Secondary time, and previous to this we have no data upon which to base an opinion. It is probable that many of the ancient types of Australian life, such as *Ceratodus*, the struthious birds, and many of the characteristic Australian plants, reached Australia from an ancient land connexion with the Oriental region, but this probably occurred at a very distant date, and has nothing to do with the much later immigration of Oriental forms which has left its mark on the Torresian region. This immigration, which is principally botanical, has taken place comparatively recently, and by means of the stepping stones of the islands of the Malay Archipelago, not by a continental land bridge.

Origin of marsupials in Australia.

If this be granted we have still to account for the presence of the marsupials in Australia, which can hardly have arrived before the close of the Secondary or the beginning of the Tertiary epoch. To account for the presence of these mammalia we are left with the hypothesis that at some time, probably at the close of the Secondary period, the Antarctic continent extended further in a northerly direction than it does at present, and that it was subjected to a milder climate capable of supporting animal and vegetable life in some profusion. If such a continent existed with rays of land passing up on the one hand to Terra del Fuego and South America, and on the other to Tasmania and Southern Australia, we could understand how the marsupials passed from America into Australia by an Antarctic route (Fig. 41).

There is much to be said in favour of this hypothesis. In the first place, recent exploration on the remains of the Antarctic continent has shown conclusively the true continental nature of these regions, and the discovery of coal and fossil trees has demonstrated that a mild climate capable of supporting luxuriant vegetation once existed there; secondly, the ocean to the south of Terra del Fuego and of Tasmania is ridged with comparatively shallow banks which may indicate where a former land connexion lay; and thirdly, the occurrence of so many related forms of animal and vegetable life in South America and the Bassian region of Australia is most easily accounted for by the supposition of a former land connexion between these two regions. The special evidence to be drawn from the distribution of the marsupials is also in favour of this connexion. In the Santa Cruz (Pliocene) beds of South America are to be found generalized polyprotodonts, incipient diprotodonts, and the *Prothylacinus*, which is almost identical with the Tasmanian thylacine. In North America and Europe only polyprotodonts are known, and there is no evidence of the existence of marsupials in any Oriental or African deposits. We must admit therefore that the resemblance of the early South American marsupials to the Australian forms is far closer than can be found in any other region of the world, and yet if we refuse the Antarctic connexion, South America is the most distant region imaginable from Southern Australia.

Antarctic forms.

In considering the Bassian region it was found that mingled with the typical Australian forms were many of an Antarctic nature whose nearest relatives inhabited other land territories in the southern hemisphere, chiefly South America and New Zealand. Such are the trees of the genus *Fagus*, the plants *Donatia* and *Astelia*, the parastacine crayfish, the fish *Prototroctes* and *Aphritis*, the cystignathine frogs, the snails of the families *Macroogona* and *Bulimulidae*. If these forms entered Australia from the north we should expect to find them better represented in Northern Australia than in Southern, and

to pick up some traces of their having once existed in other parts of the world, either Palaearctic or Oriental, which they must have traversed in their wanderings, but no evidence of this is forthcoming.

For these reasons, the barest outline of which have been given here, the hypothesis of a former greater extension of the Antarctic continent by which Antarctic immigrants reached Australia via South America, is accepted by many naturalists at the present time.

Summary of the history of the continent.

We may sum up the changes through which Australia has passed as follows. In Cretaceous times, and probably long previously, Australia had already acquired many of its characteristic animals and plants, but the origin of these forms is lost in obscurity. At this period a Cretaceous sea almost completely divided Australia into a western and an eastern island, and as yet the inhabitants of Australia probably constituted a fairly homogeneous group, without much admixture of tropical or Antarctic forms. Some time at the close of the Cretaceous period New Guinea, which was joined to North-eastern Australia, was connected by a continental arm with the islands in the Pacific running down to New Zealand, and by this route a partial colonization of New Zealand with certain Papuan forms was brought about. At about this time or at the beginning of the Tertiary epoch an arm of the Antarctic continent stretched up to Tasmania and the Bassian sub-region, by which a stream of Antarctic life, including the marsupials and many animals and plants, entered the south-eastern part of Australia. During Tertiary time the connexion of Northern Australia and Papua with the Oriental tropics has grown closer through the upheaval of many islands in the Malay Archipelago, and a continuous stream of Oriental life, principally plant-life, has gradually filtered through Malaysia into Northern Australia, competing with and in places supplanting the old Australian types. The almost complete isolation of Western and Eastern Australia by the Cretaceous sea was succeeded during Pliocene times by a short lacustrine period, which was

soon replaced by the desert conditions which have continued to the present day to form a barrier between west and east. This isolation between west and east is, and has always been, greatest to the south; along the north coast there has been a considerable stream of immigration of Torresian forms into West Australia and of Western Australian forms back into the Torresian province.

Recent desiccation.

The Antarctic connexion was probably short-lived and ceased early in Tertiary time, as the forms of mammals later than the marsupials have never been able to enter Australia except by casual means. Of comparatively recent events, the complete desiccation of the central deserts which supervened on the lacustrine period is perhaps the most important. We cannot say to what extent this desiccation has been responsible for the comparatively dry conditions now experienced in the continent as a whole, or whether the pronounced xerophylly of Australian vegetation was acquired in ages long prior to this comparatively recent drying up of the interior, but it is certain that the presence of vast tracts of desert and semi-desert in the centre of the continent exerts and must have exerted in the past a baneful influence on the country as a whole. Drought has been the main enemy of life and has left its mark on the animal and vegetable products of Australia; and the same influence which has moulded them is still at work, checking the advance of man in colonization and taxing his resources and ingenuity to the uttermost.

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[PLATE IX. TREE FERNS (*Cyathea*) IN A GULLY IN THE GUM FORESTS NEAR GEEVESTON

(Phot. Mr. Beattie, from G. Smith's *Naturalist in Tasmania*)

PLATE X. FELLING EUCALYPTUS TREES

(Phot. Mr. Beattie, from G. Smith's *Naturalist in Tasmania*)

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CHAPTER V

ECONOMIC CONDITIONS AND INDUSTRIES

By H. S. Gullett

Economic Survey

The close of the nineteenth century may be taken to mark a decided change in the character of Australian industries. Broadly speaking, the Commonwealth was then terminating what may be described as its pastoral era, and beginning a more serious and complex life as an agriculturist, a manufacturer, and a trader.

Introduction.

The importation of live stock to Botany Bay in 1788, consisting of 7 horses, 7 cattle, 29 sheep, 74 pigs, 5 rabbits, and some poultry, increased slowly on the beautiful but infertile sandstone hills about Sydney, and the practices of agriculture made but little progress until the pioneers, following closely upon the footsteps of the explorers, penetrated to more fruitful country further inland. Once the wide interior, with its wealth of native grasses, was disclosed, pastoral settlement travelled fast. But not

until the middle of the century, when the rush of people to the goldfields provided a substantial demand for farm produce, did the agriculturist or the manufacturer make much headway. The produce of comparatively few acres sufficed to supply the needs of the Australians down to that time. Railways were unknown, the roads were indifferent and limited, transport was slow and expensive. With the oversea carriage of fresh produce impossible, and the population almost at a standstill, the outlook for the farmers until the year 1851, like the outlook for the manufacturer and the trader, was poor indeed.

But if agriculture advanced slowly, and secondary industries were still unborn, the Australian colonies, even at that period, had established one great industry. The world hears more of Australia's droughts than of Australia's good seasons, but still the country has upon its native grasses alone built and maintained for many years the largest flock of sheep possessed by any one land. Long before the discovery of gold gave birth to the farmer and the manufacturer, and to railways and the coastal fleets of ships, and made Australia of significance to the Empire, the flocks and herds of the pastoralist were ranging over half the continent.

Pioneering conditions.

Australia was, and still is, an easy land to pioneer. Speaking broadly, and excepting the rich coastal territory, the prospect was either that of the light eucalyptus forest, with very little underbrush, or the open plain. Wherever the first explorers went, if we overlook a few desert reaches, which taken against the whole area are limited in extent, they found in the normal season abundant pastures awaiting the flocks and herds of the colonists. Water, if not plentiful, was fairly easy to obtain by dams and excavations; the aborigines, although sometimes vexatious, were rarely a serious menace to the pioneers; the country was practically free of animals which molested either man or beast. Over millions of acres the flock-owner discovered land which gave a generous living to his animals. Under the wide greenwood of the new continent, the merino sheep of Spain, thriving in the

sunshine, multiplied and improved in quality ; and horses and cattle representing, like the scattered colonists themselves, most of the breeds and types of the British Islands found conditions equally congenial. There were several unprofitable periods. So long as the green forest remained, the grasses were meagre, and as compared with to-day, wiry and innutritious. The trees kept the sun from the soil and robbed it of moisture. In the dry seasons the pastures faded early, and stock-masters often lost heavily. Then the market for fresh meat was small, and to most graziers inaccessible. Live stock was sometimes sold for the price of its hide and its tallow. Squatters riding long distances to a game of cards gambled lightheartedly in fat bullocks. Wool, always more or less profitable, was then, as it is still, the young country's main asset, and as the sheep multiplied the flocks were driven further out, and colonization was extended.

Ring-barking.

At about the time of the gold discoveries, ' ring-barking ' was introduced from America. The eucalyptus is easily killed. The squatters found that a man with a sharp axe could run a ring round all the trees on several acres in a day, and that the stock-carrying capacity of those acres was increased many times by the operation. In a few years the sparkling forest perished over thousands of square miles of country, and in its place came the ghostly grey skeletons of the dead timber. Pastoral Australia was in a flash made ugly and depressing. But the pioneer was careless of the picturesque. He wanted more grass, more sheep, more fleeces. ' Ring-barking ' cleared the way for a rapid increase in live stock and people. As the bark and branches rotted and fell, as the sun streamed down uninterruptedly and sweetened the soil, as bush fires of mysterious origin swept through the decaying trees and burned them down and made food for the grasses, the land was strengthened and made more profitable. ' Ring-barking ' put new life into the pastoral industry.

Settlement before the discovery of gold.

But however pre-eminent Australia might have become as a producer of fine wools, and beef and mutton and tallow and hides, there could have been no national

greatness in the unbroken continuation of the pastoral era. Down to the time of the gold rushes the continent was remote and unknown. The voyage from Europe occupied from four to six months, the population in 1850 numbered only 405,000, and the people were sharply divided between those who had more broad acres than they could count or work to advantage, and those who laboured for them with but a shadowy prospect of advancement. As there was little or no market for farm produce, there was no demand for the land in farm areas. The young towns growing up in the different colonies were insignificant and unprogressive. Australia in an economic or national sense was unborn. Before 1850 men looked into the future and saw a wide rich land precariously held by a scattered race of pastoral potentates and their servants, and on the coast a scanty breed of merchants. Immigrants trickled in from the United Kingdom, but there was no regular flow. The outlook for the worker was very often poor; men with capital enough to embark in pastoral pursuits were comfortably off in England. Only the imaginative adventurer with or without money, or the failure, or worse, in the mother country, was attracted to Australia in the first seventy years after its 'colonization' by Governor Phillip.

Effects of the discovery of gold.[1]

Then Hargraves proclaimed the presence of gold, and as discovery succeeded discovery the word Australia had a new meaning in the world. Many easy fortunes were made. The stories of penniless men acquiring sudden wealth are not all fiction. The traveller in Australia actually meets occasionally an old man whose pick unearthed nuggets in the feverish 'fifties'. But although the alluvial gullies at Ballarat and elsewhere were perhaps the richest the world has known, the men who failed in their excited quest outnumbered by twenty to one those who were favoured.

So began industrial Australia. Thousands of miners were miners for the occasion only. The camps included

[1] The minerals and mining industries of the Commonwealth are further dealt with in Chapter VI.

men of every calling. Disappointed on the diggings, the majority, perhaps, fell to lives of intermittent dissolution and drudgery. But many of sterner quality were shrewd enough to see that Australia possessed other forms of riches, which, if less alluring than gold, were better assured and more permanent. Thousands of the miners drawn from the farming districts of the United Kingdom turned instinctively to the rich idle acres through which they passed in their stampede from one new goldfield to another. The sudden flood of population had at once created markets for farm produce which could not be supplied by the scattered early agriculturists. Living on the diggings was excessively dear. Men quickly recognized that there was more money in growing food for the miners than in the mining itself. In a few years large areas of land, which had hitherto remained in the hands of the Crown, were taken up in small holdings. Australian farming became firmly established, and the idea that the real mission of a great portion of the continent was agricultural and not pastoral travelled rapidly. Prophecy took a new and happier shape. Men began to dream of the land as the home of a numerous race of small holders : a spirit of nationhood was born in the colonists.

Economic results of individual wealth.

But the gold discoveries did far more than turn people's attention to Australia's purpose as a farmer. Although the majority failed to win fortune on the diggings, the value of the gold taken from the ground in those early years was substantial, and, unlike the gold won in various parts of the world to-day from deep quartz-mining, it was obtained at a low working cost close to the surface. There was no greedy levy by company promoters, no heavy outlay on machinery, no high fees to directors and salaries to experts and managers. The great bulk of those early millions went to labour. It was easily earned and extravagantly spent. Money circulated freely ; trade flourished. The governing authorities, excited like those they governed, embarked light-heartedly upon development works ; private enterprise, equally optimistic and bold, launched new industries. And all the while the

outside world, aroused by the sustained story of riches so simply gained, poured both men and money in the young country. Each year, too, brought a large proportion of people whose purpose was not to mine but to engage in farming or business.

Development of towns and communications.

In 1852 the value of the gold won was £11,800,000; between 1850 and 1860 the population leaped from 405,000 to 1,145,000. The settlements on the coast in a few years were made cities; hundreds of townships arose inland, some built in a night entirely of canvas, to be folded and to vanish completely as the gold in the locality was worked out, but many to become substantial, expansive, and permanent. The picturesque coaches of Cobb & Co., which ploughed through a morass in winter and lumbered through a haze of dust in the summer, disappeared before the railways. At the outset men rushed off the vessels in Hobson's Bay, and scarcely wasting a glance on the plans and tents which comprised Melbourne, took to the wide rough tracks which led to the fields. The few with money rode or drove; the great multitude walked. The early 'rushes', unlike some of those of more recent years, were close to the coast. But the absence of railways soon became intolerable to a community which could well afford the necessary expenditure, and the lines came quickly in colony after colony.

Each year the communication with the outside world was steadily improving. Owners of deep-sea vessels saw in the Australian trade a big passenger traffic already assured, and the promise of growing freights. Australia began, in point of time and expense, to creep closer to the Old World, and within itself the various settlements, hitherto as far apart as they are to-day from Japan and South Africa, entered upon an always improving intimacy. In 1852 the first inter-colonial steamship service was established, and traded between Tasmania and Victoria.

General economic development.

By 1870 the population of the six colonies reached 1,647,000. A glance into the parliamentary records of New South Wales or Victoria of about that time shows

what the goldfields had accomplished. The purely pastoral stage was for ever gone. The increasing importance of the farmer is emphasized in the battle raging then, and still unfinished, between the interests of the large squatter and the small holder. The cry of 'the land for the people' rang through the young legislatures, incongruous as that might appear in a continent three-quarters as large as Europe and occupied by only 1,500,000 people. Free traders debated against protectionists, ample evidence that Australia had become a manufacturer, and desired, as soon as possible, to become self-supporting. Outside, labour disputes were no longer only those between the flockowner and his shearers: trades unions were established in many trades and industries.

But although the gold discoveries had done much, the future of Australia was by no means clear. The country was one of limited industries almost down to the close of the century. The burst of farming settlement, encouraged by high prices for produce, following upon the inflow of the miners, was soon checked by over-production.

Over-production and financial crisis.

The cultivation of but little soil was required to provide wheat, meat, fruit and vegetables for 2,000,000 or 3,000,000 people. Exports were still restricted to imperishables. Wheat-growing made headway, but other branches of farming languished. The squatters continued to declare, and with much justification, that the country's greatest asset would always be the produce of the large holdings—wool and meat and hides. The dairyman, the orchard-grower, the small grazing farmers, those classes whose presence means a close and numerous population, appeared to have no future. The sensational alluvial fields had been succeeded by great quartz mines controlled by powerful companies, and worked by men for wages. Australia's diggings no longer attracted the Old World emigrant. The population, except for a low birth-rate, corrected to some extent by a low death-rate, was almost stationary. In the early 'nineties' a disastrous financial panic terminated a period of low prices for produce, heavy government borrowing, and an orgy of excited

speculation chiefly in urban lands. The outlook for industrial Australia was extremely disconcerting.

Cold storage and transport facilities.

But during the decade preceding the financial failure there had been working some forces more important even than the gold discoveries of 30 or 40 years earlier. Invention had placed at the service of the southern farmer the cream separator and the refrigerator. Steamship companies had increased, quickened, and cheapened all transport to Great Britain and other countries. Cold storage on land and sea meant that Australia could export in a fresh condition practically all the surplus product of her wide grazing and agricultural lands. The available market was no longer the home market of a lightly populated country, but the market of the world. The extreme shortage of money following the 'land boom' prevented the colonists from taking immediate advantage of the new position; and the wide advertisement given to that 'boom' abroad for a time completely suspended immigration. But immediately before the close of the century there was widespread evidence of the beginning of better days. Fortunately, just as Australia was given the transport facilities necessary for reaching outside markets, the world's prices began to advance.

The drought of 1902.

The century closed with a drought of unprecedented severity. A country so large seldom enjoys a good season in every part; there is in most years a shortage somewhere in Australia, but when a zone of plenty is succeeded by a zone on which there is a temporary drought the consequences are not disastrous. But in the drought which culminated in 1902 the shortage was general. Graziers and farmers sought vainly for relief: the losses in live stock were enormous. Coming so soon after the financial troubles the disaster might have been expected to bring about general ruin and depopulation. The impression made by the two tragedies on the outside world is shown by the fact that in the ten years between 1895 and 1905 Australia's total net gain by immigration was only 5,000. But within the country itself there was a spirit of undaunted optimism. The celebration which

attended the federal union in 1901 was marked by a note of strong confidence in the immediate material welfare of the community. In a few years the people had recognized that with markets awaiting all the diverse produce which a continent could produce there was close at hand an industrial re-birth. The feeling was general that in a young country of great dimensions such things as droughts and financial difficulties were but transitory difficulties of small moment.

Industrial Australia in the twentieth century.

A new industrial Australia began with the Federation. The progress in the first twelve years of the twentieth century far exceeded that of any previous twelve years in the brief history of the country, and that notwithstanding the enormous national loss caused by the drought. To some slight extent this progress might be indebted to the Federation, which has swept away the old border tariffs between the six colonies or states, and has assisted business development by uniform postal and telegraph services, while the growth of the federal spirit has gone far to make all parts of Australia better known to the Australian people, and so made progress more uniform. But in the main the good reading supplied by the statistics which cover the period 1900–12 is due to the plain fact that the country's settlers, raising their horses and cattle and sheep and grain and butter and fruit, have been enabled to sell their produce in the markets of Europe, Asia, and America. Each season, as the prosperity of the farmers became more pronounced, there has been a greater appreciation by the individual and by the nation of the richness, diversity, and vast dimensions of Australia's farm lands. The prices paid in the markets of Tooley Street and Covent Garden and Smithfield give sound profits to Australian settlers. Distance now counts for little. Fresh butter is carried from Sydney to the Thames for $\frac{1}{2}d.$ per lb.; fresh meat for $\frac{9}{16}d.$; fruit for less than 1*d.*

Small holdings.

The confidence of the small holder was illustrated in 1903, the year following the driest season Australia has known. In 1903 the area under wheat and the bushels harvested made up a record; and each season since has

seen very keen demand for all farm lands close to rail or water communication, an increasing inquiry for the virgin country further out, and at the same time spirited government activity in encouraging the subdivision of large estates, the building of new railways on a continental scale, and the construction of huge irrigation works. This marked confidence in the capacity of the country to produce wealth and carry a big population has been demonstrated also in the immigration returns. As elsewhere indicated (compare p. 560), the gain by immigration from about 1890 to 1905 was by no means great. In 1908 a system of assisted passages for farmers and farm-workers and domestics resulted in a net gain of 17,000. Gradually the encouragement and assistance were extended to other classes. In 1909 the net gain was 29,000 ; in 1910 37,000 ; in 1911 69,300 ; and in 1912 93,000. And despite this increasing flow the demand for many classes of labour has been far from satisfied.

The economic basis in Australia: the land.

The development of lands owing to the opening up of oversea markets must be laboured. Practically the whole produce of Australia comes out of the soil. If all is well with the stock-breeders and the cultivators, all is well with the Australian nation. If there is room for their multiplication the nation will advance rapidly to a place among the Great Powers. If the land settler fails, the Australian nation fails. The time has not yet come when wealth is derived from other nations by selling them manufactured goods, or acting as a sea-carrier, or as a lender of money. Except for her mines Australia is a primitive farmer and grazier. It may be shown that her manufactures are already considerable and full of promise, that her railways are multiplying, that her shipowners are wealthy and ambitious, that she is expending millions annually on her young army and navy. But the man on the land is responsible for all her activity. It is often urged that Australian cities are too large, that an undue proportion of the people are shirking the work of pioneering. But while it would be better for the country if many of those city dwellers were employed on the soil, it should not be

forgotten that they are all maintained indirectly by the soil.

Relative position of principal classes of occupation.

An estimate of the total value of the production of Australia has been furnished on page 14, and by calculation from the figures there referred to it may be laid down that upwards of £100,000,000 came from farming and pastoral pursuits, and the progress of the small settler as against the squatter is clearly shown. A few years earlier the pastoralists' output was easily first, and the years in which the farmer has come to the front have been marked by almost 'record' prices for all classes of pastoral produce. The marked prosperity of Australia in the opening years of the new century is clearly explained. The swift rise of young manufactures, the increase in the value of total production by £73,000,000 between 1901 and 1910, the revival of immigration, the spirit of optimism in all classes of the people, the building of railways on an unparalleled scale, the great irrigation schemes—these things are almost entirely due to the fact, now clearly recognized, that Australia is a small holder's country; or, if not all a small holder's country, sufficient of its wide expanse is adaptable for that purpose to ensure at an early date comfortable homes to a people many millions strong. The confidence which characterizes all the young industries to-day is based upon an improving knowledge of the country's home-making qualities, together with an understanding of the congestion which each decade becomes more pronounced and serious in older countries. Any consideration of Australian industrial and economic conditions must keep these two factors in view.

Pastoral and Agricultural Industries

Pastoral occupation.

The pastoralist scarcely gets his due in Australia at the present day. For many years it has been popular to speak of the great landowners who braved the worst of the pioneering, and who built up the country's flocks and herds, as selfish monopolists and opponents of progress,

and even as a menace to the national existence. The younger generation of Australians, with their minds full of a quick advance to nationhood and imperialism, and conscious of the shadow of the East, declare that the pastoralists have outlived their utility. The demand of the great majority is for the subdivision of the large grazing holdings. Every day parallels are drawn between the enormous squattage of 100,000 acres worked by a score of men and 'peopled' with a sheep to the acre and dead timber and wire fences, and that same area when cut up into 200 wheat farms each supporting its British family and its labourers, and in addition to its crops of wheat, still carrying, thanks to the improved methods of the small holder, as many live stock as it did under its old form of tenure. This is the popular picture; the squatter is criticized, abused, and subjected to differential taxation.

Pastoralists and Australian development.

But away from the political turmoil, very little consideration leads to a more generous estimate of the pastoralist and his work. It is interesting to notice how far the story of the pastoral industry is the story of all Australian industries and development. The early squatters played a gallant part in exploration; they bore the brunt of what opposition there was from the unhappy blacks; they took vast expanses on which the water-supply was inadequate for settlement of any sort, and made them habitable; they attacked and demolished the wide eucalyptus forest on the lands which are now proving most valuable for the wheat-grower, and so made them ready for the plough; they ran their stock over those lands for nearly a century and sweetened and strengthened them and ensured liberal crops to the cultivator of to-day; they introduced live stock from all parts of the world and carried out innumerable experiments which have made the raising of live stock simpler and more profitable; for a century or more they were the chief producers of national wealth; they built up a flock of merino sheep whose wool has no equal, and, eagerly bought by all countries, has been Australia's best advertisement abroad; they raised

hundreds of thousands of horses which carried the King's soldiers in India and South Africa; above all, they and their 'station hands' evolved what is known to-day as the 'typical Australian', the tall spare sun-browned man, soft and slow of speech, but steady of eye and resolute in action, who while altogether Anglo-Saxon in breeding and sentiment, is yet distinctively and exclusively Australian. It was the squatters' shepherds who blundered on to the most famous deposits of gold, the squatters' money which built and maintained the cities and country townships before the miner and the farmer began, the squatters who wrote the earliest autonomous constitutions and whose produce was the basis of the young manufacturing industries. And with their great record in memory it is good to know that they will never pass right out of the Australian life. The squatter with his huge areas of land, his Spanish merinos and herds of English Herefords and Durhams, and his wholesome outdoor life, will always make a picturesque background to the increasing strenuousness of Australian industrial life. He will be pushed back from the country of good rainfall close to the coast, but out on the wide interior he will continue to shear his merinos and follow his cattle, safe from the trespass of the plough.

Comparative distribution of pastoral and agricultural lands.

The Australian country-side, as we have seen, is undergoing a decided change at the hands of the settlers. The wide territory of the single squatter this year is next year the home of a hundred pioneering farmers. The agriculturist covets every square mile of country on which the rainfall is in excess of 17 or 18 inches. The most famous Australian squatting districts had this rainfall and more, so that it is difficult to indicate the most notable grazing areas of Australia. The picturesque and rich western district of Victoria, the noble sweep of Riverina and the Liverpool Plains in New South Wales, the pastoralists' paradise on the Darling Downs tableland in southern Queensland, all of them celebrated squattages, are either in the hands of the farmer already or certain soon to be so. Therefore in any consideration of the

pastoral industry it is necessary to bear in mind that the industry, as the occupation of large and wealthy holders, is shifting its ground. Much is written of the increasing immunity of the large holder from drought. That is scarcely correct. The march of the farmer with more concentration upon each square mile of territory means more safety and uniformity of returns for all the area which the farming movement acquires. Small holdings mean the conservation of more water and fodder, and more railways to give transport to stock in the excessively dry season. A hundred farmers will survive a drought on a given area of land, on which in the same season a single grazier would perish. But although each year as the small holder advances, Australia becomes further insured against the drought, it is erroneous to speak of the increasing safety of the large pastoralists. Obviously as the country of good rainfall is subdivided the proportion of the large holders on the interior of light and fickle rainfall becomes larger. In pointing to this, however, it is necessary to set out that the yield of pastoral products tends to become more regular. In the past, Australian wool and meat have been produced and exported by a small class of large holders. The tendency now is for the quantity of the product to be rapidly increased, but for the individual contribution to be greatly reduced. The pastoral industry will continue to be one of Australia's first assets, but its character will be changed.

Changes in sheep-farming practice.

The multiplication of the small holding will mean an increase in the numbers of live stock. But possibly there will be some interesting changes in the quality and character of the output. Farm stock and station stock differ considerably. Already there is a marked increase in the numbers of sheep of British breed. The small holders, encouraged by the export market for frozen lamb and mutton, are raising more meat and less wool, and in consequence they are abandoning the comparatively light and slow-growing merinos for the heavier English breeds such as the Lincoln, the Leicester, the Romney Marsh, the Shropshire, the Southdown, and others, which

reach a suitable export weight at an earlier age than the Spanish sheep. Then the crossing of the two types is becoming more popular each year, as the progeny combines a good mutton sheep with a fleece which is more saleable than the coarse covering of the pure British breeds.

Territorial distribution of pastoral occupation.

The pastoralist industry flourishes in all of the six states of the Union, but it is naturally richest in the states of larger area, where the small settler has encroached least upon the spacious estates of the pioneers. The following table showing the relative ownership of live stock is a fair indication of the pastoral output :

	Horses.	*Cattle.*	*Sheep.*
New South Wales	650,000	3,140,000	45,561,000
Victoria	472,000	1,547,000	12,882,000
Queensland	594,000	5,132,000	20,332,000
South Australia	249,000	385,000	6,267,000
West Australia	134,000	825,000	5,158,000
Tasmania	41,000	202,000	1,788,000
Northern Territory	24,000	513,000	57,240

These figures, however, must not be accepted as an actual reflection of pastoral activities in the various states. Included in this return are the sheep and cattle and horses owned by the farmers. The bulk of the animals in Victoria are owned by small farming holders, and in New South Wales the proportion of the ' small ' men is rapidly advancing. In Queensland the pastoralist is still in possession of a vast domain which includes countless square miles destined one day to go to the farmer. Tasmania, which has been a notable nursery of the best quality of merinos, is scarcely ' pastoral ' in the mainland sense. In South Australia the squatter is rapidly being ousted from the country with a farming rainfall ; but in Western Australia, the boundaries of which encircle about 1,000,000 square miles, there are still wide provinces which have not been pioneered even by the squatter.

Rainfall and pastoral occupation.

Of Australia's 3,000,000 square miles over one-quarter receives a rainfall of 20 inches and upwards. The experience of a century has taught that, speaking generally, the country with a rainfall of 16 inches and upwards is

suited for settlement in relatively small areas. Behind that there is another zone containing, let us say, all the country with a rainfall from 12 to 16 inches which, thanks to irrigation and improved methods of cultivation, especially 'dry farming', may one day be in the possession of the agriculturist. But for a long time the best that can be hoped from this zone is that it will be taken up in 'grazing farms' of 3,000 to 10,000 acres. Doubtless an occasional squatter will always be found carrying on his operations on even the most favoured country, despite all that partial taxation, government pressure, and tempting offers can do to remove him. Nevertheless, again speaking generally, it may safely be laid down that the tendency to-day is for the squatter in the old sense, the man with from 50,000 to 1,000,000 acres, to retreat towards the country with a rainfall of 12 inches or less. His departure from the grazing riches on the coast will be gradual and uneven. He will soon disappear from the ocean margin in South Australia, Victoria, and New South Wales, but in the north of the continent, in Queensland, the Northern Territory, and in the northern half of Western Australia a long time will elapse before there is likely to be a demand from the small holders for the territory he occupies.

Merino sheep: introduction.

Naturally in the early days of colonization, when the whole continent offered a choice, the graziers took what they deemed the best. They turned their animals and shepherds on to the coastal country with the best rainfall. They found that at once, despite the hotter sun, all the farm stock introduced from the British Isles found the new settlement as congenial as the colonists. But a few years were enough to convince the pioneers that, if they wished to make use of their wide domain, they must raise produce which could be exported. Their thoughts went naturally to wool; and the similarity of the natural conditions to the conditions of Spain and other lands in which the merino sheep flourished, led to the importation of a few of these animals. The pioneer in the Australian production of wool, Captain Macarthur,

came for his merinos, strangely enough, to England. He purchased from King George III a small flock running at Windsor, which a few years before had been presented to the King by a Spanish nobleman. The sheep proved unsuitable to the wet pastures close to the Thames, and when Macarthur landed them in Sydney he found that there too the heavy coastal rainfall was not favourable to the sheep from the hot plains of the Peninsula. In a few years the general recognition of this fact had a pronounced effect upon Australian colonization. As the flocks increased they were driven inland, and with excellent results. To-day the rich coastal lands may be searched in vain for the merino, but as far inland as there is enough water to keep them alive they are found thriving as they thrive nowhere else in the world.

Development and variation of breeds.

The development of the merino sheep in Australia makes absorbing reading for those interested in evolution. Australian flock-masters have moulded and changed their sheep to a degree scarcely credible when the limited time occupied by their experiments is remembered. The first Australian merinos were described as lanky animals with light bodies and a sparse covering more like hair than wool. Long after the industry was begun the average weight of the Australian fleece was 4 lb. To-day the average is 8 lb. The total flock numbers nearly 100,000,000, and taking the value of wool for the purpose of rough calculation at 8*d*. per lb., the annual gain to Australia by the doubling of the weight of the fleece comes to something like £16,000,000. Actually the reward to scientific breeding would amount to far more. For not only has the weight of the fleece been increased, but the quality of the wool has been completely changed, and the weight of the original sheep probably doubled. Another point of interest to the scientist is the striking variation in the types of the sheep which are now scattered over the continent. The large-framed strong-woolled merinos of the hot inland plains are almost as distinct from the finer-woolled, lighter sheep of the colder country as any two breeds of the established sheep of Great Britain.

Much of this variation has been produced naturally by local conditions of soil and climate, but much is due to the pains of the breeders to evolve animals best suited to particular localities. To attend an Australian merino sheep show is to understand at once how even on so small an area as the British Isles there are so many distinctive types of domestic animals ; and the observation of the immediate effect of the new land upon animal life leads to speculation as to how far the overseas dominions will in the course of time evolve new and distinctive types of the Anglo-Saxon people.

Sheep-breeding.

The frequent sales of great flocks, because of the spread of the farmer, has raised the question of whether the quality of the Australian fleece is likely to suffer by the change in the form of tenure. It is doubtful if the farmers will maintain the same high standard as the old large flock-masters. Breeding stud merinos is not an occupation for the man with limited capital. Many years will elapse, however, before there is likely to be any appreciable falling off in the quality of Australian wool. Down to 1912 it was steadily improving, and with the outside world bidding keenly for the best stud sheep, as well as for every ounce of the wool, the maintenance of the standard is strongly encouraged. At the annual sales of stud merinos it is not uncommon for a merino ram to be sold for 1,000 to 1,500 guineas, and buyers from Argentina and South Africa compete eagerly with local flock-masters. For nearly a century Australia had buyers searching the world for types of merinos likely to improve her flocks. To-day the introduction of outside stock has practically ceased, and it is interesting to observe the extent to which inbreeding is successfully conducted. In some of the most famous studs, no strange blood from beyond the property has been introduced for forty or fifty years. Merely by selection and the exclusion of the imperfect the standard has been constantly raised.

Horse-breeding.

As regards horses and cattle the passing of the large holder is also having the effect of increasing the numbers and changing the relative strength of the breeds. Beef

cattle are steadily giving way to dairy cattle: the Durham and the Hereford, the Angus and the Devon are being to some extent displaced by the Milking Durham, the Ayrshire, the Jersey, the Guernsey, and other milking breeds. In horses the advance of the farmer means a falling off in the strong preponderance of the light saddle types. The thoroughbred, while still in the ascendency, has not that monopoly on the affections of horse-lovers which it enjoyed so long on the squatting areas. For some years it has paid better to breed plough horses than saddle hacks or Indian remounts, while the popularity of the motor-car has also had some influence in discouraging the production of all light types.

Cattle breeding

The great cattle-breeders are chiefly in the sub-tropical and tropical north where the monsoonal rains are regular and heavy, the soils rich and deep, and the pasture luxuriant. Over wide areas of Queensland and in the Northern Territory and the north-west of the continent wide regions held at nominal rentals, and often totally without fences or other improvements, are used for the raising of beef for the southern markets. There conditions of life are as wild as in the earliest days of Australian colonization. The blacks still thrive in their native state; the extent over which each owner's cattle graze is determined only by the water-supply; a white manager and half a dozen white stockmen, assisted by a few expert aboriginal horsemen, will manage a station of 10,000 square miles. In the Northern Territory there are single runs which carry upwards of 50,000 head of cattle and on which the annual increase of calves varies from 10,000 to 20,000.

Economic aspects of pastoral occupations.

If the pastoral industry in the older states is waning and changing, if the traveller to-day finds railways and cultivation paddocks, and comfortable farm-houses and thriving townships, where a few years ago he startled the shy back-country sheep in their 5,000-acre paddocks, he can reflect that for a little while at least there is in the north a fertile wilderness still unexploited and unspoiled. But the pioneer's work draws to its close

in every land. Even in Northern Australia the surveyor is busy planning railways; the Commonwealth parliament at the end of the 1912 session approved an extension of railway for the Northern Territory. The Queensland government is building lines into the same region. Agricultural experts are at work discovering how to make the cattle stations of the north profitable in farm areas, and an assisted immigration policy is being formulated. Nowhere in Australia is the pastoralist permanent except out on the plains where the rainfall is so low that the farmer cannot follow.

Of the £50,000,000 which may be taken as the rough average annual value of the pastoral output nearly four-fifths are won from sheep. Wool alone contributes nearly £30,000,000, and of this almost the whole is exported. Of the 792,868,000 lb. produced in 1910 only 9,000,000 lb. were retained for local manufactures. Of the rest about one-tenth is scoured before being sent away; the balance goes abroad as it leaves the sheep's backs. The local treatment of this immense fleece is one of the dreams of the Australian manufacturer. Nearly all of the wool is now sold before export, one of the many indications that Australia is awakening to the necessity of securing as much profit as possible from her products. The rise of the local broker means the retention of heavy commissions which, until a few years ago, went almost entirely to London. The next step will be the multiplication and increased capacity of the country's woollen mills.

The foreigner shows an advancing appreciation of Australian merino fleece. Great Britain buys about 45 per cent. of the total export, but relatively the mother country is a decreasing buyer. Great advances are being made by France and Germany, while Japan is each year increasing her orders.

Social condition of the Australian squatter.

While the Australian squatter has never been more prosperous than he is at the present time, it can truthfully be said that he has seldom been less happy. For a century it has been customary in any survey of Australia to give him and his life a leading place. He owned principalities of

fertile country blessed with a good rainfall. He encountered occasional droughts, but in the main he led an easy pleasant life, and won large profits without effort. He was remarkable for the comfort, and even the luxury of his homestead, for his love of sport, and above all for his success with thoroughbred stock. He was, in brief, the landed aristocrat of Australia. Further inland and in the tropical north was another class of squatter, following a rougher and more primitive life, dwelling in a less pretentious type of homestead, far removed from railways, and often unaccompanied by women. At present the tendency is for the first class to be displaced by the farmers. In speaking of the Australian pastoralist whom the world has known best, it must be made clear that the conditions of his industry and his life are rapidly changing.

Agriculture.

In any consideration of agriculture in Australia the continental character of the country must at the outset be borne in mind. Australia is three-quarters as large as Europe, and like Europe it extends over a wide sweep of latitude. If the dimensions of the Commonwealth are overlooked it is not easy to grasp the range and diversity of her agricultural products. From north to south, through Queensland, New South Wales, and Victoria, the distance is about 2,500 miles, and further south again is Tasmania. About 1,150,000 square miles of a total of 2,974,000 lie within the tropics. Most of the vegetation which thrives in the East and West Indies will thrive in Northern Australia. Travelling south, conditions suitable to the plant and animal life of every country in the world will be in turn discovered. Moreover, the traveller will find that already Australia has successfully borrowed from nearly all countries in building up her young agricultural industries. As the economic plant and animal life of Europe is various, so is that of Australia. As yet many of the young rural industries are insignificant, but in the course of a century experiments have been numerous and widespread, and the results have been sufficient to demonstrate the almost boundless elasticity of the country's natural possibilities.

Agricultural divisions of the continent.

It is not easy to sum up the agriculture of a continent, even though it is the smallest of the continents. What is typical of northern Queensland is more typical of the East and West Indies than it is of Tasmania; what is typical of Tasmania is more typical of Kent than of Central Australia. But despite the complete contrast in natural conditions between the north and the south, and between the coast and the interior, general treatment is possible in writing briefly of Australian agriculture as it is to-day.

Agricultural Australia falls roughly into two classes on either side of the Tropic of Capricorn. On the Queensland tablelands north of the Tropic of Capricorn are to be found many roots and cereals and fruits which grow close to the sea-level a thousand miles further south; and far south of the geographical tropical boundary will be found much tropical vegetation. But where altitude does not correct the latitude the boundary serves to divide the crops and the practices of the farmers. Doubtless the time will come when the deep rich soils, the fierce sun, and the abundant and regular rain of tropical Australia will produce something beyond a tangle of native grasses and coastal jungle. In every Old World land similar conditions give occupation and homes to a dense population. But, if the sugar industry is excepted, Australia has done little or nothing with her tropical riches beyond carrying out some interesting and encouraging experiments.

South of the tropics the agriculture of the Commonwealth is fairly uniform for a territory so large, although it tends each decade to become more complex and distinctive according to locality. Crops and practices in southern Queensland, New South Wales, Victoria, Tasmania, South Australia, and the southern half of Western Australia are, broadly speaking, similar, subject to the amount of rainfall. Nearly all round the southern half of the mainland, if we pass over the area to the north of the Great Australian Bight, there is within a short distance of the coast a low, broken mountain range. Sometimes this range rises abruptly from the sea; some-

times it is from 50 to 100 miles inland. Everywhere it sharply divides the character of the farming industry.

The coastal margin.

The slope from the hills to the ocean is marked by rich soils and an assured and generous rainfall, and is the only part of Australia upon which there is yet anything approaching to closer settlement in the Old World sense. But even there the pioneering is far from finished. The timber on this long frontage was heavy, and the undergrowth considerable; and although the ultimate reward was rich, the majority of the early settlers preferred the less formidable, even if less fruitful, lands a little further inland. The unsuitability of the coast to the merino sheep made it necessary for those who chose it for their home to engage in cultivation, at least until the cream separator and the refrigerator established the export trade in butter. By a large majority Australia's early farmers were not skilled in agriculture before they arrived in the new country. As we have seen, they comprised in the main the disappointed gold-diggers; and this class of land settler preferred the easy life of the grazier, or at most the freer practices of wheat-growing, to the intensive practices necessary to be successful on the small clearings, wrested only by long years of labour from the heavy coastal forest.

Dairy farming on coastal lands.

Hence the development of the most accessible and richest soils in Australia was long delayed. The coastal margin is well adapted for root crops, for maize, for a variety of fruits, and above all for dairying. To-day its farmers are almost without exception milkers of cows and makers of butter. The majority of them grow roots and fodder on a limited scale, both for direct selling and to assist in the maintenance of their cattle and the feeding of their swine. But nearly all are dairymen first and cultivators afterwards. They are good dairymen and careless cultivators. Marked improvement is taking place in the quality of their herds, but as tillers of the soil they are, generally speaking, not nearly so expert and economical as the wheat-growers further inland. Until recently much of this fertile sea-board was indifferently

served by water transport facilities, and almost without railways; but each year the sea service is becoming more efficient, and the state railways are being actively advanced. Both New South Wales and Queensland are completing their coastal lines, the Victorian coast is well served, so is that of South Australia, while in Western Australia the government is also realizing that one square mile of the forest country on the coast when the stern and expensive pioneering is over, is worth more to the nation than two square miles of the less difficult country a hundred miles inland. The remnants of the coastal forest are rapidly falling; the dairy herds are multiplying; more thought is being given to cultivation, and as the value of immunity from drought is fully appreciated, the prices of the land near the sea are increasing faster than on any other portion of agricultural Australia.

Small holdings: example of coast-lands early settled.

Until about the close of the nineteenth century the Australian farmer had a fine scorn for the small holding. He liked to reckon in square miles. Anything below the 'half section' (320 acres) he looked upon as a plot fit only for the Chinese gardener. But in a few of the old coastal districts there were always some notable exceptions, men who made substantial incomes, and even reached independence by the proper use of little farms of 60 and 80 acres. In recent years the example thus set is having a widespread effect. All round the coast the tendency is to reduce the individual holding and to improve the practices. Men are learning that one well-fed cow or one well-tilled acre is more profitable than two which are neglected. But while acknowledging this, the expert Old World farmer, accustomed to making full use of a limited area, is still impressed with the general looseness and waste which distinguishes Australian agriculture. The standard of farming is what might be expected in a continent of 3,000,000 square miles, possessed by 4,700,000 people.

The mountains and tableland.

Proceeding inland, the roads across the mountain range run through narrow fertile valleys, where the farming conditions are not dissimilar to those on the coast. This

journey taken at almost any point round Australia reveals the wealth of the people in broad acres. Judged by the appearance of Europe, it is seen that the time will come when these low ranges will support millions of hardy thrifty farmers. But to-day, except in the valleys, they are practically unpeopled. The land seeker passes them carelessly in his pursuit of areas which are richer and easier to make fruitful. The roads wind upwards, and as the mountains are cleared the traveller is out on a tableland which, although so far as the farmer is concerned it is limited in width, has a length of some thousands of miles. On the coastal margin the annual rainfall would vary from 20 to 60 inches, with a much heavier fall in the tropics. On this tableland immediately behind the mountain range, the fall varies from 18 to 35 inches, and everywhere diminishes as one proceeds inland. The soil changes to a remarkable extent, but nearly everywhere it is of good quality, and given sufficient moisture is, in broad terms, all fit for farming pursuits. The timber is seldom heavy, and the light open eucalyptus forest, splashed with pine, and occasionally attended by a scanty undergrowth, has nearly all been dead for many years.

The wheat belt

It was out on this long tableland that the squatters made their early homes and built up the great merino industry. We have seen that the sheep and cattle owners destroyed the green timber, and so greatly assisted the farmers who were to follow. Every year, usually in the late summer, great station holdings are subdivided and sold to wheat-growers, and so little of the original forest remains that much of the land sold in January yields a crop of grain before the year has closed. The whole of this 'wheat belt', as it is termed, is well covered with natural grasses, which although thin and hard while the forest remains green, thicken and sweeten after the ring-barking, and continue to improve under live stock or cultivation. On the coast the native grasses are as a rule indifferent, and exotics, including English clovers and other varieties from cool climates, have been found successful;

while in the tropics and sub-tropics grasses from tropical lands abroad grow luxuriantly. The most notable introduction for the warmer parts of the coast has been the *Paspalum Dilletantum*, which grows to a height of several feet, and has become one of the chief food-stuffs of the increasing dairy herds. Inland from the coastal range, however, no alien grasses have been found as profitable as the native species. Indeed, if we except lucerne, or alfalfa, which is a favourite along some of the river valleys and with the irrigationists, it is unusual to find any growth other than those which the first settlers discovered, the only exception being on a few of the coolest and best-watered districts close to the mountains. As a rule, the native grasses are short and sweet, but they increase in size and coarseness as the tropical regions are approached. There are also over wide areas a wide assortment of herbage plants and many low-growing edible trees and shrubs, which have proved a priceless asset in seasons of prolonged drought.

Inland limit of wheat cultivation: rainfall.

This extended wheat belt runs irregularly through all the states of the mainland, from central and even northern Queensland, round the south up into the central coastal lands of Western Australia. It is sometimes as narrow as 50 miles, while it seldom exceeds 200 miles. Its inside boundary is invariably decided, not by the quality of the soil, but by the diminishing rainfall. A feature of the continent is that while the soil may vary in character, it is nearly everywhere of sufficient strength to favour cultivation provided there is enough moisture. This explains at once the wealth and the danger of the Australian inland. Over nearly the whole continent heavy rain is followed by a luxuriant crop of grasses. Sometimes a number of wet seasons will come in succession on areas which for years previously were deficient in moisture and almost bare of vegetation. The run of good years emboldens the grazier, and sometimes the farmer, to take unwise risks. Flocks are pushed out on to the dangerous zones, and in the seasons of plenty so heavy is the growth that the sheep make little mark upon it. Cultivation may

be rewarded by one excellent crop, sometimes two. Then comes the drought and disaster. The sown wheat lies dry in the dusty soil; the flock-master is hopelessly overstocked; man and beast are in sore trouble.

But this gambling takes place only on the land which lies beyond the legitimate wheat belt. Men who venture with their ploughs and with an excessive number of live stock beyond the irregular line which marks the 16 or 17 inch rainfall take their risk with their eyes open. They are tempted by land at nominal prices, graced by what appears to be a permanent run of bountiful seasons. Big fortunes are often snatched by those adventurers, but the wise Australian farmer attempts no cultivation beyond the recognized farming rainfall, and the wise grazier bases his numbers of sheep or cattle to be carried to the square mile on the country's capacity in the bad seasons. Still, the temptation is pressing, and most of the settlers on the doubtful country yield at times, and indulge in a gamble.

Scenery of the wheat belt.

On the wheat belt proper the country is in an ugly state of transition. The green forest has been destroyed, or is swiftly falling. The traveller passes over vast tracts of flat or gently undulating country. If the squatter has not been displaced, his wide paddocks usually make a dismal grey picture of standing dead timber, with here and there a solitary green tree which has escaped the axe of the ruthless 'ring-barker', or has grown up since the great massacre. Occasionally enough forest has been spared to make a little plantation; but only occasionally, for the pioneer looked rather to the profitable than to the picturesque. Green timber meant indifferent grasses. In Western Australia and in limited areas of Queensland, some of the wheat belt remains in its virgin state in the possession of the Crown. But generally it is either in the hands of the squatter or the farmer. Even where the farmer has driven off the squatter the scene is seldom one of rural beauty. Rural Australia lies in the intermediate stage. Nature has been outraged and made hideous, and the settlement of man is not yet old enough to be picturesque. Most of the farms are still crude and

naked. The early settler is careless of gardens and plantations. He is content when the timber is felled and burned. The clearing which will give him crops satisfies his eye. Not until his financial fight is over does he begin to think of either the beautiful or the comfortable.

Settlement and residential amenities.

For the next half-century the pioneer will be busy on some portions of this grand farming inheritance. But over much of it the hardest of the work is finished, and each season now sees the farming districts taking on the appearance and atmosphere of civilization. The earlier settlers are rebuilding their first rough homes; growing families, who knew not the sense of victory which the bare clearings always gave to the pioneer, are pleading for orchards and gardens and a service of running water from windmills and elevated tanks; avenues of trees are being planted from the home to the public road; plantations are being dotted over the bare paddocks; there is a widespread desire to make the farm something more than a mere maker of money. And the same spirit is manifest in the settlers collectively. In the hundreds of little townships which are springing into being, the shops and dwelling-houses, built of weather-board and iron-roofed, which, bare of garden or shelter, lined streets which were in summer deep in dust and in winter deep in mud, are being succeeded by something quite different. Excellent water services are working wonders. The bare streets are becoming shaded avenues of leaping eucalyptus and other trees; squares and parks are planted; the home of the individual becomes more substantial and takes shelter in its garden. As the farmers now vie with each other in improving the appearance of their holdings, so do the neighbouring towns. Over this wheat belt in all the states enough has been done to encourage the belief that rural Australia, inhabited by an ambitious race of men, will soon be far more pleasing to look upon than even the beautiful bushland which has been swept away.

Farming on the wheat belt.

The important crop on this area is wheat. In 1910 the Commonwealth had 12,000,000 acres under cultivated crops of all kinds, and of this wheat covered about

7,370,000 acres. All farmers on the wheat belt mix their farming freely. Stock-breeding is very simple in Australia. Animals are rarely housed in either summer or winter ; only on some of the high tableland districts do the dairy farmers go so far as to protect their cattle at night with rugs. Nor is hand-feeding general. The great sheep industry is dependent entirely on natural pastures, except in the occasional season of drought. The only animals which are hand-fed are those in constant work, and an increasing number of the dairy cows. The Australian grazier secures his land and buys his animals and leaves the rest to nature ; and if he resists the temptation to over-stock, he seldom has to worry about his flocks or herds. This fact makes the ardour of cultivation unpopular. The small holder of to-day, like the large holder of the past, still likes the idea of the wool growing while its owner sleeps. Those who have land enough to live by grazing almost invariably do so, regardless of the certainty that by cultivation their incomes would be doubled or trebled. And those who can live by cultivating part of their lands and grazing the balance, do so because such a practice is both congenial and economical.

Crops and live stock.

The farms on the wheat belt range in area from a few hundred to a few thousand acres. A man may live comfortably with his family on 320 acres or upwards, and the majority of the wheat-growers have from 320 to 640 acres. The farmer with 500 acres crops about 200 acres each year, about 150 of this being under wheat, and the balance perhaps under oats or barley. The bulk of the wheat and oat crop is allowed to ripen, but the growers are influenced in this by the cleanliness of the growing crop and the relative prices of grain and wheaten or oaten hay. Australia makes very little meadow hay, but depends upon the crops of wheat and oats cut a little green, and upon the increasing areas of lucerne or alfalfa. On the remaining 200 acres the farmer either runs from 200 to 300 sheep or engages in dairying. The farmer's flock is usually made up of merino ewes, crossed with rams of English mutton breeds. This gives a lamb which,

dropped in the early winter, reaches a weight suitable for export before the spring grasses have dried off. The cross-bred lamb grows faster than the pure merino, and if not killed young, it combines the large frame of the Lincoln or the Romney Marsh or the Shropshire with the improved fleece of the merino. It is a better wool sheep than the English breeds, and a better mutton sheep than the merino. In addition to wheat and sheep and perhaps a dairy herd the farmer may also engage in orcharding, and supplement his income by the growth of apples, pears, peaches, apricots, plums, or grapes for the table, wine, or raisins. Excepting the berries and tropical kinds, most fruits grow well at any point along the wheat belt. For a few pounds the settler may erect a windmill at one of the large excavated tanks from which he will probably obtain his water, and he is thus able to lay water on to his house and garden, and add much to the comfort of his wife and family and to the appearance of his homestead.

Farming methods.

Most of the wheat farmers follow a rough system of rotation, which they vary according to the strength of their soil and its freedom from black oats or other alien weeds. The usual practice is to follow one or more wheat crops with a season's bare fallow, or a crop of rape, although the growth of green forage crops as an adjunct to wheat-growing is still in its early stages. The sheep are useful for feeding off the fallow, if the latter is not kept in a state of cultivation, and also for checking the wheat crops if they promise to advance too vigorously. Artificial manures, usually superphosphates, are used extensively, and are applied with the seed at the drilling. After a term of cropping the land is allowed to return for a few years to grass. An interesting feature of all this country is the manner in which it re-seeds itself after years of cultivation. A paddock may have been for ten years under wheat and bare fallow, when the farmer will decide one summer to allow it to return to grass. If heavy rain falls in the late summer, a thick coat of grass will appear immediately, and three months later the

growth will be superior to that of ten years before. The explanation doubtless is that scattered blades of grass ripen each year with the wheat, and go to seed, and that other seeds are carried in by the wind.

Wheat yield.

The average yield of wheat per acre is barely 10 bushels. At first sight it is not easy to see how the farmers can grow so light a crop at a profit. And yet wheat-growing is the country's most remunerative rural industry. There are two explanations. The crop is very cheaply produced. The soil is generally friable, and ploughing is done with implements of many furrows, and the harvesting is probably the most economical in the world. In agriculture, as in all rural industries, labour-saving machinery is a feature. The inventive genius of the British colonist having no outlet in engineering or manufacturing found scope in machinery for shearing sheep, milking cows, and harvesting wheat. The 'combined harvester', driven round and round the standing wheat, gathers, threshes, winnows, and bags the grain as the horses travel. The straw, stripped of its heads, is usually burned to make way for the ploughs which re-enter immediately after harvest; although some farmers endeavour to roll it down and plough it in for manure. The Australian farmer is always conspicuous for his carelessness about conservation of fodder and for his blind faith in Providence. Ploughing begins as soon as possible after the harvest; as soon, indeed, as the teams are available after carting away the grain to the nearest railway station. The Australian wheat harvest comes early in the summer, and is usually over by the beginning of January. The loose soil which has been under crop will at once take the ploughs, and the farmer who turns it over without delay leaves it under the revivifying rays of the hot sun for three or four months before the next seeding. All the seeding takes place in the autumn, and so mild is the winter that the young crops grow steadily through the coldest months.

Transport of wheat crop.

The old-fashioned bags are still in general use. The American system of bulk handling has long been discussed

in Australia, but the wheat crop is scattered lightly over an area so large that it is doubtful if elevators would yet prove economical. All the wheat belt occupied by farmers is served in some degree with railways, and new lines are being vigorously extended. In some of the new districts wheat is hauled long distances, but probably 90 per cent. of the crop is raised within 16 miles of railway communication.

Conditions of land-tenure.

The man who begins on the land to-day does so under conditions far easier than those which prevailed in the days of the early pioneers. There is a wide choice of soils within the civilized zone. Some of the states, especially Queensland and Western Australia, possess vast territories of green forest, which can be purchased at prices ranging from a few shillings to about £1 10*s.* 0*d.* an acre, according to quality and distance from the railway, and payment may at the option of the buyer be extended over about 20 years. The governments of all the states also offer improved land which has been bought back in large blocks from the squatters and subdivided into what are known locally as 'living areas'. Of course the price for this is substantially higher than that charged for the unimproved country, but the terms of payment are even lighter. In Victoria, for example, the state offers irrigated blocks on a 31½ years' purchase, payment, which covers both capital and interest, being at the rate of 6 per cent. on the buying price. In addition the governments, through state savings banks and similar institutions, will advance money towards clearing the land, the building of houses, and other improvements. Money borrowed cheaply on the credit of the state is used for these purposes, so that the settler is not asked to pay high interest. Throughout Australia the government aims sincerely to encourage the farmer in every possible way. Cheap steamship berths are given to British agricultural emigrants, and both to the immigrant and to the local people with very little capital there are sound opportunities for acquiring enough land to make a good income. How successful this policy has been may be inferred from the

fact that it would be safe to say that quite 90 per cent. of Australian farmers, most of whom are prosperous freeholders, began either as British farm labourers or as the sons of farm labourers.

Agricultural labour.

The existence of such a wealth of agricultural land of good quality and the general shortage of labour makes landowners very generous in their treatment of the working man. Tenancy is rare. The Australian people have a strong preference for freehold, despite their socialistic tendencies in some other directions. Agricultural wages are high: a thrifty man will easily save £50 a year when engaged on an Australian farm. When he has saved £100 or a little more he multiplies his income by the purchase of a team of horses. Landowners are always ready to provide seed and good wheat country, ready for the plough and the teamster: the man does the cultivation and the harvesting, and shares the product equally with the landlord. After a few years at 'shares farming' the teamster has capital enough to take up country of his own. It is often justly complained that 'shares farming' is slipshod, and that the teamster usually leaves the soil weak and weedy. But with all its evils it serves to produce natural wealth and to give a start to many deserving men.

Dairying.

The dairying industry, as we have seen, has its proper home on the rich, well-watered land close to the coast. But it is engaged in by thousands of farmers on the wheat belt. On the coast the grass is green over most of the year, and with a little hand-feeding profits can be made fairly uniform. On the wheat belt, except on a few of the cooler and higher tablelands, the season of green grass is limited. If the autumn rains are good, there will be a good winter growth, but in the average season feed is not abundant until August or September. Between August and December there is a surfeit, and then the whole country-side ripens as a wheat-field, and the grass seeds fall. From December until late autumn the country, although it appears dry and increasingly bare, in reality gives in these grass seeds an excellent living to all classes

of lives tock. Animals will make condition upon it, but it is indifferent for the production of butter. Thus the dairying industry away from the coast is at its best only for a brief season late in the year, although as soon as the dairy farmers on the inland give proper attention to forage and fodder crops and the making of ensilage they will be assured of prolonged and more uniform profits.

Cattle breeds.

The quality of the dairy cattle is poor as compared with European standards, but each year it is steadily improved. When the cream separator and refrigerating machinery reached Australia, farmers entered with enthusiasm into an industry which promised them monthly returns and independence of their limited local markets. Before that time beef had been the main purpose of Australian cattle. The pure dairy herds were limited. All breeds of beef cattle were hurried into the bails, and the average butter return was necessarily low. But the Australian farmer has a keen fancy and a true eye for form in live stock. The care he had always given to merino sheep and thoroughbred horses he extended to his milking cows. There has been an increasing importation of pure sires from the United Kingdom, especially of the Milking Shorthorn and the Ayrshire breeds, while the Jersey and the Guernsey have also had many advocates. Some of the state governments, notably that of New South Wales, also imported freely, and placed the pure-bred stocks at the disposal of the farmers. The result has been a rapid levelling up in the quality of the Australian dairy herd. Between 1900 and 1911 the dairy cows of the country increased from about 1,000,000 to 2,000,000, and in the same period there was a heavy culling of inferior animals in favour of heifers of better breeding. It may be confidently predicted that before many years Australia will be as famous for its dairy cattle as it is now for its merino sheep and its army horses. The country people are instinctively fanciers of aristocratic stock.

Export of dairy produce.

Like the rest of the rural industries of importance, dairying has been built up on the export market. Australian butter is sent from the port of shipment to London

for a halfpenny per lb., and Tooley Street prices allow a handsome profit to the dairy farmers of the Antipodes. An interesting point about the Australian butter industry is that it is carried on under all sorts of climatic conditions. The old belief that a cold or temperate climate was essential to the production of the best butter has been completely demolished by the introduction of cold storage. One of the most notable districts in the Commonwealth is located in the north-east corner of New South Wales, just below the Queensland border, where the conditions are sub-tropical. In no part of the continent is superior butter made.

Supervision of dairying.

Dairying is carried on under close government supervision. This begins with the inspection of the herds, to guard against butter being made from the product of diseased cattle, and the officials have the power to order the destruction of affected animals. Next, all the milking must be done in sheds having concrete floors, and milk and cream, if retained for even a few hours on the farm, must be placed in an isolated and properly ventilated building. Then the government places at the disposal of the butter factories highly trained experts, who frequently spend some weeks assisting a factory manager to improve the quality of his output. Finally, all butter intended for export is subject to compulsory inspection and grading, and every packet of butter sent abroad is stamped plainly with the grader's award. This system at once discovers inefficient butter-makers, and its effect has been to improve and make uniform the whole of the country's dairy product.

Co-operation.

As a rule Australian farmers are not disposed towards co-operation. But the dairying industry is a bright exception. The Commonwealth contained in 1910 about 550 factories, and of these the great majority were owned by the farmers on the co-operative basis. Nearly every farmer owns a cream separator: the milk is separated immediately after milking, and the cream is delivered to the butter factory by the farmer himself, or is called for by the factory's collecting wagons. In a decreasing number of districts the milk is delivered to creameries.

Labour.

In recent years dairying has been checked by the shortage of labour. The young Australian has a keener interest in horses than in cattle, and prefers station and general farm work to the milking shed. This has led to the free use of the milking machine and also to much dairying on the 'shares' principle. The machine, which is an Australian invention, satisfies the most exacting owners of pure-bred herds, and has unquestionably come to stay. Each machine milks two cows simultaneously, the milk being taken by a combination of suction and pressure from the four teats at the same time. One man attends to the milking of four cows, and the cattle show their indifference to the process by feeding complacently as they are milked. The 'shares' principle gives good incomes and opportunities to working men with families. The landowner finds and keeps the cows: the family does the work, and the profits are divided.

Pigs and cheese.

Naturally dairying is accompanied by pig-raising. The Commonwealth possesses upwards of 1,000,000 swine. Nearly all British breeds are well represented, with the Berkshire in a heavy majority. Cheese is also made on a growing scale, both at proprietary and co-operative factories. In 1910 the output reached 16,500,000 lb. But although the quality is good the cheese is not yet fashionable even with the Australians themselves, and imports of British and a number of foreign brands are still considerable. The Australians as a whole, however, are not heavy cheese eaters, a fact probably due to the climate and the cheapness and good quality of the beef and mutton.

Fruit-growing.

Beginnings in orcharding have been made in every part of Australia where farming is practised, and in all the states an increasing number of people live by fruit-growing alone. Practically every known fruit finds a congenial home somewhere in the continent, and the fruit industry appears likely to become one of the first sources of rural income. Until cold storage made export possible, the orchard-grower, like the dairyman and the raiser of beef and mutton, was closely restricted. Down to the

nineties a good season meant excessive production, local markets over-supplied, and prices unprofitably low. But during the first decade of the new century a remarkable change has been worked. A big and remunerative export trade has been developed, especially in apples, while pears and even grapes have been sent fresh to London, and have made the long voyage successfully. After suffering for a century because of its isolation from the markets of the world, Australia is now finding that isolation of immense money value. The fruit of the Commonwealth, all grown under natural conditions in the open air, ripens from December to February or March. Exported to Great Britain and the Continent, and also to North America, it reaches the markets of the northern hemisphere in the early spring, when they are empty of fresh naturally-grown northern produce, and in consequence sells at prices well above those obtained by any northern orchard-grower for similar produce. In a less degree Australian butter and fresh meat share the same advantage. To the Australian fruit-grower this means that, provided the proper varieties are raised, every pound of his product is assured of ready sale on a basis which gives good returns to men who enjoy cheap lands and, thanks to the climate, cheap production. This explains the rapid extension of orchards. The total area under fruit advanced from 147,000 acres in 1901 to 185,000 acres in 1910.

Cold storage and canning.

The aim of the orchard-growers now is to produce fruit which will stand the long voyage across the equator to the northern world; and so rapid has been the progress in cold storage appliances that there appears much justification for the Australian belief that very soon not only grapes but even peaches and apricots and all the more delicate fruits will travel in a fresh condition to Europe and the rest of the northern hemisphere. Another important factor in this industry is the quick development of fruit-drying and canning, which ensure the profitable use of fruits which are not suitable for the export trade.

Wine. The grape is extensively cultivated, the total area under vineyards in 1910 being about 60,000 acres. Wine is made in New South Wales, Victoria, South Australia, and Western Australia, and here again it would be difficult to place limits on the possibilities of expansion. For some years, however, the area planted has shown no increase, which is due in part to the indifference of the great majority of the local people to wine as a drink, and in part to the fact that the wealthier classes consider it more fashionable to drink the imported article than to place the local product on their tables. Nevertheless, some excellent wines are produced, notably the lighter kinds, while an export trade worth about £120,000 annually has been built up with Great Britain, chiefly in full-bodied red Burgundies, which are extensively drunk in the mother country. Large areas of Australia are so similar in soil and climate to the most famous wine-growing districts of Europe, that the production of wines of the highest qualities would appear to be only a matter of time.

Irrigation. Irrigated agriculture in Australia has an assured future of the greatest importance. The rivers of the country are insignificant when compared with some of the water systems of other continents, but properly handled they are ample to provide for the irrigation of immense tracts of the rich inland soils. Streams, some permanent, some intermittent, but all, taking the wet seasons with the dry, passing down huge volumes of water, traverse great valley plains which have an ideal disposition for the artificial application of water. The governments of all the mainland states are engaged on schemes to impound and conserve the flood waters, and to lead them out to the soil during the dry seasons. The inland plains which are capable of irrigation are fertile and friable. Their gentle undulations make irrigation an easy task for the engineer. They lie close to the sea-level, and so are favoured with warm sunshine over nearly the whole of the year. Therefore, if moisture can be provided, they have a very long growing season—the most important factor in economic irrigation.

PLATE XI. YANCO EXPERIMENTAL FARM, N.S.W. FLOODING LUCERNE CROP

(High Commissioner for Australia)

PLATE XII. AN UPPER TRIBUTARY OF THE MURRAY RIVER
(High Commissioner for Australia)

Given an assured supply of water, the irrigation-farmer cannot have too much sunshine. Already large areas are served with water, and the farmers grow from six to eight crops of lucerne (alfalfa) in a year, which is a fair indication of the possibilities of this class of agriculture.

The Murray basin: Victoria.

So far irrigation works have been almost solely confined to the waters of the wide Murray River system,[1] which extends over southern Queensland, western New South Wales, northern Victoria, and the south-east corner of South Australia. Victoria led the way about 1886 with extensive state works on the Goulburn River, while at the same time small pumping schemes were started by private enterprise at Mildura in the same state and at Renmark in South Australia. For some years irrigation made poor progress, owing in part to the hostility of the farmers, who were ignorant of its possibilities and conscious only of its cost, and in part to the absence of export facilities for fruit. The government made the mistake of providing the water and leaving the rest to the land-holders, nearly all of whom were satisfied with what they could produce on their large holdings without the assistance of irrigation. During the opening years of the new century, however, the Victorian government, feeling the burden of expensive works which had done nothing to increase the number of the settlers on the irrigated lands, and earned little or none of the interest charged on the outlay, reconsidered the position. Mr. Elwood Mead, a distinguished American engineer, and chief of the Irrigation Branch of the United States Department of Agriculture, was induced to go to Victoria and take control of the works. In a few years, Mr. Mead, assisted by the improved export market for fresh produce, worked a complete change in the outlook. Acting on his advice, the government made it obligatory upon all land-holders whose land was irrigable to pay for the water whether they used it or not. This had an immediate effect. Farmers either engaged in

[1] See R. T. McKay, *The Murray River, Irrigation and Navigation*, Sydney, 1903.

irrigation, or they sold to men who would do so ; and the government took the opportunity to purchase large areas for subdivision and re-sale in small blocks to local irrigation farmers and to settlers from Great Britain and America. In 1909, Mr. Mead, accompanied by Mr. Hugh McKenzie, Victorian Minister for Lands, made a tour of southern Europe, the United Kingdom, and North America, to advertise these irrigated lands in Victoria. Large additional sums were spent on extending the old works and in establishing new ones. Down to 1910 Victoria had expended nearly £3,000,000 on irrigation ; 143,000 acres were irrigated in that year, and a much larger area was irrigable. Further schemes are contemplated.

New South Wales, &c.

At about the time of the Victorian revival, the government of New South Wales began to construct the famous dam on the Murrumbidgee River at Burrinjuck, which, measured by the water it impounds, is second only in magnitude to the Nile Dam at Aswan. It is 240 feet in height by 784 feet across, and impounds 33,630,000,000 cubic feet of water. It is situated in a rough hilly locality close to the site of the federal capital, Canberra. The water stored is not diverted at the dam, but its regulated flow follows the bed of the stream for about 200 miles, when it is withdrawn by gravitation to irrigate a wide sweep of the highly fertile plains of the lower Riverina. The full irrigating capacity of the dam is upwards of 1,000,000 acres.

A large portion of this area has been purchased by the government from its old pastoral holders, and is offered to settlers in small farms. No freehold is granted. The settlers receive the land on 99 years' lease, subject to conditions. Interest at the outset is based on $2\frac{1}{2}$ per cent. on the capital value, which is about £20 an acre, and the value is to be assessed at intervals of 20 years. The settlement scheme was instituted by Mr. McGowen's Labour Government in 1912, and in view of the strong dislike of the Australian rural holder to leasehold, it will be observed with keen interest by all the Australian states. South Australia is also engaged upon bold

irrigation schemes, and in Western Australia and Queensland the subject is under serious consideration.

Farming on irrigated lands.

Australian irrigation is marked by the length of the growing season and the wide choice of industries. The Victorian farmers, on holdings of about 60 acres, generally place from 20 to 30 acres under assorted fruit trees and vines, about 20 under lucerne, and carry on dairying on the balance. As in America, irrigated lands in Australia promise soon to become the most profitable and pleasing section of the rural districts. The strong soil and sunshine and the abundant river water quickly change the bare new blocks to gardens of luxuriant growth and brilliant flower; the homes, served with water and surrounded with gardens, are as comfortable as those in the suburbs of a large city, and income is as well assured as it is possible for a farmer's income to be. The existence of wide tracts of pastoral country which can never be irrigated, but will always be heavily stocked, connotes an assured demand at good prices for all the fodder the irrigation farmers will raise, while the fruit and dairy produce has a ready sale overseas.

The tropical region.

Consideration of the great region which lies north of the Tropic of Capricorn is concerned rather with natural resources and with possibilities than with agricultural industries which have been actually established. In northern Queensland, the Northern Territory, and the northern portion of Western Australia are great areas of deep rich soils, favoured by heavy regular rainfall and strong sunshine. It may be safely predicted that at some future date this part of Australia will be more densely populated than any portion further south.

White labour in the tropics.

It is a bold endeavour to develop the tropical region with white labour. When first the decision to do so was announced to the world it was received with incredulity and hostility. Within a very short time, however, the strong reasons which prompted it have led to the project being regarded with sympathy in almost every country outside Asia. The Australian's objection to the Asiatic worker is racial, moral, and industrial. The country has

had enough experience of Eastern races, and particularly of the Chinese, to know that every industry in which they are employed becomes impossible for the white labourer, and that despite all restrictions there is sufficient intercourse between the white and coloured peoples to create grave concern about the future population of an area upon which the Asiatic worker was present in large numbers. To employ coloured labour in the plantations of the north connoted handing that area over to a numerous population of Asiatics, controlled by a few white owners and overseers.

Sugar plantations.

It is yet too early to speak with confidence of the employment of white labourers under tropical conditions. Australia has established, however, that, given some support at the outset, sugar plantations can be carried on north of the Tropic of Capricorn with white workers. Since the Kanakas were deported from the canefields, the area under cultivation has shown a slight increase. It is true that a generous bounty has been paid to 'white-grown' sugar, but the protection of this industry is not greater than the protection given in the national interest to other young industries in the temperate zone. One important fact has been established: British workers are willing to work in the tropical plantations. The claim of the Australian is that the white is a more successful and profitable employee under any conditions than the black. For many years, however, the venture will be in an experimental stage, and it may be that the splendid ideal of a British 'white' continent may have to be abandoned. In the meanwhile it is pursued with enthusiasm, and financial sacrifice is cheerfully made for its sake.

Tropical products and settlement.

Apart from the sugar plantations, the tropical industries are insignificant, but many useful experiments have been made, and it is clearly established that the region is well suited for practically all the economic plant life of other tropical lands. Happily the tableland which in the southern areas succeeds the coastal range is also to be found in the north. The great bulk of Australia's tropical lands lie at a sufficient height above sea-level to

give them a tolerable climate, and to make possible the carrying on of industries suited to lands in cooler latitude. Dairying is already followed with success within the tropics, and the manufacture of butter is certain to play a large part in the development and peopling of the north. The Commonwealth government is vigorously proceeding with the initial steps towards the colonization of the Northern Territory. Experiment farms for agriculture and live-stock raising are being established, and an active railway policy has been decided upon.

Agricultural education.

The land settlers of all description receive generous encouragement and assistance from the state. In addition to making land available at low prices and upon easy terms, and to advancing money for the purchase of live stock, plant, and improvements, the state governments pay close attention to agricultural education. Each state of the mainland has a special Department of Agriculture and staff of experts in all branches of crop-raising and live stock. Agricultural colleges and experimental farms have been established, and some of these are engaged in farming on an extended scale. In 1911 these institutions had almost 9,000 acres under crop, and owned upwards of 60,000 head of live stock. In addition to the education given at the colleges and farms, the experts travel extensively and deliver lectures in the settled districts. The state also imports pure-bred live stock for use by the farmers and distributes large quantities of seed for experimental purposes. The Commonwealth is taking similar action in the Northern Territory.

Manufacturing Industries and Trade

Australia gives great promise as a manufacturer. The local population, measured by numbers, provides only a limited market, but the Australian is individually a much heavier buyer and consumer than the European. This is shown by the relatively high value of the country's trade and by the fact that the Commonwealth stands third in order of the export markets of Great Britain.

Then the population, although small to-day, is assured of rapid increase, as appears from the immigration figures between 1908 and 1912.

Raw materials: tariffs.

Australia is exceptionally rich in raw material of many descriptions. With the proper use of her natural resources only beginning, exports of all kinds in 1912 reached a value of about £78,834,000, and were made up almost entirely of raw material, while in the same year imports, comprised mainly of manufactured goods, were worth £78,835,000. The import of manufactures must continue on a large scale, as in all other countries, but it is becoming recognized in the Commonwealth that it is anomalous to send huge quantities of raw material half-way round the world and to receive a great deal of it back as manufactured goods. For some years exports have been carefully considered against imports, and, substantially assisted by a strong protective tariff, many young manufacturing firms have successfully attempted to convert more of the raw material into the finished article without the assistance of the factories of Great Britain and other parts of the world. The capital invested in local manufactures increased from £46,824,000 in 1906 to £64,000,000 in 1911, the number of factories from 11,575 to 14,455, and the employees from 228,000 to 311,000. This makes it fairly clear that the manufacturing industries are at least sufficiently prosperous to encourage those who have invested in them to increase their capital.

Early manufacturing.

Manufacturing began in a small way even before the discovery of gold. Before 1852, however, the establishments were small, and chiefly engaged in the preparation of food-stuffs. The 'rush' to the goldfields denuded the factories of nearly all their male workers, and for a few years no progress was possible. But just as many of those who failed to find fortune in the quest of gold turned to agriculture, many more who had been drawn from the manufacturing centres of Great Britain turned instinctively to the life of the young cities. The manufacturer had now at his door a much wider market, and his labour troubles were for the time solved. By 1861 some 4,500

hands were employed in manufacturing, nearly all of them in Victoria.

Protection.

The colonies which engaged in manufacture, with the exception of New South Wales, adopted a strong policy of protection, and after the establishment of federation, the New South Wales free traders were voted down in the Commonwealth parliament, and a substantial tariff wall was built round Australia as a whole. At the same time, inter-state free trade was declared. By 1910 the factory employees numbered 287,000, of whom roughly about 200,000 were divided equally between New South Wales and Victoria. In the first decade of the new century the employees were increased by about 10,000 a year, while the capital added by the owners made an annual gain of over £1,000,000.

The Commonwealth tariff applies to about 60 per cent. of the merchandise imported. On all the dutiable goods the average is 30·2 per cent., and on all goods 'dutiable and free' 17·27 per cent. The average charge per head of the population in 1910 was £2 5*s*. 6*d*., against £1 14*s*. 5*d*. in Canada, £2 19*s*. 6*d*. in New Zealand, and 14*s*. 7*d*. in the United States. It is recognized that much can be done by the partial manufacture of goods of which the raw material is not yet produced in the country, and to encourage this the tariff discriminates between finished goods and piece goods imported in the bulk. By amendments carried in 1906, preference is given to goods manufactured in Great Britain. In granting this, however, the Australian parliament made it clear that while the British manufacturer obtained an advantage over the foreigner, the Australian manufacturer should be amply protected against both. Nevertheless, the preference given is considerable. In 1910 Australia imported British manufactured goods to the value of £29,641,000, and the preference operated on 63 per cent. of these, or upon £18,674,000, and the actual advantage to the United Kingdom was £1,070,000.

Range of manufactures.

Manufactures extend over a wide field. In 1911 the output of the local factories had a total value of £133,000,000,

of which £80,000,000 represented raw material, and the balance the value added in the process of manufacture. In the value of the output the factories of New South Wales are first with 41 per cent., then comes Victoria with 30 per cent., Queensland 13 per cent., South Australia 9 per cent., Western Australia 4 per cent., and Tasmania $2\frac{1}{2}$ per cent. From the tables in the statistical appendixes it is possible to obtain a rough indication of the possibilities of Australian manufactures, although it will be obvious that the fact of the export of raw material and the imports of goods manufactured from that material does not necessarily indicate an immediate opportunity for economic local manufacturing.

Australia is well supplied with coal and other motive power, and is especially rich in deposits of iron ore. So far the attempts made to establish iron works have not been remarkably successful, although valuable pioneering has been done at Lithgow in New South Wales. The Broken Hill Proprietary, Limited, one of the most famous Australian mining companies, decided in 1912 to enter on a large scale into the iron industry, a site for works was obtained from the New South Wales government at Newcastle, and steps were taken to raise the necessary capital. Particular importance is attached in Australia to the establishment of successful iron works. Public sentiment strongly favours the local manufacture of all the iron and steel used on the government railways, in the construction of future ships for the Australian navy, in the equipment of the army, and in other directions. Another great future field for manufactured goods is in wool. In 1910 there were 25 woollen mill factories in the country, employing some 3,000 men, and the value of the wool they treated reached only £347,000, while the value of the wool exported was £28,770,000.

Labour conditions.

A strong effort is being made to build up the manufacturing industry on a basis which will ensure good living conditions to all the workers engaged in it. In giving protection to the local industries, the Commonwealth parliament has made it clear that every assisted

industry must pay a fair living wage, and observe statutory hours of labour. Broadly speaking, it may be said that Australia has decided that it is preferable to be without a manufacturing industry that cannot afford to pay a living wage; and by a living wage is meant a wage which enables the worker and his family to live in reasonable comfort, with a fair chance of advancement. Some of the factories have been hampered by a shortage of skilled labour, but this is being overcome by the growth of immigration. The good labour conditions naturally affect the cost of production, and this raises the question as to whether Australian manufacturers can look, for a long time at least, for a market overseas. So far the exports of manufactured articles, other than butter and wine and flour, and of partially treated metals, have been restricted almost solely to a small amount of agricultural machinery. America is pointed to as a country which pays high wages in its factories, and has a large and expanding export trade. But the Australian manufacturers are far from the point at which the local population will enable them to produce on the American scale. With their limited markets, their cost of production will probably continue higher than those of the outside world for some years to come, except perhaps in some special directions.

Bounties.

In addition to the tariff, the Federal government has given bounties with the object of encouraging the production of raw material, for which Australia appears adapted, but which has not yet been profitably produced. These bounties aim particularly at the encouragement of settlement in the tropical areas of the north, and are offered upon flax, hemp, jute, cotton seed, linseed, rice, coffee, tobacco, and some dried fruits. Iron manufacture is encouraged in the same way, and so too is the manufacture of wool tops, the production of shale oil, and the growth of sugar by white labour.

Commerce.

Between 1788 and 1826 the total oversea trade of Australia grew to a little more than £500,000; between 1826 and 1851 it advanced to about £5,500,000; in 1852 it reached £15,500,000; in 1853 £29,000,000, and

1854 £36,000,000. The sudden increase, due to the gold discoveries, was well maintained for the next ten years, since when there has been, with occasional brief seasons of depression, a steady advance, and in 1911 the exports and imports exceeded a total value of £146,000,000. This gives an average value per inhabitant of £32 12*s.* 0*d.* which is the highest since the happy gold-digging days, and relatively very high against other countries.

Perhaps the best feature of recent trade developments is the excess of the value of the exports over the imports. In 1911 the exports reached £79,000,000 against imports valued at £70,000,000. Here in brief is the feature of the great industrial prosperity of Australia during the new century. The country has had previous prosperous periods, but some at least of these were distinctly traceable to the expenditure of borrowed money, and to unjustifiable speculation. The present prosperity is due almost solely to production, and is all the more remarkable in view of the large amount of industrial pioneering which is taking place. There have in that period been a large number of ventures which have absorbed much labour and capital without having been developed sufficiently to pay dividends. The Commonwealth statistician sums the position up in the following terms : 'The excess of imports in the earlier years represents the introduction of capital in the form of government loans and for investment in private undertakings, and the excess of exports in the later years represents mainly the interest and profit on the earlier investments, repayments of loans to foreign bond-holders, and also freight on trade which is carried mainly by ships to the Commonwealth and other countries.'

Foreign and British trading.

Trade with some foreign countries has made marked progress during the period under notice, especially with Belgium, France, and Germany, while an advance has also been made in dealing with the United States.

Figures show that if the trade with the United Kingdom has not been maintained relatively, it has made

great actual progress. Doubtless it has been much assisted by the preferential customs treatment.

The development of Australian trade with the East has been distinctly disappointing. The chief increase with continental countries has been due to the larger direct exports of wool and imports of manufactured goods. Until recent years the bulk of Australian wool was sold in London, and afterwards distributed from there to foreign countries. During the opening years of this century the representatives of French, Belgian, and German traders have been present in Australia in greatly increased numbers, and have displayed activities which have been freely contrasted with the somewhat self-satisfied methods of the representatives of British houses. The results, however, indicate that there is very little wrong so far as the Australian market is concerned with either British goods or British selling methods. It was scarcely to be expected that the extraordinary monopoly which the United Kingdom had of Australian trade would be retained; and that the value of the intercourse between the two countries has been almost doubled within a decade must be regarded as an extraordinary tribute to the sentimental and commercial bonds which unite the two countries.

CHAPTER VI

MINING AND ECONOMIC GEOLOGY[1]

By Griffith Taylor

Western Australia

	Total to 1911.	*Produced in* 1911.	*Chief fields and some of the mines.*
	£	£	
Gold . .	103,850,487	5,823,075	*East Coolgardie.* Great Boulder, Ivanhoe, Kalgoorlie G. M., Associated North Block. *Ora Banda.* Victorious. *Murchison.* Great Fingal. *E. Murchison.* Black Range. *Mt. Margaret.* Sons of Gwalia.
Copper			*Ravensthorpe.*
Ore . .	522,049	33,709	*Mt. Malcolm.* (Murrin Murrin.)
Matte .	530,476	44,409	*W. Pilbarra.* (Whim Well.)
Coal . .	933,578	111,154	Collie Coal-field.
Tin . . .	980,577	55,220	Greenbushes, Moolyella.
Lead . .	381,191	15,000	Northampton.
Silver . .	267,495	18,333	

History of mining.

The mining industry, curiously enough, seems to have developed later in Western Australia than in most of the other states. Copper ore was found in 1842, coal in 1846, and lead in 1848, but none of these finds led to anything. In 1869 a reward of £5,000 was offered by the government for a payable goldfield, but it was not till 1886 that the Kimberley goldfield was proclaimed. Meanwhile rich copper had been discovered near Roeburne in 1872, and some gold had been washed on the Ord River in 1882.

After 1886 mining progressed remarkably. Each year saw a new goldfield proclaimed. In 1887 the Yilgarn fields were discovered; in 1888 Pilbarra, in 1890 Ash-

[1] The chief authorities for this account are the reports of the various geological surveys of the Australian States. The writer is greatly indebted to Messrs. Gibb Maitland (W.A.), W. Twelvetrees (Tas.), W. S. Dun (N.S.W.), and especially to D. J. Mahony (Vic.) and L. K. Ward (S.A.), for personal help. Various memoirs have been consulted, especially Pittman's *Mineral Resources of N.S.W.*, Süssmilch's *Geology of N.S.W.*, Mawson on *Broken Hill*, and others acknowledged in the text.

burton, in 1891 Murchison, in 1892 Coolgardie, in 1893 Kalgoorlie, and in 1894 Kanowna. In 1889 a 'rush' set in to the Pilbarra fields. In 1891 many nuggets were found at Nannine on the Murchison. But 1892 and 1893 were marked by the phenomenal returns from Coolgardie and Kalgoorlie. The former was discovered by Bayley and Ford, and the latter by Flannigan and Hannan. In 1893 shaft-sinking was begun on a large scale; previously the gold was won largely by washing or 'dry-blowing'. In 1897 a nugget weighing 463 oz. was found at Lake Way, and two years later one of similar value near Pilbarra. In 1898 tin was first worked on a large scale at Moolyella (Pilbarra), and in 1899 the Phillips River field and the Anaconda mine were producing large quantities of copper. About this time the Collie coal-field started working on a much enlarged scale.

In 1902 the Coolgardie water-supply scheme was completed. Since this date the chief events in mining history have been the steady expansion of the gold mines all through the auriferous belts of the state.

Geology.

The chief formation represented in Western Australia consists of a series of granites and of schistose and gneissic rocks whose age is almost certainly pre-Cambrian. They occur chiefly in the southern half of the state. In the north, in the Kimberley division they seem to underlie fossiliferous beds of lower Cambrian age. The chief goldfields are associated with these very ancient eruptive and metamorphic rocks. The schists and allied rocks which constitute the auriferous belts of the state occur as broad bands or patches in the granite. These bands have a well-defined parallel arrangement trending usually in a north-west and south-east direction. The outcrops of these more or less parallel elongated strips are due to the folding of the strata which originated during the 'efforts of the earth to adjust itself to the contraction resulting from the gradual cooling of the interior'. We see the same trendlines developed in Eastern Australia also.

In addition to the gneissic rocks of an acid type there

are numerous basic rocks. These comprise gabbros, dolerites, amphibolites, and transition rocks conveniently

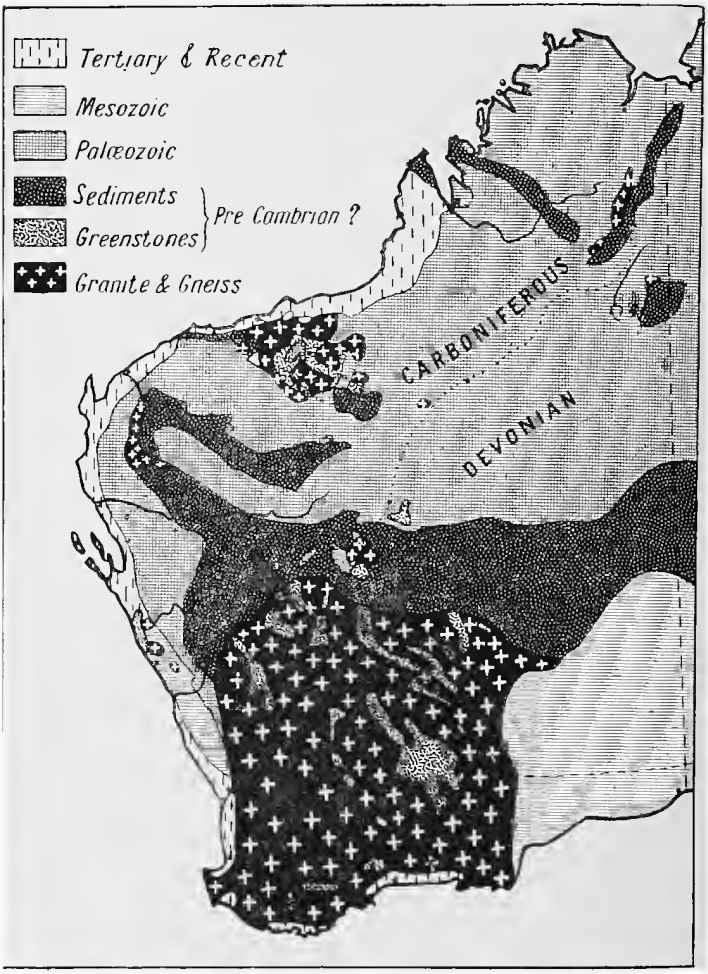


Fig. 42. Geology of Western Australia.

labelled 'greenstone schists'. The tin deposits of the state occur in the older granitic rocks of the series. The gold reefs are often associated with pegmatitic dykes, and with junctions of the granite with the basic rocks mentioned above.

The Cambrian series is developed chiefly in the north of the state, especially in the Kimberley region. Silurian

Fig. 43. Mining Centres, &c., in Western Australia.

rocks are inconspicuous in Western Australia, though, curiously enough, they form the dominant terrane in the auriferous regions of Eastern Australia. Large areas in the northern arid region appear to belong to the later Palaeozoic sediments, but very little is yet known of their

stratigraphy. Permo-Carboniferous strata occur in four or five localities. They are of no economic importance except the Collie coal-field in the south. Cretaceous strata are of interest since in Australia they usually contain artesian water. Bores through the Eocene limestone plateau to the north-west of Eucla have passed through Cretaceous shales from which a supply of water has been derived. Unfortunately hitherto the water has usually been brackish. The Tertiary strata are of no importance, except that the large surface deposits of laterite and the sand drifts of the interior practically prevent the prospecting of many favourable regions.

Gold. The chief goldfield in the state is undoubtedly that surrounding the town of *Kalgoorlie*. *Coolgardie* is now of little value. These wonderfully rich ore deposits have been subjected to close examination and their genesis may be described as follows. The original rocks consisted of sedimentary strata which were deposited on a granitic and gneissic floor. Lava flows were associated with these strata which were possibly of pre-Cambrian age. By earth movements these were tilted into their present highly inclined positions, and were subsequently intruded by large masses of basic and ultrabasic rocks. The latter have also been invaded by a series of acidic rocks. Slight further earth movement has then taken place, causing considerable shearing and faulting of the rocks, the shearing resulting in the formation of the lines along which the auriferous lodes of the field occur.

The class of deposit is that known as a ' lode deposit '. This is a more or less vertical zone of rock usually continuous with the surrounding rock, but distinct from it in carrying metallic ores disseminated through it in payable quantities—and as a rule characterized by strong foliation. The lode occurs in (1) quartz diabase, (2) calc-schists, (3) acid amphibolites. The Great Boulder, Horseshoe, and Ivanhoe are worked on the quartzose and less carbonated portions of the first type.

The quartz diabase has been subjected to shearing and also to general chemical alteration. As a result the rock (' green-

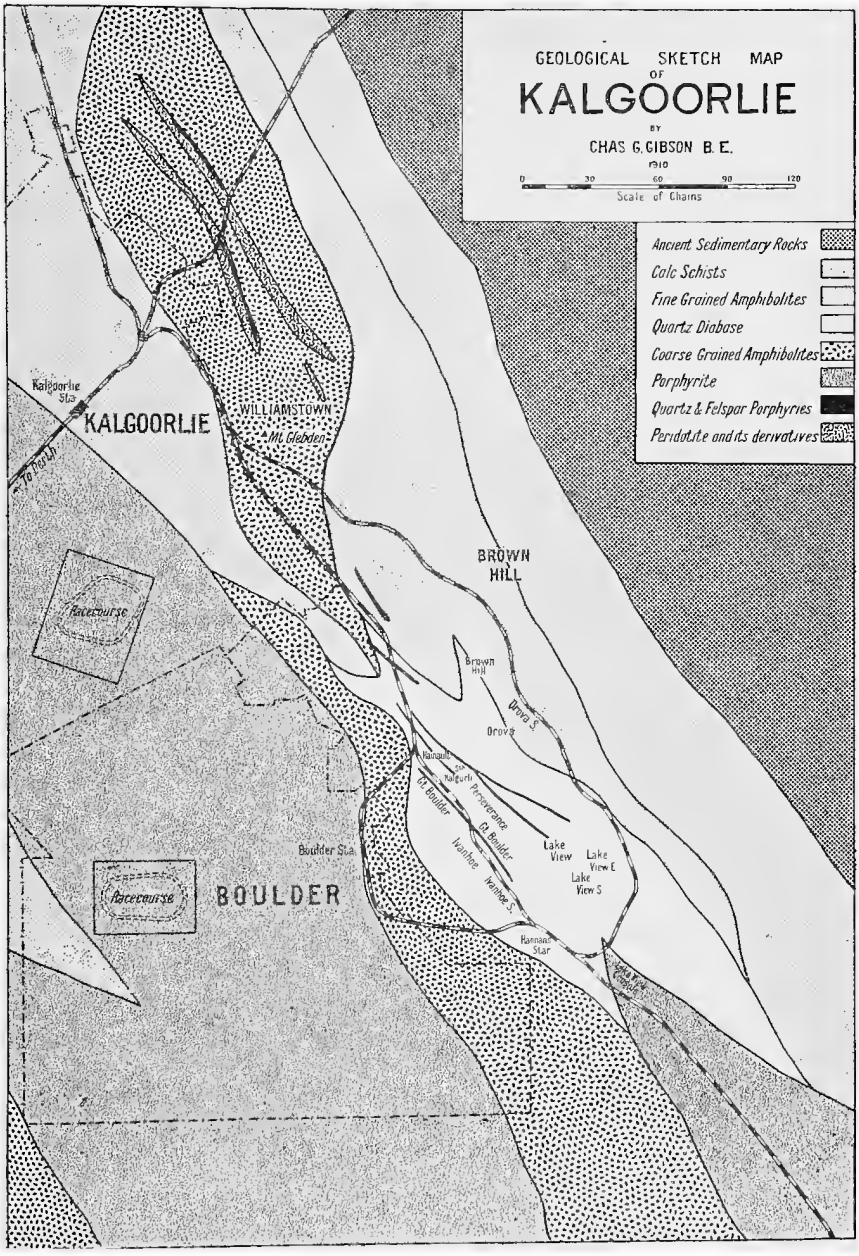

GEOLOGICAL SKETCH MAP
OF
KALGOORLIE
BY
CHAS G. GIBSON B. E.
1910
0 30 60 90 120
Scale of Chains
Ancient Sedimentary Rocks
Calc Schists
Fine Grained Amphibolites
Quartz Diabase
Coarse Grained Amphibolites
Porphyrite
Quartz & Felspar Porphyries
Peridotite and its derivatives
Kalgoorlie Sta
KALGOORLIE
WILLIAMSTOWN
Mt. Gleboden
To Perth
Racecourse
BROWN HILL
Brown Hill
Drove S
Drove
Hannans
Kalgurli
Perseverance
Mt. Boulder
D. Boulder
Boulder Sta
Racecourse
BOULDER
Ivanhoe
Ivanhoe S.
Lake View
Lake View E
Lake View S
Hannans Star

FIG. 44.

stone') has been converted into an indefinite mixture of lime, iron, and magnesian carbonates (chlorite, &c.) with some residual silicates and quartz. In this series the rocks where the alteration is greatest are the most highly auriferous.

The less altered gabbros of the western end are practically non-auriferous, whereas the highly altered chloritic diabases are extremely rich. The lodes in the calc-schists are usually of poorer value, and the same holds true for the coarse-grained amphibolites. Small rich veins, however, are characteristic of the latter formation.

The lode channels themselves are very persistent both in strike and depth, and have frequently been known to continue without a break through several leases. The principal lode minerals, in addition to the gold and tellurides (calaverite, petzite, sylvanite, hessite, coloradoite), are iron pyrites, marcasite, chalcopyrite; carbonates of iron, lime, and magnesia, together with chlorite.

The chief mines along the 'Golden Mile' at Kalgoorlie (running approximately from north to south) are as follows: Oroya-Brownhill, Associated Northern, Kalgoorlie, Hainault, South Kalgoorlie, Great Boulder, Great Boulder Perseverance, Ivanhoe, Lake View Consols, Golden Horseshoe, Associated and Hannan's Star.

In 1910 a world-wide sensation was caused by the discovery of the *Bullfinch field*. The geology of this region is typical of the west and indicates how and where new auriferous areas are to be expected, so that a short account of this new field is of interest.

The old theories regarding the great longitudinal extent of the individual auriferous belts have been found to be erroneous. Near the Southern Cross the only important 'greenstone' belt extends north-west for 70 miles. This constitutes the Yilgarn hills, which are clothed with Morell gum and salt-bush. The Southern Cross belt is crossed at an acute angle by a series of granite dykes having a north-west course which seem to have exercised considerable influence upon the concentration of the gold. The hornblende schists ('greenstones') form the country rock containing the gold-bearing lodes.

Two types of auriferous lodes occur :

(*a*) Quartz reefs in the form of lenses. These have a definite ore-channel, but below water-level there is a tendency for the ore-lodes to become pyritic.

(*b*) ' Jasper bars,' which stand out as long ridges. They are traversed by jasper and opal veins. The dislocations leading to these veins seem to have formed channels for the auriferous solutions, since the gold occurs chiefly near these siliceous veins.

Both the pyrites and quartz appear to be secondary minerals developed in the altered schists ; while the gold has evidently been deposited from circulating ground waters, perhaps by the sulphate of iron formed by the decomposing pyrites.

The Black Range Gold Mines are situated about 150 miles east of Lawlers. Sandstone is the town site for this group of mines. The country is flat, with a few low ridges and numerous hills capped by laterite. The geology here in some respects resembles that of Bullfinch. The auriferous belt consists of hornblendic rocks (' greenstones ') of a massive character, though near the granite areas these are foliated. The greenstones are cut by granite dykes and by hematite-quartz lodes, locally known as ' jasper bars '. These bars are merely highly altered bands of schistose greenstone and are auriferous, though not in payable quantity. They probably mark thrust planes. All the deposits worked are quartz reefs which run north and south, and dip at a very flat angle to the west. They strike approximately at right angles to the ' bars ' or ' hematite lodes ', and appear to be due to induced fissures caused by the main thrust-planes. From 1903 to 1907 the Black Range Gold Mines had produced 46,734 ounces of gold, while the neighbouring Oroya Black Range accounted for 21,088 ounces.

Copper.

The principal sources of copper have been the districts of Phillips River (70,871 tons), Mount Malcolm (47,857 tons), and West Pilbarra (41,889 tons).

An interesting mining field lies 150 miles east of Albany. The *Ravensthorpe,* or Phillips River field, is some 40 miles

inland from the port of Hopetoun, with which it is connected by rail. It is an important gold producer, in addition to being perhaps the chief source of copper. The geology of the field is highly complex, and consists of: (1) Basic schists. (2) Granites with intersecting dykes of 'greenstone' (diabase, &c.). In the schistose portion of this series many of the copper 'dykes' are situated, whilst others lie at the contact with the greenstones. (3) Greenstone series from which the above dykes originated. (4) Overlying these are the Kundip sandstones of unknown age.

All the mining has been confined to the fracture zone. The lodes of the fields strike east-north-east, and are of two types. The first are basic cupriferous dykes, consisting of bands of greenstone, quartz, and chalcopyrite; and the second, siliceous and ferruginous deposits which apparently fill leaching channels along the rock joints. A peculiar feature is that the sulphides occur far above the ground water level. Many mines have been worked for gold, though this will probably give place to copper at a lower level.

The chief mines are Mount Cattlin, Maori Queen, Floater, and Elverdton.

The *Mount Malcolm* copper mines are about 120 miles north of Coolgardie. The mineral belt is of the usual type, consisting of greenstones with quartz, jasper, and ironstone veins. The oxidized zone (rich in carbonates) extends downwards to the ground water level about 100 feet below. Here the ore changes into black sulphides, with iron pyrites.

The West Pilbarra copper is chiefly derived from the *Whim Well* copper mine. It has proved to be the largest and richest ore-body yet discovered in Western Australia in the oxidized zone. The country rock in which the deposit is situated is a weathered talcose schist. The ore occurs in a very flat-lying lode conforming to the bedding of the enclosing schists. The outlook in this region, however, is not very promising.

Tin. There are only two districts of any importance, namely, Greenbushes and Pilbarra. By far the greater proportion has been won as 'stream tin'.

Greenbushes lies in the south-west corner of the state. The alluvial deposits may be divided into two main groups: the ancient river courses or 'deep leads', and the newer existing channels. The former often attain depths approaching 100 feet. In many of the tin-bearing districts the granites are traversed by numerous pegmatite dykes, consisting chiefly of quartz and albite, with subordinate mica, garnet, and cassiterite. Just to the south of Greenbushes there are several mines working on lodes ('stock works') in the granite. The course of the ancient (buried) river deposits has been mapped, and it is found that where the lead follows the strike of the pegmatite vein (with which the lodes are associated), then they are much richer. This is the case with the 'Greenbushes lead' in the south of the field.

The *Moolyella* (Pilbarra) field lies 100 miles south of Condon. It was discovered in 1898, and in the next two years yielded £14,334 worth of tin. The stream tin is derived from pegmatite veins as at Greenbushes, and the alluvial in Moolyella Creek has been worked for a distance of about 2½ miles. Very little work has been carried out on the lode tin occurring in the granite.

Coal.

The only coal-field of economic importance occurs at Collie in the south-west corner of the state. The area occupied by the Collie River coal measures is approximately 50 square miles. The beds consist of alternations of shales, sandstones, and grits of Permo-Carboniferous age, which rest directly upon granites, &c. The boundary is generally defined by faults, one on the south-west having a downthrow of 2,000 feet.

The seams in descending order are:

	Feet.	*Tons.*
Cardiff, No. 1	9–12	18,175,104
Cardiff, No. 2	7	17,547,840
Collieburn, No. 1	9	46,433,088
Collieburn, No. 2	6	38,996,640
Seam	8	50,683,968
Proprietary, No. 1	4–8	138,843,936
Proprietary, No. 2	5–7	
Wallsend	9–17	
		310,680,576

The coals are hydrous, semi-bituminous, non-coking coals, which approach very closely to lignites in some parts. The average calorific value appears to be 10,000 British thermal units. There are approximately 137 feet of coal in the 2,072 feet so far explored by mining and boring.

The coal production of the state up to the end of 1911, which is entirely that of the Collie coal-field, amounted to 2,028,057 tons, valued at £933,578.

Iron. Owing to their position, and to the absence of coal in the vicinity, the iron deposits are absolutely undeveloped. All iron ore needed for fluxes is obtained from adjacent lateritic deposits of no value as sources of the metal itself. The most important deposit occurs in the Murchison district in the Wild Ranges at Wilgi Mia. It is 40 miles from the Cue Railway. The deposit consists of highly inclined beds or lenses of almost pure hematite or of mixtures of hematite and quartz, and is due to the chemical alteration of highly foliated and crushed belts of greenstone. It is calculated that there are about 26,000,000 tons of ore suitable for smelting at this locality. Other deposits occur at Mount Hale, Mount Taylor, Mount Mathews in the same region, and at Koolan Island on the north coast.

South Australia

	Output, 1912. *Quantity.*	*Value.*	*Chief Mines.*	*Men employed.*
		£		
Gold . .	6,592 oz.	28,000	Tarcoola (Toolulpa, Woodside, Echunga, Barossa)	920
Copper . .	125,000 cwt.	461,500	Wallaroo, Moonta, Yelta, Balhannah, Blinman, Yudnamutana (Kapunda, Burra)	4,500
Silver .	2,700 oz.	326	Edinora (Glen Osmond)	
Crude salt .	64,300 tons	40,187	Lake Fowler Lake Hart	500
Ironstone flux	42,200 tons	26,375	Iron Knob, Cutana, Donnellys, Mount Jagged	
Phosphate rock	6,100 tons	6,100	Flinders Range	

History of mining.

Probably the first mine worked in Australia was that at Glen Osmond (silver) near Adelaide in 1841. Next year copper was discovered at Kapunda, and in 1845 the equally famous mine of Burra was first worked. In 1846 an auriferous reef was found at Montacute, but gold was not an important product until the Echunga mines were developed. In 1871 no less than £300,000 had been won from the latter, and Barossa about the same time produced gold worth £180,000. The principal mines of the state, Wallaroo and Moonta, were discovered in 1860–1, and these continue to produce copper in large amounts. In 1877–8 the low price of copper led to the closing of Burra and Kapunda, after metal worth £5,000,000 had been won.

In 1886 a goldfield which yielded £300,000 was discovered at Teetulpa. In 1900 a similar field at Tarcoola showed that portions of the far western country were auriferous. It is remarkable, however, that no large goldfields resembling those of the other states have been discovered, for the geological conditions are not unlike.

Iron ore was exported from Iron Knob in 1907, but the freights appear to be prohibitive.

In 1911 the government purchased the Yelta Copper Mine. The most interesting feature of late, however, has been the development of the phosphate rock.

Geology.

The broader geological features of South Australia are fairly simple. The Mount Lofty and Flinders Ranges consist of a diversified series of folded Cambrian sediments which enclose inliers of still older rocks. The Gawler Ranges also consist chiefly of pre-Cambrian (Archaean) rocks, which probably continue right through to West Australia. There is then a tremendous break in the succession, though some glacial deposits of Permo-Carboniferous age are of great scientific interest. In Jurassic times the coal measures of Leigh's Creek were deposited. But the next large period of sedimentation occurred in the Cretaceous period. The great artesian basin of this age occupies the north-east of the state and also underlies the south-west corner. Tertiary beds cap

the latter in the Nullarbor Plains. Eyre's Peninsula is largely Tertiary, and deposits of the same age occupy the lower valley of the Murray.

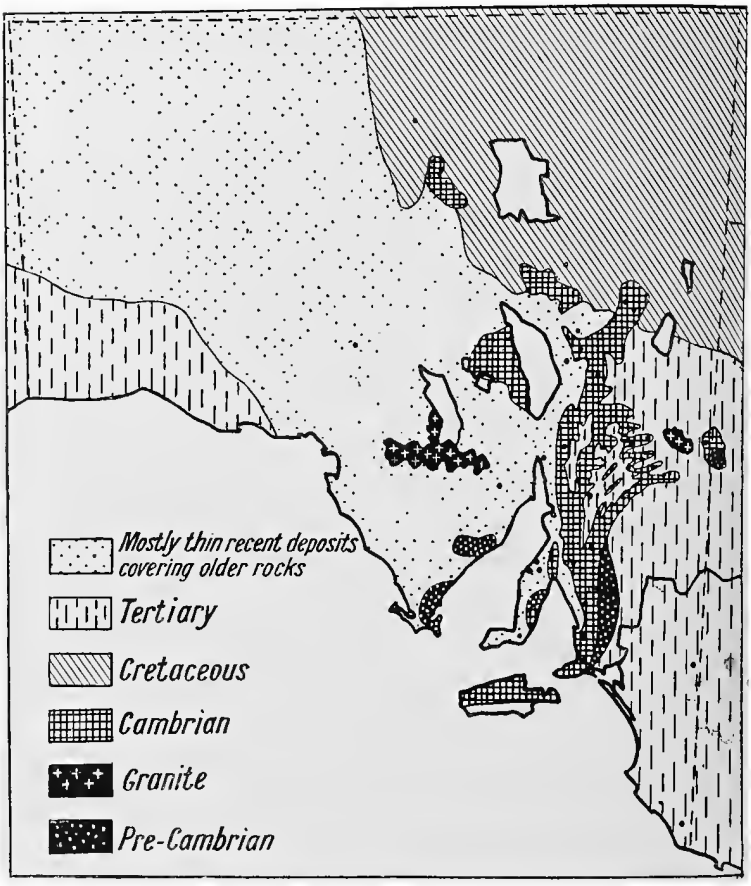


Fig. 45. Geology of South Australia.

Copper. The chief copper mines are Wallaroo and Moonta. Other less important are situated at Blinman, Yudanamutana, Beltana, &c. Burra and Kapunda have been extremely valuable but are now of little account.

The *Wallaroo* mine is situated at the north end of Yorke's Peninsula, Moonta being about 10 miles distant. The mine was discovered in 1860 and has been working

for over 40 years. The country rock is schistose, and there are five lodes on the property which strike south-east. The lodes vary in width from a few inches to

Fig. 46. Mining Centres in South Australia.

12 feet, and the cupriferous material is chiefly chalcopyrite. The ore contains from 3 to 10 % of copper, with occasionally small quantities of richer copper ore.

During the period 1860–1904 no less than 1,540,180 tons of dressed ore were raised, with an average content of 15½ % copper. This represents 235,630 tons of copper. In 1907 over 6,000 tons of copper, worth nearly £600,000, were won.

The *Moonta* mine was amalgamated with the Wallaroo mine in 1890. The general conditions are much the same in both mines. The bulk of the veinstone, chiefly quartz or country rock (porphyry), gives 2 to 5 % of copper. Sometimes clean chalcopyrite gives 20 to 30 % copper and bornite 30 to 50 %. The dressed ore from this mine averages higher than that from Wallaroo, containing about 19 % copper. Both properties are connected by a government railway with Port Wallaroo, where the company's smelting works are situated.

Coal. The coal measures occupy several small basins in the Cambrian rocks of the Flinders Range, covering an area of about 16 by 6 square miles. The measures consist of blue clay, shale, and ironstone bands. The beds dip towards the centre of the basin, which appears to be 2,000 feet below the surface. There are several coal seams in these measures, one of which, at 300 feet, was worked for some time at *Leigh's Creek*. Unfortunately, the coal tends to disintegrate on exposure. An analysis gave :

Volatile hydro-carbons	26·9 %
Fixed carbon	41·4 %
Ash	14·2 %
Water at 212°	17·5 %

It is possible that this coal may be used if briquetted.

Iron. There are two localities of importance, one being at *Cutana* close to Broken Hill, and the other at Iron Knob to the west of Port Augusta. The former consists chiefly of limonite, the beds being 10 to 20 feet thick. There are said to be nearly 2,000,000 tons of 50 % ore.

Iron Knob is 41 miles west-south-west of Port Augusta. There are two large deposits here totalling approximately 20,000,000 tons of ore. The ore is chiefly hematite, and is at present carried 33 miles by rail to the coast, and then shipped for use by the Broken Hill smelters at Port Pirie.

Uranium, &c. There are two localities where considerable quantities of radium products have been found. These are Mount Painter in the north-east and Olary near Broken Hill.

At *Mount Painter* the rocks consist of gneiss or granite, intruded by numerous pegmatite dykes. Torbernite and autunite (both hydrous phosphates of uranium) occur in 'vughs' associated with quartz and hematite.

At Radium Hill, *Olary*, the mineral found is carnotite, which encrusts ilmenite, mica, and quartz. The lode-stuff traverses gneissic granite into which dykes of granite and diorite have penetrated.

Phosphate deposits occur at intervals throughout the Cambrian sedimentary rocks, as shown in Fig. 45 (p. 228). They are apparently bedded deposits interstratified with shales and sandstones. Bands and nodules of phosphate also occur in the clays resulting from such rocks. It has been suggested that the phosphate is due to the phosphatic animalculae of Cambrian times, whose remains charged certain shales, just as lime-secreting organisms have led to limestone strata. Phosphate rock.

Many of the Cambrian limestones contain from 1 to 4 % of phosphate of lime. The 'rock' is quarried in shallow pits and open cuts, and the boulders and nodules obtained give from 50 to 70 % of tricalcic phosphate.

About 500,000 tons of crude salt were scraped during 1903–1912. The chief supplies are the salt lakes of southern Yorke's Peninsula, of which *Lake Fowler* is the largest. *Lake Hart*, about 60 square miles in area, contains immense supplies of salt of good quality. It is situated on the transcontinental railway, 120 miles north-west from Port Augusta, and will undoubtedly be a large producer in the near future. Salt.

Victoria

	Output in 1911.	*Total to* 1911.	*Mines.*
	£	£	
Gold . .	2,140,855	289,663,989	Ballarat, Bendigo, Ararat, Chiltern, Maryboro', Walhalla, &c.
Silver . .	2,135	211,975	
Coal . .	298,829	2,177,562	Outtrim, Wonthaggi.
Copper ore .	2,088	215,761	Walhalla.
Tin ore . .	3,417	777,947	Tallandoon.
Antimony .	8,928	224,712	

Geology. As in New South Wales the main Divide and its accessory ranges constitute a great central area of lower Palaeozoic rocks of Ordovician, Silurian, and Devonian age. These are intruded by large masses of granite and dyke rocks, and are flanked by deposits of later Palaeozoic age.

The chief Mesozoic areas are found in the two southern

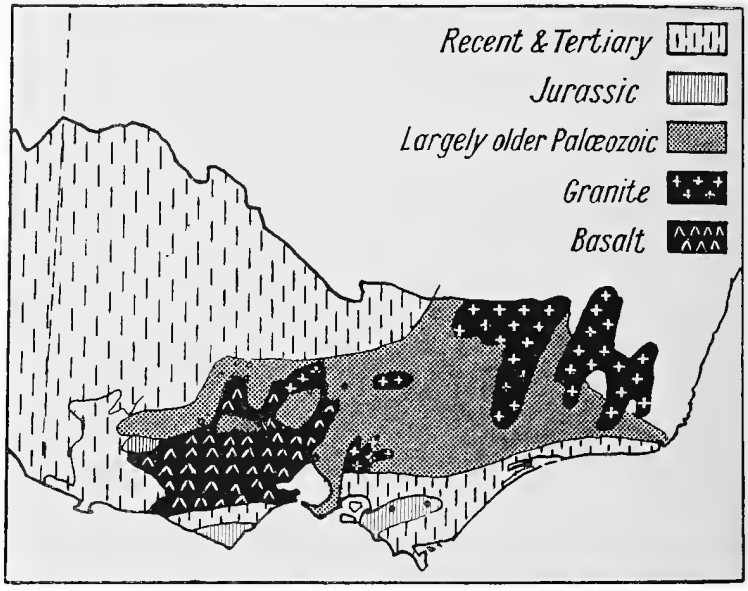


Fig. 47. Geology of Victoria.

projections of Victoria, namely the Western Port area and the Cape Otway Ranges.

Low-lying or undulating tracts of Tertiary and post-Tertiary country extend south of the Murray, from Wahgunyah westward to the Glenelg River. Another large area is found around the Gippsland Lakes.

The most striking feature, however, is presented by the newer volcanic series of Tertiary basalt. The chief area of this rock fills the 'Great Victorian Valley' west of Melbourne between the Divide and the Cape Otway Ranges. Older basalts are distributed in smaller

areas, as near Western Port and on the 'Dargo High Plains'.

The first payable discovery of gold was made in 1851, and within a year or two of that date the principal goldfields were located and rapidly developed. The alluvial deposits proved fabulously rich in many instances and easy to work, for the gold was practically lying on the

Gold.[1]

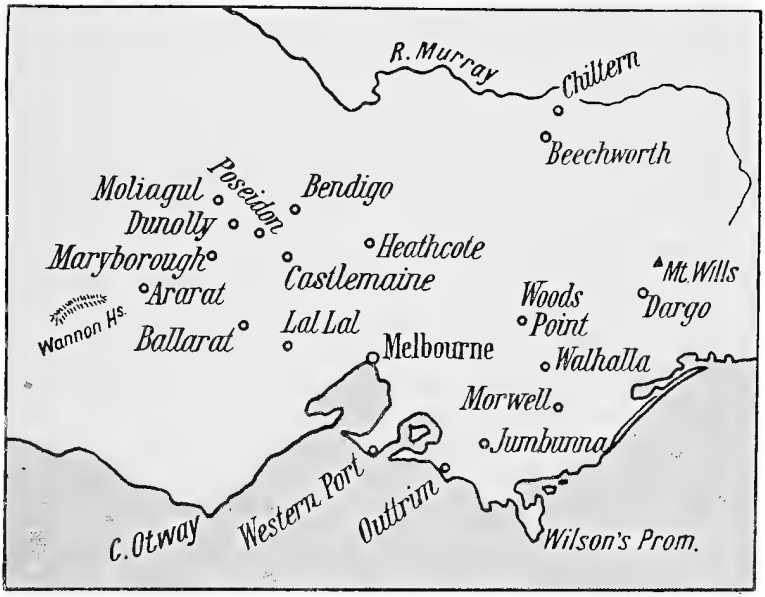


Fig. 48. Mining Centres in Victoria.

surface, often in the form of large masses or nuggets. The largest of these, known as the Welcome Stranger, was covered by only one inch of soil; it weighed nearly 3 cwt., contained 2,380 oz. of gold, and was sold by its discoverers for £9,563 to the London Chartered Bank at Dunolly. Nuggets containing from 20 oz. to 2,380 oz. of gold have been recorded to the number of over 1,320. Between 1851 and 1860 the value of the recorded gold yield amounted to the enormous sum of £94,000,000, and

[1] The following paragraphs on Victorian minerals have been communicated by Mr. D. J. Mahony, *Geological Survey of Victoria.*

it is a well-known fact that a large quantity sent away privately is not included in this record. This period marks the beginning of Victorian prosperity, for the population increased from 77,000 to 540,000, and many of the successful diggers settled down to pastoral and other occupations.

As time went on the rich shallow alluvial was gradually exhausted and attention was turned to other forms of mining, such as working the deeper alluvial ('Deep Leads') and auriferous quartz reefs. This necessitated the use of machinery and the possession of capital, with the result that the bulk of the industry passed from the 'digger' into the hands of companies which employed labour. New finds of rich shallow alluvial, however, are still made from time to time, as at Mount William (1900), Nick-o'-Time (1903), Waanyarra (1903), and the Poseidon Rush (1906). These produced many nuggets ranging up to about 900 oz. as well as finer gold. At Poseidon a deep lead is now worked.

The total value of the gold produced to the end of 1912 was about £292,000,000, a sum amounting to considerably more than one-third of the British National Debt. To this total the goldfields of Bendigo (16 square miles) and Ballarat (14 square miles) have each contributed some £70,000,000. The present annual output is valued at about £2,100,000.

Gold recovery may be classified under three headings: quartz mining, alluvial mining (deep leads and dredging), and cyaniding. Of these quartz mining, with an annual production of about £1,250,000, is the most important. The auriferous quartz lodes or reefs occur in slates and sandstones of Ordovician or Silurian age and have been followed to great depths (4,600 feet at Bendigo). Only certain portions of the reefs are payably auriferous.

The deep leads are old river beds (? Pleiocene) containing auriferous gravels buried below lava flows or accumulations of alluvium ranging up to 300 or 400 feet thick. In mining the course of the ancient stream is traced by systematic boring, and then it is usually necessary to

install large pumping plants before the auriferous gravels can be dealt with. The principal systems of deep leads are found in the Ararat and Chiltern districts and along the Loddon and Avoca valleys, especially near Ballarat and Maryborough. The annual yield is about £361,000.

Dredging is carried on in the valleys of streams, principally in the north-eastern district. The dredge is generally a pontoon carrying machinery by which the alluvium is scooped up by buckets attached to a moving belt, separated from its gold content by washing in a sluice box, and redeposited in the rear of the dredge. Deposits up to about 40 feet thick are treated in this way. The name dredge may give a false impression to those unacquainted with this form of gold recovery, for instead of floating in the river the dredge usually cuts its way through river flats, and since it fills in the excavation behind it, it may be entirely surrounded by dry land, with only sufficient water around it for floating room. Such mechanical perfection has been attained that 1 grain of gold (value 2*d.*) per cubic yard of alluvium will, under favourable circumstances, pay all working expenses; one dredge, for instance, during 12 months' operations treated 601,000 cubic yards for 1,600 oz. of gold (1·3 grains per cubic yard) and paid dividends amounting to £600. Hydraulic sluicing (the plants in most cases being erected on pontoons that are periodically floated to new sites as work advances) is also applied to some alluvial deposits. The annual yield is about £326,000 worth of gold.

The introduction of the cyanide process has afforded an economic means of treating material (tailings, &c.) which was formerly discarded as worthless. The present value per annum of the gold recovered by this method is about £240,000.

The following brief notes will indicate how auriferous quartz occurs in some of the principal goldfields.

Bendigo. In this field the slates and fine-grained sandstones of Lower Ordovician age have been bent into a series of arches and troughs running nearly north and south, which may be compared to a number of sheets of

corrugated iron piled one on the top of another, but the folds in the rock are more pronounced, and the distance between the tops of adjacent arches is about one hundred yards. If the apex of any of the arches be traced for some distance it is found to undulate, so that at certain

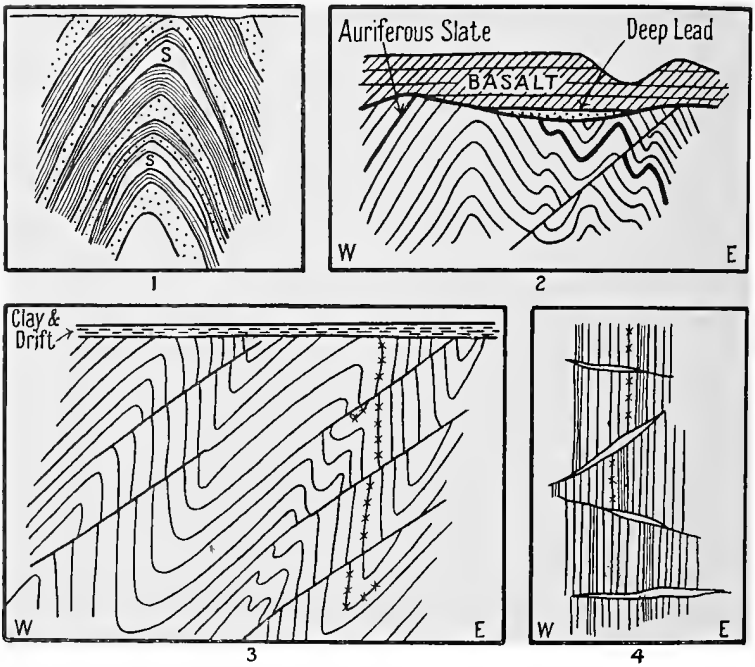


Fig. 49. Sections of Victorian Gold-mines. (1) Bendigo; s=saddle reefs. (2) Ballarat West, showing deep lead below basalt and dark slate along which quartz occurs, auriferous only where bed dips west. (3) Ballarat East, showing leather jackets and associated quartz up to 40 ft. thick, auriferous only where bed dips east. Indicator shown by crossed lines. (4) Ballarat East. Indicator veins shown by crossed lines.

points the shape of the beds resembles that of the inverted bowl of a spoon or an elongated dome. Quartz reefs are found along the arches and parallel to the beds, and are known as saddle reefs on account of their shape: twenty or more of these reefs may be found one below another in the same mine. They may occur anywhere along the axes of the folds, but have been generally

richest when associated with a certain zone of strata near the elongated domes described above. It is interesting to note that the most favourable beds are distinguishable by their fossil contents.

Saddle reefs are also typically developed at Lauriston and Castlemaine.

Ballarat. The structure of this field has lately been elucidated by the detailed geological survey carried out by Mr. W. Baragwanath. The strata consist of slates and sandstones probably of Lower Ordovician age, which have been thrown into a series of sharp folds, but not so regularly as those at Bendigo. At Ballarat West the payable auriferous quartz is developed along certain dark-coloured slates on the west side of the anticlines, but similar occurrences on the east side appear to be unpayable. At Ballarat East the gold-bearing quartz appears to occur in beds dipping east and not in those dipping west. Most of the gold won in Ballarat East comes from reefs associated with faults (' leather jackets ') which dip at about 45° westward ; these bodies of quartz range up to 40 feet or more in thickness and have yielded immense quantities of ore. The ' indicators ' for which Ballarat East is famous are certain narrow dark-coloured strata at the intersection of which with quartz spurs exceedingly rich patches of gold are found in quartz which is unpayable elsewhere. The amount of gold won from this type of deposit is small in comparison with that derived from the leather-jacket reefs, but the remarkable richness of the patches has given the indicators an undue importance in popular estimation. Another type of reef is found in vertical faults ; these reefs are themselves unpayable, but the veins and spurs crossing them are generally good.

Indicators are found northward of Ballarat at Maryborough, Dunolly, Tarnagulla, Moliagul, Rheola, and other places.

Maryborough. Many of the auriferous reefs in this goldfield are closely associated with nearly vertical lamprophyre dykes. The veins, which are generally lenticular, occur between the igneous rock and the

surrounding sedimentary strata (Lower Ordovician), either on one or on both sides of the dyke.

Wood's Point. At the Morning Star dyke, which is the most remarkable feature in this field, the gold occurs in quartz veins which traverse the dyke from side to side.

Limited space precludes even short notes on Walhalla, where one ore chute in Cohen's Reef, a fissure lode associated with a dyke in the famous Long Tunnel mine, produced gold valued at about £4,000,000; or of Cassilis (refractory ores) and other goldfields, each of which has its characteristic features.

Other metals.

Cassiterite, the common ore of tin, occurs near Tallandoon, Mount Wills, Beechworth, the Upper Latrobe, and Mount Franklyn River. The production has never been very large, but the newly opened Tallandoon lodes are very promising. Copper occurs as a sulphide in several localities in Gippsland. One of the most interesting is situated near Walhalla: the ore is found in a dyke rock rich in hornblende which also carries a small quantity of platinum and palladium. Antimony and wolfram are also produced.

Coal.

The coal measures yielding black coal are of Jurassic age, and occur in South Gippsland, in the Cape Otway district, and in the western part of the state near Coleraine, but mining operations are carried on only in the first-named district, principally at Outtrim, Jumbunna, and Wonthaggi, where the State Coal Mine is situated. The present output is about 700,000 tons per annum.

Brown coal of Tertiary age occurs in enormous quantities in the Latrobe and Morwell Valleys and the Alberton district (South Gippsland), Lal Lal, Laverton, and elsewhere. One bore near Morwell pierced seams aggregating 780 feet thick in a total depth of 1,000 feet. A conservative estimate lately made by the Director of the Geological Survey and based on the known area and thickness proved by boring, gives the probable quantity as 30,000,000,000 tons. Up to the present very little work has been done on these deposits, but they are a source of vast potential wealth to the state.

Diatomaceous earth of very superior quality is mined near Lillicur in the Dunolly district and is known to occur in several other localities. The output is about 400 tons per annum. Magnesite is mined near Heathcote and gypsum in the Mallee, where it forms surface deposits of great extent. Basalt, sandstones, marble, and limestone are quarried for building purposes, and large quantities of clay and shale are converted into bricks. Other non-metallic minerals.

New South Wales

Mineral, &c.	*Total during* 1911.	*Chief Mines.*	*Their Output,* 1911
	£		£
Coal . .	3,167,165	Northern District (Newcastle, &c.)	2,320,673
		Southern District (Bulli, &c.)	636,163
		Western District (Lithgow, &c.)	210,328
Silver-lead .	2,652,548	Broken Hill	1,502,931
		Kangiara	32,656
		Yerranderie	105,600
Zinc	1,414,980	Broken Hill	1,289,634
Gold . .	769,353	Cobar	153,550
		Canbelego	111,264
		Hillgrove	38,119
		Araluen	35,015
		Wellington	33,254
		Adelong	32,459
		Peak Hill	21,659
		Braidwood	20,086
Copper . .	590,102	Cobar	370,109
		Kyloe	66,483
		Cangai	33,288
		Dandaloo	13,520
Tin . . .	307,089	Tingha	143,684
		Emmaville	94,784
		Wilson's Downfall	24,304
		Ardlethan	
Iron . .	145,406		
Opal . .	57,300	White Cliffs	
Shale . .	36,980	Murrurundi	
		Hartley	
		Wolgan	

Coal was discovered in 1797 both at Coal Cliff in the south, and near Newcastle, and has been worked practically ever since that early date. Although gold was recorded in 1823 by McBrien, and in 1841 by Clarke, yet copper was the first metal to be mined in New South History of mining.

Wales. This was at Molong in 1845. Soon afterward the iron deposit at Mittagong was worked, and iron was smelted in 1848. But the mining industry really dates from 1851, when Hargraves discovered payable gold at Summer Hill. In the same year Kerr obtained a nugget weighing 106 lb. in the vicinity of Bathurst. The Uralla leads were exploited in 1856, the Forbes deep leads in

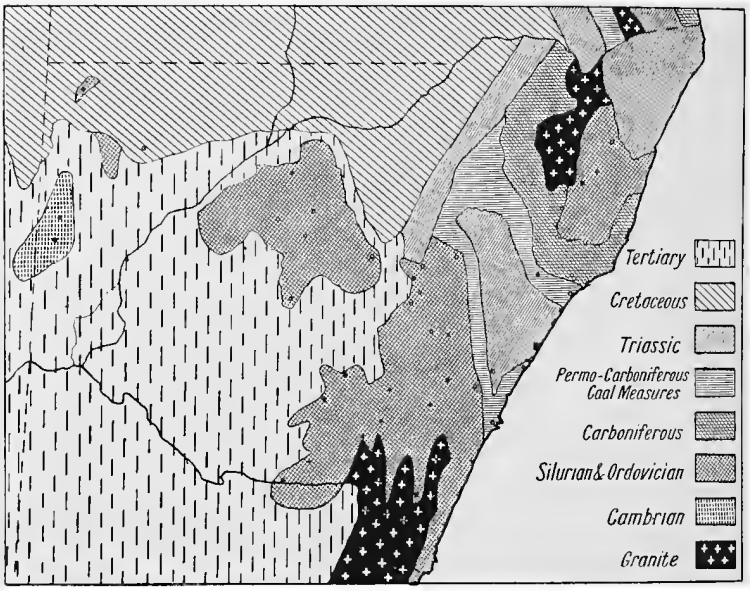


Fig. 50. Geology of New South Wales.

1862, and about the same time 20,000 people were working the alluvial at Young. Cobar copper dates from 1870, though the Great Cobar Company was not formed till 1876. In 1872 tin was first profitably mined at Inverell. Mention must be made of Holterman's nugget—the largest mass of gold on record—which was found in 1872 at Hill End, and weighed 630 lb. Iron on a large scale was smelted at Lithgow in 1875. In the far west of the state silver was discovered at Thackaringa in 1876, and seven years later Broken Hill was pegged out, the big

company starting in 1885. About 1880 the question of coal under Sydney was raised, and various bores were put down, at Helensburgh (1884) and Sydney (1891), to test its presence. In 1893 the important goldfield of Wyalong was discovered, while 1899 marks the first use of gold dredges on the Macquarie. The rise of the Canbelego (Mount Boppy) goldfield in 1902, of the silver mine of

Fig. 51. Mining Centres in New South Wales

Yerranderie in 1908, and finally of Ardlethan tin in 1913, are among the most interesting events in the later mining history.

General geology.

New South Wales consists essentially of an area of ancient Palaeozoic rocks (largely Silurian) in which basins filled with later sediments have originated. The Silurian (including the Ordovician) slates and sandstones form two of the chief outcrops along the eastern Cordillera. There is also a low peneplain of similar rock (the Cobar

peneplain) in the centre of the state. These sediments are invariably strongly folded and tilted, the strike being commonly north-west. Some of the chief mines associated with the three main areas of Silurian and allied rocks are :

SOUTHERN AREA.—*Gold* : Wyalong, Adelong, Parkes, Forbes, Gundagai, Wellington, Araluen, Corowa ; *Copper* : Burraga, Kyloe ; *Silver* : Yerranderie.

CENTRAL AREA.—*Gold* : Canbelego, Cobar ; *Copper* : Cobar, Nymagee, Mount Hope.

NORTHERN AREA.—*Gold* : Hillgrove, Uralla ; *Copper* : Cangai.

But the oldest rocks are probably those extending into the state from the South Australian Highlands. They form low ranges of gneisses, schists, and sediments of pre-Cambrian and Cambrian age. In these occurs the biggest ore deposit in Australia—that of Broken Hill.

Cutting right across the centre of the Silurian area is a geosyncline (earth-trough) of Permo-Carboniferous age in which were deposited the productive coal measures. Here are worked the three important coal-fields of Newcastle, Lithgow, and Bulli, and various oil-shale deposits, as at Wolgan. It is capped over a large extent of its surface by Triassic sandstones and shales. Another Triassic basin lies in the extreme north-east of the state.

In the south-west is a comparatively shallow basin of Tertiary sediments. In the north-west a similar but older depression of Cretaceous age forms part of the chief artesian basin of Australia.

The level-bedded, comparatively young sediments of the Tertiary, Cretaceous, and Triassic basins contain no economic deposits of importance except along the edges of older ' inliers ', where alluvial gravels derived from the latter are found. Exception, however, must be made with regard to the opal of White Cliffs and Lightning Ridge, which occurs in siliceous beds of Cretaceous age. In many parts of the state these Tertiary gravels, containing gold, gems, or tin, have been covered and pro-

tected from erosion by basalt lava flows of Pleiocene age. These constitute the 'deep leads' of Uralla, Gulgong, and Corowa. During Carboniferous times, and perhaps somewhat later also, occurred very extensive intrusions of granite, especially in the north-east. With these are associated the tin deposits of Tingha and Emmaville.

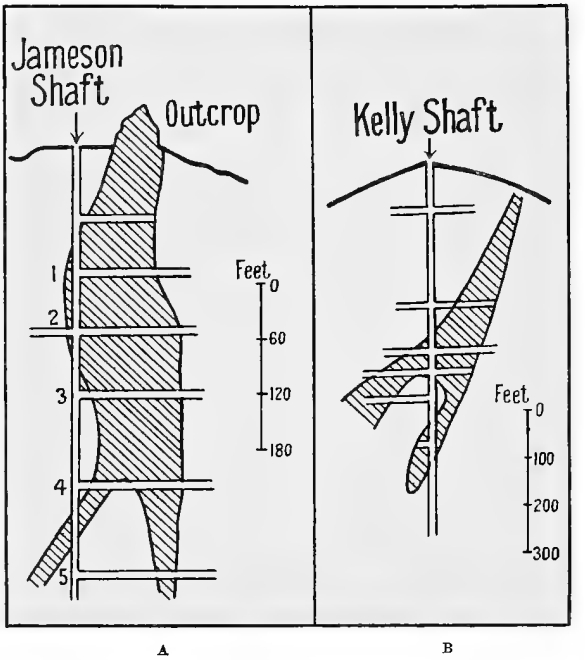


FIG. 52. A Transverse Vertical Section looking North-east in Proprietary Mine. B Ditto in Block 10 Mine.

Broken Hill. Although this celebrated field is well within the state of New South Wales, yet practically all communication is carried on through Adelaide, with which it is connected by rail. The smelting works have also been established in South Australia at the nearest seaport, Port Pirie. The population of Broken Hill in 1911 was 31,386, while Port Pirie totalled 11,307. The total value of the minerals gained reaches £65,000,000. The Broken Hill Proprietary Company was floated in 1885, and consisted of seven blocks. Four of these were

Silver, lead, zinc.

sold in the next three years ; namely, Block 10, Block 14, and two to the British Broken Hill Company. Twenty-five years ago nothing was known of this wonderful treasure, the only surface indication being a long serrated ironstone ridge. Sinking operations passed from the hard ferruginous gossan into a rotten kaolin gangue, then through rich oxidized ore to a secondarily enriched sulphide belt, and finally to unaltered sulphides. In 1893 Mr. Pittman came to the conclusion that the lode was a ' saddle-reef ' occupying anticlines due to folding of the strata, as at Bendigo. He stated, however, that 'it is extremely likely that the original fissure preceding the Broken Hill lode, which had a mechanical origin, was afterwards considerably enlarged by the chemical action on its walls of the waters circulating within it'. Other geologists, notably Professor Gregory, consider the lode to belong to the more ordinary fissure type. Gregory believes that the rocks in the vicinity of Broken Hill are largely metamorphosed Plutonic types, and that, therefore, the saddle-reef theory (implying a sedimentary country rock) is untenable.

The lode is profitably worked for a length of nearly three miles, but ore deposition can be traced to have taken place for a much greater length. It would appear that the main locus of deposition takes an arched shape, the top of the arch being situated in the Proprietary Mine near the Block 14 boundary. The huge bulges of ore are apt to distract attention from the fundamental features of the lode. For instance, at the southern end of the lode a narrow vertical mineralized zone extends to the surface. This has been a line of weakness, for its fault-plane characters are in evidence at intervals.

The walls of the lode are mica-schist or sillimanite-biotite-schist, at times garnetiferous. Highly quartzose rocks generally containing garnet are a feature in the vicinity of the lode.

The case-hardened outcrop consisted in part of brecciated country rock cemented by manganiferous ironstone. Below this occurred the rotten kaolin ore, rich

in silver and chlorides. In its deeper portions carbonate of lead eventually became the predominant ore. Zinc compounds are practically absent near the outcrop. They are readily soluble in circulating waters, and hence have disappeared. The carbonate zone gives place to a sulphate zone, which leads directly into sulphides. The upper limit of the latter (galena, zinc sulphides, &c.) is notable for its coarse character, its enriched lead contents, and its high silver values.

The most noticeable feature of late years at Broken Hill has been the recovery of zinc from the tailings. In 1902 zinc to the value of £10,625 was exported. In 1911 it reached £1,414,980. The number of men employed along the line of the lode was 7,704 in 1911.

Mine.	*Value of Output in* 1911.	*Total to* 1911.
	£	£
Proprietary	942,149	33,994,053
Block 14	69,662	3,352,798
British	236,352	2,307,595
Block 10	170,937	3,856,666
Sulphide Corporation . . .	1,043,564	
South	509,400	
North	536,443	
Junction North	193,281	
South Blocks	130,643	

It is, however, very difficult accurately to determine the mineral production at Broken Hill owing to the fact that much of the output is shipped as concentrates to foreign countries.[1] Approximately, however, as metal and in concentrate form, Broken Hill ships via Port Pirie something like 140,000 to 150,000 tons of lead, 180,000 to 200,000 tons of spelter, and 7,500,000 oz. of silver per annum. The Broken Hill Mines have disclosed ore reserves of about 15,000,000 tons, which average about 15 % of lead, 7½ oz. silver, and 14 % zinc per ton.

Coal.

The productive coal seams of New South Wales cover an area of about 20,000 square miles, stretching north, south, and west from the port of Sydney. They have been

[1] This note has been kindly furnished by Mr. W. S. Robinson.

classified as follows (in descending order) by Professor David (cf. Fig. 53, p. 248) :

	Thickness.	*Amount of Coal, &c.*
1.	1,150	Upper or Newcastle coal measures, containing an aggregate of 100 feet of coal.
2.	2,000	Dempsey series, freshwater beds, no good coal.
3.	570	East Maitland coal measures, with 40 feet of coal.
4.	5,000	Upper Marine series, characterized by the fossil *Productus brachythereus.*
5.	130	Lower or Greta coal measures, containing an aggregate of 20 feet of coal.
6.	4,800	Lower Marine series, characterized by the fossil *Eurydesma cordata.*

The Newcastle coal measures include ten important seams. Of these the Borehole (8–9 feet) has received the greatest attention, and is worked at nineteen collieries. In the Bulli (or southern) coal-field the upper 'Bulli seam', about 6 feet thick, is the only one worked. The lower seams have not yet been properly prospected.

There are seven seams worked near East Maitland, averaging 4 feet thick. These seams do not occur in the other fields.

The *Lower* coal seams around Greta and West Maitland lie on the side of an anticline, so that the coal dips rather steeply (e.g. 45° at East Greta). This series also outcrops about 140 miles south in the gorges of the Clyde River.

The chief coal measures (Newcastle-Bulli) may be compared to a huge black saucer, whose rim outcrops at Newcastle (north), Bulli (south), and Lithgow (west), but whose centre (below Sydney) is buried 3,000 feet under Triassic sediments. As the periphery is approached the overburden becomes less. Thus at Mittagong (south-west) the deep river gorges reach the coal. At Helensburgh (south) the shafts to the coal are 1,100 feet deep.

The Greta coal measures form another less complete 'saucer' about 5,000 feet lower than the Newcastle series.

The coal from the three principal fields varies considerably in composition. That from the Newcastle district is most suitable for gas-making and household purposes, and contains the least amount of ash. Coal

from the Illawarra (Bulli) district is essentially a steam coal with but little ash. The Western (Lithgow) coal is also suitable for boilers and is perhaps the best coal for smelting purposes. Mr. Pittman has estimated the coal available as 115,346,880,000 tons.

The coal exported from Newcastle is sent chiefly to Victoria, Chile, South Australia, New Zealand, the United States, and the Philippines.

ANALYSES OF COAL (averages, after Süssmilch)

	Locality.	*Water.*	*Volatile Hydro-carbon.*	*Fixed Carbon.*	*Ash.*	*Calori-metric Value.*
Lower Coal Measures	Hunter River	1·74	39·42	51·68	7·14	13·6
	Ashford	0·71	22·90	68·96	7·43	13·83
	Clyde River . .	0·68	34·96	52·92	11·53	—
Middle Coal Measures	East Maitland . .	1·60	38·85	53·85	8·70	12·4
Upper Coal Measures	Newcastle District .	1·95	34·48	54·20	9·33	12·8
	Singleton ,,	1·72	36·76	52·87	8·25	12·7
	Curlewis ,	2·40	33·30	56·30	8·00	12·0
	Gunnedah ,,	2·55	35·35	55·35	6·75	12·3
	Lithgow ,,	1·87	31·49	52·61	14·03	11·5
	Illawarra ,,	0·97	23·10	65·26	10·67	12·6
	Sydney ,,	0·66	17·57	71·09	10·68	13·0

Gold. New South Wales is only fourth in the list of Australian states, so that no space is available for a detailed account of her gold-mines. However, a general idea of the gold deposits may be derived from the following table, which is based on Mr. Pittman's account in his book, *Mineral Resources of New South Wales.*

(*a*) Auriferous Reefs in Sedimentary Rocks :—(1) *Silurian age* : Cobar, Hargraves, Hill End, Wyalong ; (2) *Carboniferous age* : Hillgrove.

(*b*) Impregnations in Sedimentary Rocks :—(1) *Silurian age* : Mount Drysdale, Yalwal ; (2) *Bedded Tuffs (Silurian ?)* : Lyndhurst.

(*c*) Reefs in Eruptive Rocks :—(1) *In hornblende granites* : Young, Araluen ; (2) *In felsites* : Pambula.

(*d*) Alluvial Gold :—(1) *Permo-Carboniferous age* : Gulgong conglomerates ; (2) *Cretaceous 'leads'* : Mount Brown, Tibooburra ; (3) *Tertiary 'deep leads'* : Gulgong,

Corowa; '*Shallow leads*': Forbes, Uralla; (4) *Recent and Pleistocene*: *Beach Sands*: Richmond River; *Dredging*: Macquarie River.

The output for the chief goldfields will be found in the statistics given previously, while their distribution is shown on Fig. 51.

Copper.

A large proportion of the copper of the state is derived from the famous Cobar mines. These are situated about 450 miles west of Sydney on a branch of the railway to Bourke. The mine was discovered in 1869 and started work on a large scale in 1876.

The country consists of Silurian sandstones and slates. There was no important outcrop of mineral, but merely a slight elevation consisting of a ferruginous and usually siliceous gossan. The oxidized zone capping the sulphide ore-body extended downwards to the 250 feet level. The Cobar ore consists essentially of a mixture of iron and copper sulphides, of which Carne gives the following analysis: iron 42·65%, copper 10·15%, silica 16·09 %, sulphur 20·74 %, and oxygen 9·16 %. The ore usually, however, contains about 3 % of copper.

The importance to the field of the low percentage of silica lies in the fact that gold and silver ores from neighbouring mines can be worked in as siliceous fluxes to combine with the excess of iron, though there is unfortunately a tendency for the silica values to increase throughout.

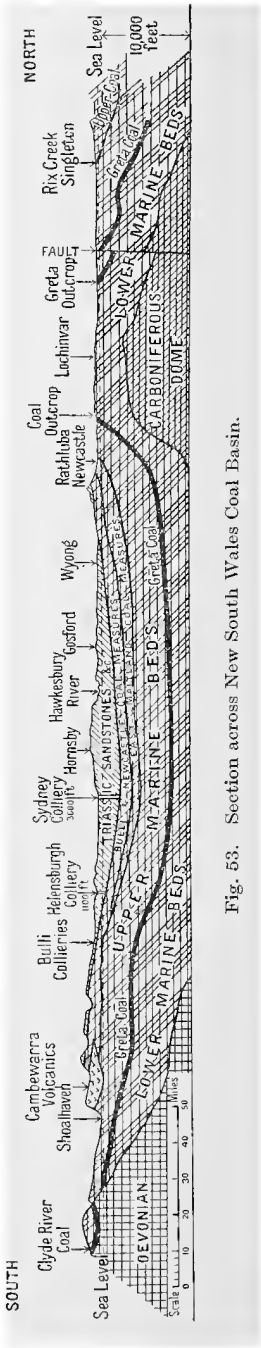


Fig. 53. Section across New South Wales Coal Basin.

During 1910 the output of copper by the Great Cobar mine was 6,548 tons, valued at £366,688. The width of the ore-body as exposed by a cross-cut from the No. 12 'plat' is approximately 135 feet of 3·7 % copper ore.

Other important mines of the field are Cobar Chesney, Queen Bee, and Great Cobar North.

Tin. The bulk of the yield in New South Wales comes from the Tingha-Inverell district on the western slopes of the New England Range. At first the present drainage channels were worked, then the higher terrace levels, and later still the earlier drainage systems buried beneath sheets of basalts.

Carne regards the aplitic masses and pegmatite dykes, and still more the siliceous intrusions in the granite and adjacent sedimentary rocks, as the true ore-bringers in the New England district. Those granitic rocks of an acid type belonging to the Permo-Carboniferous age are usually more favourable.

Since 1900 over thirty dredges have been at work, chiefly near Tingha and Inverell. They have won 10,566 tons of stream tin, worth £1,040,255, in the succeeding twelve years.

Opal. There are two important localities in New South Wales, i.e. at White Cliffs (65 miles north-north-west of Wilcannia) and at Lightning Ridge near Walgett. The precious opal occurs in the Upper Cretaceous rocks of the artesian water basin. It is of secondary origin and is found in irregular veins and patches in a white siliceous rock. The usual procedure is to dig a trench or pit where fancy may dictate; and fortunately sinking is easy. Usually the shafts are only about 10 feet deep. In 1911 Lightning Ridge produced £39,100, and White Cliffs £17,700.

Iron. There are numerous deposits of iron ore in New South Wales, but only those at Cadia and Carcoar are of large extent. At the latter place there are about 3,000,000 tons of haematite and brown ore, while a much greater deposit has been discovered at the Iron Duke Mine (Cadia) near Millthorpe on the Western Railway. Mr. Jaquet estimates that there are some 36,000,000 tons

of haematite and magnetite here. The ore contains 57 to 65 % of iron, 5 to 10 % of silica, and ·013 to ·05 % of phosphorus. It appears to be a bedded deposit. The rocks above and below consist of an altered augite andesite.

Queensland

	Output in 1911.	*Mines.*	*Approximate Output,* 1911.
	£		£
Gold . .	1,640,323	Charters Towers	568,486
		Mount Morgan	545,158
		Gympie	216,439
		Ravenswood	86,492
		Cloncurry	53,543
		Etheridge	40,838
		Rockhampton	38,548
		Croydon	33,583
Copper . .	1,151,351	Cloncurry	470,000
		Mount Morgan	297,000
		Gladstone area	170,000
		Rockhampton area	100,000
		Chillagoe	44,000
	Tons.		Tons.
Coal . .	323,998	Ipswich	624,071
		Wide Bay	53,355
		Clermont	25,247
	£		£
Tin . . .	307,847	Herberton	200,000
		Chillagoe	50,000
		Cooktown	23,000
		Stanthorpe	15,000
Silver . .	56,305	Chillagoe	13,000
		Stanthorpe	13,000 (?)
Wolfram .	54,163	Herberton	29,000
		Chillagoe	22,000
Gems . .	24,393	Anakie	24,000

History of mining.

The first important event was the discovery of rich alluvial gold on the Mary River in 1867. This was the start of the famous Gympie Goldfields, and since then 2,613,785 fine ounces of gold have been taken from the two or three square miles surrounding Nash's discovery. In 1868–70 the goldfields of Etheridge, Hodgkinson, Gilbert, and Ravenswood came into prominence. In 1872 Charters Towers was pegged out, and this goldfield is still one of the most important in Australia, over 6,000,000 oz. of gold having been won since that date. In 1872 tin was worked at Stanthorpe on the southern

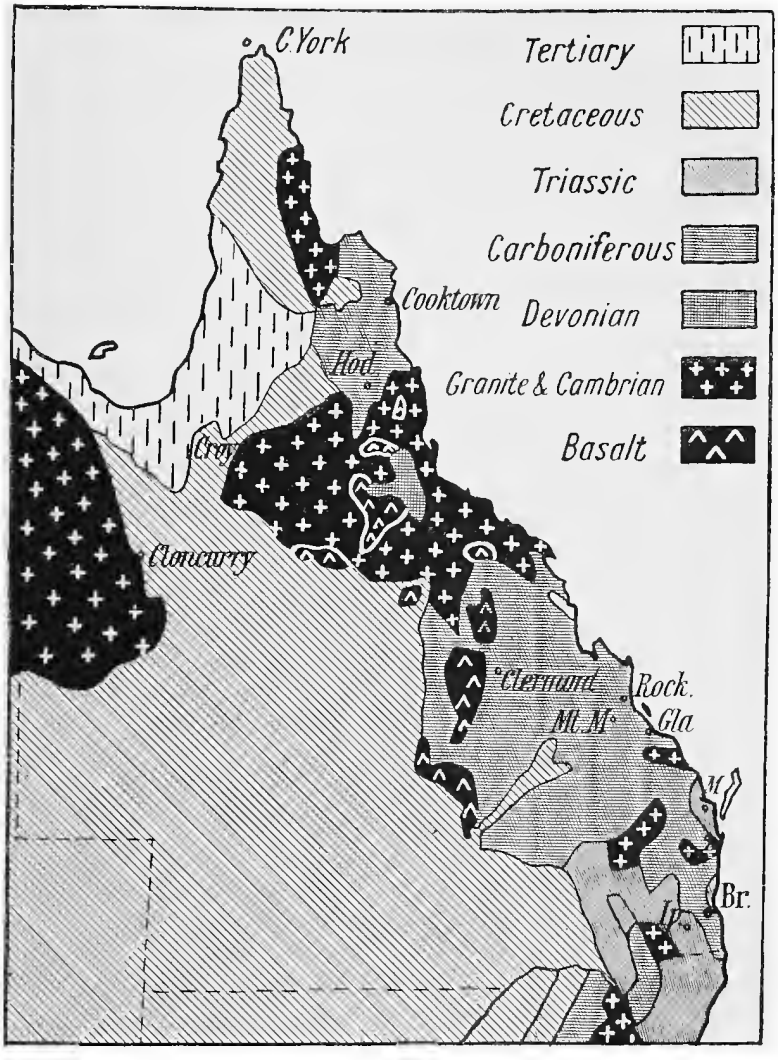


FIG. 54. Geology of Queensland.

border. In 1880 still more valuable deposits were found in the Herberton district in the north. These were worked as alluvial at first, but three years later crushing began. In 1883 occurred the astounding discovery of Mount Morgan, possibly for many years the richest gold mine on earth. In 1884 Cloncurry was first seriously worked. In 1891 the Great Fitzroy mine, just north of Rockhampton, started profitable work, but its fame dates from 1907. In 1894 wolfram was produced at the Hodgkinson field. Coal had long been worked at Ipswich, but the new northern fields of Wide Bay and Clermont have only since 1902 been important producers. Many other mining fields have been proclaimed, but the earlier fields still maintain their supremacy. Mention should, however, be made of the following flourishing fields which are not given in the above list: *gold*, Etheridge, Ravenswood, and Clermont; *silver*, Silverspur in the far south; *copper*, Gladstone and Mount Perry. *Tin* dredging has lately been undertaken at Stanthorpe. Many undeveloped coal and iron deposits are awaiting exploitation in Queensland.

Geology. It has been remarked that geologically Queensland can be 'divided like Gaul into three parts'. Along the coast is a belt about 200 miles wide largely consisting of Palaeozoic rocks; in the centre and south-west is an undulating surface composed of Cretaceous rocks, and known as the Rolling Downs Formation; while in the north-west is a broad area of very old rocks which are probably largely Cambrian or Archaean.

The oldest area consists of schists, slates, and some Plutonic rocks. It probably forms the eastern prolongation of the great Westralian massif, and like the latter is rich in mineral wealth. The mines of Cloncurry occur in these ancient rocks. Many other mining fields, such as Charters Towers, Croydon, Etheridge, Ravenswood, Herberton, Stanthorpe, &c., are associated with similar ancient metamorphic or Plutonic areas.

The next important formation is the Burdekin series of Devonian age which occur chiefly in the river basin of that name.

The Permo-Carboniferous rocks are very well represented in Queensland. The lowest series are termed the Gympie beds and occur near the town of that name. The Gympie and Rockhampton goldfields are associated with this formation. The upper or Bowen series is of importance from the coal which occurs therein, though these seams (as at Townsville, Cooktown, and Dawson) have not yet received much attention.

The Triassic beds are divided into two series. The lower or Burrum series contains good coal which is worked at Maryborough, while the upper or Ipswich beds contain sixteen seams which are largely worked at Ipswich and Booroomba.

The Cretaceous beds cover the greater part of Interior Queensland. The Rolling Downs series is characterized by a great monotony of appearance, broken here and there by outliers of the upper (or Desert Sandstone) series. It is believed that the artesian water enters the basin by way of the outcrops of porous Blythesdale braystone—one of the horizons in this terrane. The Tertiary deposits are of no importance.

Charters Towers.

This field is perhaps the most important in the state, and lies near the Burdekin River and about 80 miles west of its port, Townsville, with which it is connected by rail. The main gold-bearing reefs occur within an area of $2\frac{1}{2}$ miles long by 1 mile wide. The chief reefs have an east-west strike and dip to the north. The country rock is largely granite which merges into a quartz diorite. These acid rocks are intruded by basic dykes, which run north-east to south-west in the western areas, and at right angles to this in the eastern part of the field. Some dykes have a length of $1\frac{1}{2}$ miles. The granitic intrusions have altered the sedimentary beds which occur in portion of the field into slates and schists. Probably a second acid magma affected the region at a much later date and gave rise to the felsites (or elvanites). These latter dykes run north and south. Subsequently to this intrusive action there occurred the fissuring which allowed of the ascension of the quartz and metal-bearing solutions from which the

present reefs are found. In the Day Dawn Reef the auriferous body is nowhere interrupted by these basic dykes, so that they are presumably earlier. The acid dykes seem to be associated with poor auriferous country.

The Day Dawn Reef is extremely regular in size, and has been worked for 6,000 feet and to a depth of 3,000 feet from its outcrop. There are other reefs of a similar nature in the field, the chief mines being the Brilliant and Day Dawn groups (Brilliant Extended, Mills Day Dawn, New Brilliant, Day Dawn, &c.).

Mount Morgan mine.

Mount Morgan is about 25 miles south-west of Rockhampton, with which it is connected by rail. For many

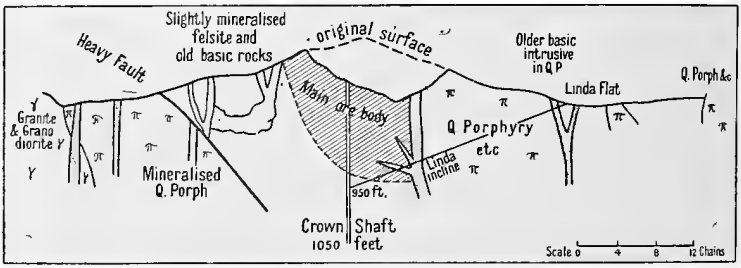


FIG. 55. Vertical Section across Mount Morgan Mine.

years the upper siliceous 'sinter' gave fabulous returns of gold of a remarkable purity. It was first believed that this new type of reef was due to deposition from a hot spring, but later research gives it a more normal origin, the gold being replaced by copper in lower levels.

The oldest rocks present are quartz porphyries and felsites. These have been intruded by the 'older basics' which shattered the older rocks. Both these formations were then mineralized by a series of hornblendic granites of later date. Still further eruptive action led to the formation of a succession of 'newer basics'.

In Lower Mesozoic times a period of sedimentation occurred, and it is believed that a considerable amount

of leaching of the minerals occurred, leading to a redistribution of the copper and gold contents.

Further denudation and ensuing oxidation gave rise to the upper zone of ore, which has been worked by the open cut. There was practically no copper in this upper zone, only silica and gold remaining. The lower 'mundic' or sulphide body was at the same time enriched by solutions percolating from above. Also, various chemical reactions between circulating waters and the massive sulphides led to 'bonanzas' or 'shoots' still lower down in the sulphide ore-body.

The change from completely oxidized ore to mundic occurs at varying levels, and with apparent suddenness. This is undoubtedly due to the varying surface of the 'ground water' level. There has been considerable faulting in late geological time, and the bonanzas and rich 'shoots' are generally associated with these planes of weakness, or with doleritic dykes. For the two classes of ore the following proportions are given as typical :

Copper gold ore.		*Mundic ore.*	
Cu	3·54	Cu	1·40
SiO_2	48·16	SiO_2	67·0
Fe	22·73	Fe	15·0
S	21·88	S	15·0

Cairns hinterland mines.

An extremely rich area of mineral country lies to the west of Cairns in the region of ancient granites and sediments which here builds up the cordillera. Tin characterizes the east. Copper, lead, and silver are found in the centre, and gold, coal, and antimony in the north.

At Mareeba on the railway, gold is found, while to the north at Mount Molloy is copper, and in the same district wolfram at Mount Carbine.

Herberton is a more important field. It is 50 miles south-west of Cairns and is a large producer of tin. The lodes are very irregular in their mode of occurrence, and seem to have generally resulted from the alteration of the country rock (granite and porphyry) by the action of mineralizing agents. In other cases, however, the tin seems to have been an original constituent of the granite.

Fluoric minerals (topaz, tourmaline, &c.) are common, especially near what were the cooler rocks at the edge of the granite.

Tin mines also occur in the vicinity at Watsonville, Irvinebank, Newellton, Stannary Hills, and Coolgarra. At *Irvinebank* in the west are lodes occurring as chloritic pipes in slates. The Great Southern and Vulcan are large mines in this field. Wolfram is chiefly found at *Wolfram Camp* and Lappa. The heavy mineral was found scattered over the ground in water-worn pebbles and boulders. It is associated with molybdenite. Often the lodes occur in horizontal ' contraction cracks ' which are obviously due to the shrinking of the granite as it cooled and solidified.

At Mount Garnet, silver and copper lodes have been found, but not much is being done with them. Similar metals occur at *Chillagoe*, where limestone is associated with granite. At Charleston galena and blende are worked. To the north is one of the oldest mining fields—that of the Hodgkinson. The Mount Mulligan coal-field may be of importance at a later date, while the Etheridge goldfield has been a noted producer for many years.

Great Fitzroy mine.

The Great Fitzroy copper and gold mine lies 10 miles north-east of Rockhampton, and has been an important producer since 1907.

Shales, dolerites, and sandstones are here closely associated with serpentine and limestones. Where the rocks are much altered quartzites are common, and these seem to merge into a rock mostly made up of silica with a small proportion of metallic sulphides. This in turn has imperceptibly been changed into massive sulphide ore. It is the latter class of ore which contains the high value of copper, while the quartzites gradually lose their cupriferous character and become more defined as a gold and silver ore.

Cloncurry.

Cloncurry is situated in the north-west of the state and is 210 miles south of the nearest port at Burketown. It is connected by rail to Townsville, 408 miles away.

The region consists of almost vertical strata, chiefly quartzites and slates, of early Palaeozoic (possibly Cambrian) age. The copper outcrops and deposits run almost universally with the strike of the country and appear to lie along fissure or shear zones. It is probable that they have been concentrated here, by leaching action from upper deposits—now removed by long-continued denudation.

Ipswich coal-field.

By far the greater part of the Queensland coal is obtained near Ipswich in the south-east of the state. The chief mines are at Bundamba, about 35 miles west of Brisbane, and on the same river. Much of the coal is floated down the Brisbane River in punts, but railways also connect the two centres. There are two main districts, of which Bundamba supplies three-quarters of the total. The productive measures cover about 12 square miles. The Bremer River area is about 3 square miles and is largely used for coke. The Walloon series still further west is not so important.

The Ipswich coal is brittle and becomes slack on rough handling, so that it cannot compete with the Newcastle coals.

The coal occurs in Trias-Jura beds, which were laid down on a floor of highly folded Palaeozoic rocks. The coal measures in the Ipswich region dip towards the west where they are covered by the Cretaceous rocks.

There are over a dozen seams in the field, of which the Aberdare (58 %) and New Chum (21 %) contribute most of the coal. The former is 11 feet thick. Ninety per cent. of the output is derived from 13 collieries, of which the Aberdare colliery is the chief, producing about 200 tons per working day.

The largest coal seam in Queensland, however, and perhaps one of the largest in the world, is the Blair Athol near Clermont. The main seam is 65 feet thick and is estimated to contain one thousand million tons of good coal.

Tasmania

	Value for 1911.	*Chief Mines.*	*And their approximate Output in* 1911.
	£		£
Tin . . .	513,500	Mount Bischoff	143,000
Copper . .	508,649	Mount Lyell	343,000
		Mount Balfour	21,000
Silver-lead .	253,361	Zeehan-Montana	38,000
		Dundas-Hercules	60,000
		Dundas-Zeehan	24,000
		Mount Farrell	24,000
Gold . .	132,108	Beaconsfield	92,000
Coal . .	26,214	Cornwall	11,000
		Nicholas	14,000
Wolfram .	7,769		
Bismuth .	5,758		
Osmiridium	1,888		

History of mining.

Gold was discovered in the 'fifties,[1] but was profitably worked much later in the Fingal district, especially near Mathinna. The New Golden Gate Company carried on operations there for many years with success, sinking to depths exceeding 1,000 feet. Gold was also worked at Lefroy in 1877, and later by the New Pinafore Company in this region. On the opposite side of the Tamar at Beaconsfield (1877) the Tasmania mine was very successfully carried on for a number of years, and in spite of the heavy cost of pumping is still working.

Tin was found at Mount Bischoff by Mr. James Smith about 1870; and practically no 'calls' were ever necessary, the mine being able to provide all machinery and also pay regular dividends. In 1880 tin was found on the west coast both in alluvial and lode, and considerable quantities, especially of the former, are still won. The Briseis tin mine at Derby and the Pioneer at Bradshaw's Creek are working profitably. New methods are in use, among which may be mentioned the plan of floating

[1] The author desires to thank Major Morrisbey for much of the historical data.

barges carrying machinery up to the faces from time to time as the drift is worked away.

Silver-lead was discovered at Zeehan about 1886. The extreme difficulty of access for provisions and machinery, and of egress for the ore, led to delay, which was overcome by the Government Railway. Unfortunately, in many of the claims it is found that the galena pinches out at a depth of a few hundred feet.

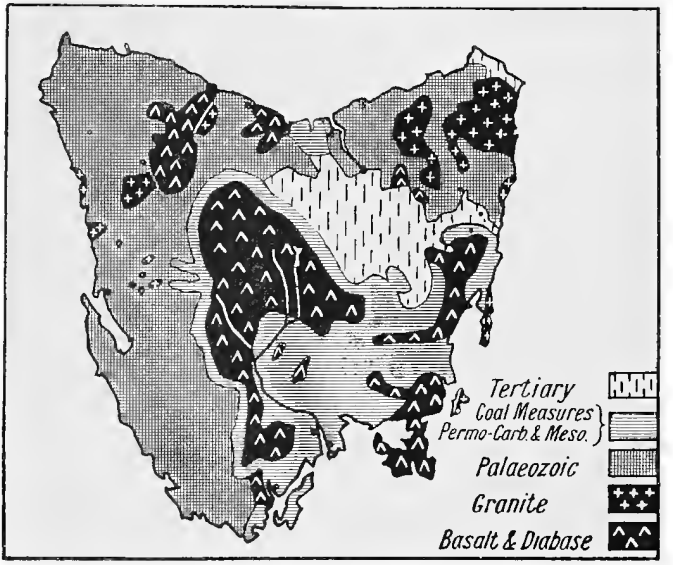


Fig. 56. Geology of Tasmania.

Copper at Mount Lyell was first profitably worked about 1884 through miners led there by following up the alluvial gold found in Linda Creek. North Lyell was not very profitably worked until it was amalgamated with Mount Lyell in 1903. The ore from the North Lyell forms a good working flux to the Mount Lyell ore. They have paid altogether upwards of £2,250,000 in dividends.

Geology.

Essentially Tasmania is a fragment of the south-eastern highlands of Australia. Trough faults on a grand

scale (of late Mesozoic age perhaps) have isolated it, further faults have left the centre as a splendid example of a horst several thousand feet above the lower country to the north and east. As in South-east Australia, the basal beds are chiefly Silurian buttressed by granite

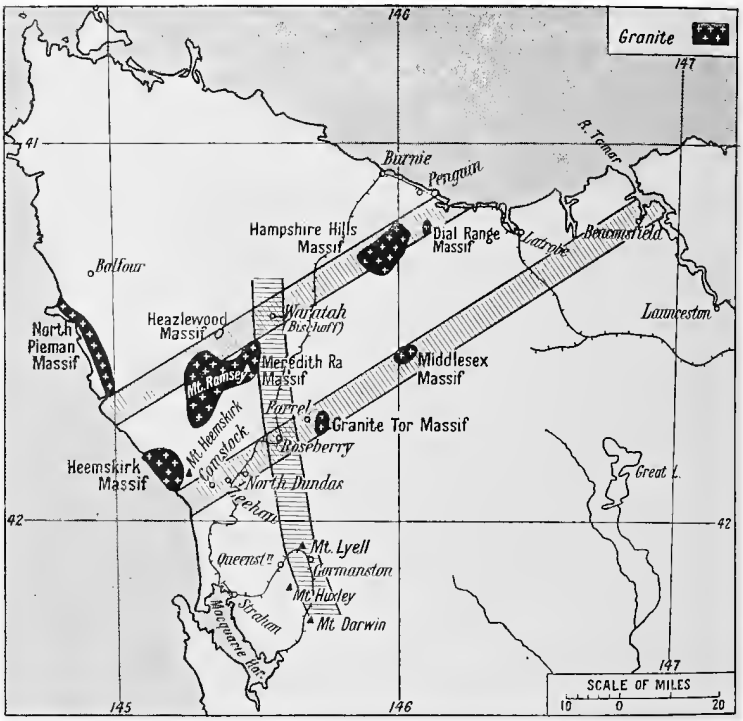


FIG. 57. Mining Belts in North-western Tasmania.

bosses. Two granite chains have stiffened the island sediments, one down the west coast through King Island, and the other down the east coast through Flinders Island. These are classed as Devonian.

A Permo-Carboniferous basin, contemporaneous with the great coal basin of New South Wales (and containing some workable seams), occupies approximately the centre of the island. But the greater part of the basin has been overwhelmed by the wonderful diabase sills which have

built up the central plateau. Outliers of Triassic beds representing a Triassic basin overlie the Permo-Carboniferous in the east. At Fingal they contain valuable coal seams similar in age to the Ipswich coal. A smaller Tertiary basin occupies the depressed area between the central plateau and the Ben Lomond massif in the north-east.

The most interesting metalliferous region in Australia is undoubtedly the north-west corner of Tasmania. Here three of the largest mines in the Commonwealth occur, each producing a different metal. Mount Lyell (copper), Mineral products.

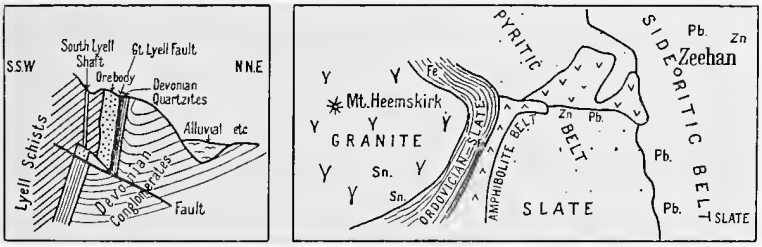


FIG. 58. (A) Section across South Lyell Mine (after Gregory). (B) Zones of Mineralization between Zeehan and Heemskirk Granite Massif (after Twelvetrees and Ward).

Mount Zeehan (silver), and Mount Bischoff (tin) are world-renowned ; but there are besides smaller but still important mines exhibiting the same diversity. A most interesting series of papers by L. K. Ward endeavours to correlate the genesis of these deposits, and a brief *résumé* of his views follows.

The somewhat scattered fields of western Tasmania appear to be disposed along certain very well defined belts or zones which are coincident with basal geological features. The zones constitute at the same time axes of several igneous intrusions and the loci of outcrops of mineral lodes. Mr. L. K. Ward believes that the epoch of mineralization followed immediately upon a period of igneous invasion, during which granites and granite porphyries intruded these zones of crustal weakness.

This occurred in Devonian times. The ore-bodies of various kinds are related to the granite types and both are derivatives from the same magma. He is of the opinion that the actual type of ore-body developed is governed principally by three factors : (*a*) the nature of the magma and its metallic contents at that particular spot, (*b*) the distance of the particular kind of lode material from its source, and (*c*) the environment (particularly as regards the heated granite) of the mineral matter traversing the lode fissures on its way to regions of lower temperature and pressure during the metallogenetic epoch.

The actual occurrences seem to exhibit the following features :

1. Lodes containing tin, tungsten, and bismuth occur within the granite borders or in immediate proximity thereto.

2. Lodes containing lead and silver with curiously constant small traces of copper occur in the troughs between the granite crests.

3. There are two such zones running north-east in which tin and silver alternate. These are (*a*) Comstock-Zeehan-Farrell axis, and (*b*) Meredith-Magnet-Bischoff axis. A third zone with a meridional direction contains the copper deposits of Mount Lyell, but these copper sulphides merge here and there, even at Lyell itself, into mixtures of blende and galena. It runs through Mount Huxley, Mount Lyell, Mount Read, and Mount Chester.

Copper.

The Mount Lyell mine is situated on the ridge of schists which connects Mount Lyell to Mount Owen and separates the Queen River from the Linda River. A railway connects it to Strahan on Macquarie Harbour, about 15 miles to the south-west. There are two main formations represented : large areas of conglomerates of doubtful age, but perhaps Devonian, and a series of metamorphic rocks, known as the Mount Lyell schists, whose history is even more doubtful. Professor Gregory says the conglomerates are younger than the schists. Others believe that the schists are derived from igneous rocks crushed

and altered by earth movements. There are uncrushed igneous rocks in the vicinity—the Queen River porphyries —which may represent the unaltered schists. These are believed to be younger than the conglomerates.

The payable ore is found close to the junction of the two formations, not only at the surface, but in the stopes also. These consist of two types : (*a*) fahlbands which occur in the schists, and (*b*) great lens-shaped masses of very pure sulphide ore. The latter are the main sources of the wealth of the Mount Lyell field. In places the soil was so shallow over the chief ore-body (the ' Iron Blow ') that the water-courses had cut down to it and exposed the fresh unoxidized pyrites.

The ore-body trends north-west, and its length on the surface was 800 feet, the width being 200 feet. It is worked by an ' open cut ' as a series of nine terraces or benches. Beneath the open cut is a series of underground works by which it is possible to estimate the shape of the ore-mass.

The ore-body is irregularly boat-shaped, consisting of an elliptical mass which tapers gradually downwards and is then cut off below with a rounded base. The ore consists almost wholly of iron pyrites containing copper, gold, and silver. The latter metals are much richer near the foot-wall of the deposits. Sometimes ' shoots ' of rich ore are found, and in 1894 one such shoot was 2 feet wide along portions of its course. It yielded £105,000. An analysis of the payable ore quoted by Gregory gives : iron 40·30 %, sulphur 46·50 %, and copper 2·35 %.

Professor Gregory advances a hydro-thermal origin for the Mount Lyell ores. He thinks that the intense heat generated by the formation of the Great Lyell fault caused any waters that came from below to rise as hot solutions. Like most Plutonic or deep-seated waters they were probably alkaline in character. They no doubt carried in solution sulphates of iron and copper and some silver and gold. These solutions nearing the surface had their temperature lowered and were subject to lighter pressures. They therefore naturally precipitated their

contents along their channels. In places the rocks have been completely shattered, and in these cases the mineralizing solutions would permeate the rock, removing the original constituents molecule by molecule, and replacing them by pyrites, thus forming the great ore-masses. This theory differs in many particulars from that advanced by Mr. Ward (*vide ante*).[1]

Silver-lead.

Mount Zeehan is about 20 miles to the north-west of Mount Lyell. It was discovered in 1882 and connected by rail to Strahan in 1892. Now there is also railway communication to Burnie on the north coast.

A red granite massif of Devonian age has intruded a series of slates of Cambrian to Silurian age. These are altered at the junction and have also been penetrated by dykes of keratophyre. There is a well-marked arrangement of the minerals in zones about the Heemskirk granite massif. In the granite itself are found cassiterite and wolframite. In the contact metamorphic zone the most significant mineral is magnetite, though cassiterite and sulphides do extend into the zone occasionally. The next belt contains essentially galena or stannite, both associated with pyrite. The eastern portion of the Zeehan field contains vein-types characterized by sideritic gangue.

In the latest stages of consolidation of the granite a considerable proportion of the metallic contents—previously concentrated within the magma—was expelled from the molten mass. It rose along the fissures which traversed the already partly-cooled outer crust of granite, and which were connected with other fissures in the superincumbent rocks extending far beyond the igneous boundaries. Hence the distribution of the ores is believed to depend on their order of consolidation, the tin being deposited nearest, the lead and zinc further from the Heemskirk massif.

The Zeehan-Montana—a continuous producer of silver lead since 1893—is in the sideritic (eastern) belt. The Oonah and Zeehan-Queen mines are in the nearer pyrite

[1] J. W. Gregory, *Aust. Inst. Min. Eng.* (1905).

belt, while the contact metamorphic belt has no mines of great importance.[1]

Tin. Mount Bischoff is situated about 40 miles south-west of Burnie, with which it is connected by rail. The mount is only a slight elevation on the tableland (2,000 feet) on which the mining town of Waratah is situated. The workings are on the south-east slope of the mount and a few hundred feet below the summit.

The mountain itself is composed of porphyry, as are numerous dykes which branch out from it. Surrounding it are a series of slates and other sedimentary rocks which near the contact are changed to porcellanite. The workings include a series of open cuts and quarries extending for about half a mile in length.

The upper portion of the deposit was alluvial, and practically all this has been removed. The material consists of boulders, clay, and masses of tin oxide, some of the latter reaching a hundredweight. Starting from the south end of the workings is an alluvial deposit known as the 'White face'. On crossing a porphyritic dyke the 'Slaughter-yard face' is reached, then the 'Brown face'. The workings show that this ore-body is funnel-shaped, the 'funnel' itself being surrounded by a dyke which has emanated from the main mass of the porphyry at the mount. Through the Brown face deposits run decomposing stanniferous dykes which do not appear to be connected with the main mass of porphyry. Besides the decomposing dykes, this 'funnel' is filled with various minerals, such as tourmaline, quartz, talc, and cassiterite, arranged in horizontal layers. Such pockets in this drift-like material were extraordinarily rich, one yielding £60,000 worth of tin.

There are also two important lodes on the property. The Queen lode has well-defined walls and cuts through both slate and porphyry. In places there was a solid vein of cassiterite a foot in thickness. Very good ore was also obtained from the western lode.[2]

[1] Twelvetrees and Ward, Bull. 8 (1910).

[2] Donald Clarke, *Australian Mines and Metallurgy* (1904).

Northern Territory

	1910.	1911.	*Miners*, 1911. *European.*	*Chinese.*	*Chief Mines.*
	£	£			
Gold .	21,711	26,702	6	264	Pine Creek.
Tin . .	31,113	22,900	60	171	Mount Todd. Umbrawarra. Burrundie.
Wolfram .	6,656	4,048	16	15	Wolfram Camp. Jinberrie.
Copper .	1,196	1,470	1	25	Daly River.

Geology. Very little is known as to the details of the geology of Northern Territory. Vast areas of Cambrian or pre-Cambrian rocks are characteristic of this portion of Australia. They are intruded by very ancient granites, with which are associated the tin and wolfram deposits and perhaps also the lodes of copper and gold. The Cambrian area seems to extend from the Edith River to the Elsey and from the Victoria River to Cloncurry in Queensland. Upper Cretaceous marine beds are developed near Port Darwin, and limestones of Tertiary date are found in the Barklay tableland to the east, where extensive artesian water-supplies are believed to occur.

Central fields. In the Macdonnell Ranges ($23\frac{1}{2}°$ lat.) gold and mica have been worked since 1897. The Arltunga field is the most important, and here gold occurs in ill-defined lodes of cellular quartz. At Tanami in the west (20° lat.) a somewhat similar ore deposit has been worked in spite of lack of water and transport.

Northern fields. The Pine Creek Railway serves a group of mines from which considerable quantities of gold, tin, and wolfram have been obtained. Labour conditions are apparently so unattractive, however, that there are only 100 European miners at work. The majority of men on the fields are Chinese 'fossickers'. At Brocks Creek (100 miles from the coast) vast sums have been spent on mining machinery for the Zapopan, Howley, and Cosmopolitan mines, which are now practically abandoned. At Mount Wells the tin is won from open cuts in the face of the hill to the depth

of 400 feet. It is one of the largest mines at work. At Wolfram Camp the mineral occurs in granite, the matrix being a soft black mica. The lode is worked by open cuts and shafts and promises well.

CHAPTER VII

COMMUNICATIONS

By H. S. Gullett

Australia is well served with both overseas and local shipping. The fleets fall into three classes: the deep-sea vessels, which supply communication with the outside world; the inter-state lines, which do not leave Australian waters; and the smaller coastal boats, confined to the coasts of each of the states. The deep-sea liners, with the exception of 8 per cent., are owned and controlled abroad, chiefly in Great Britain, but the local services are mainly in the hands of Australian companies. Shipping.

Down to 1852 the colonies were dependent for a local service upon small sailing craft which plied round the coast, and upon an indifferent service of sailing vessels from the United Kingdom and the rest of the outside world. The gold discoveries worked the same sweeping change in shipping as in everything else. In 1842 only 862 vessels with a tonnage of 233,000 were registered as having entered Australian ports. In 1852 this total leaped to 1,896 vessels with a tonnage of 844,000, and 10 years later the vessels had increased to 2,900, and the tonnage to 1,389,000. Thenceforward development was swift. The extraordinary prosperity of the first decade of the new century is reflected in the fact that between 1902 and 1910 the vessels registered at Australian ports advanced from 3,608 to 4,048, and the tonnage from 6,234,000 to 9,333,000, and the tendency naturally has been towards the employment of larger vessels.

Directions of recent development in shipping trade.

The feature of the shipping in the new century lies rather in the continued development of trade between the Commonwealth and the United Kingdom and European countries than in development with the East or with America. In 1910 the shipping with Europe amounted to almost 4,000,000 tons, or 42 per cent. of the total oversea trade of the Commonwealth. The tonnage between the Commonwealth and New Zealand increased from 1,405,000 tons in 1906 to 1,741,000 tons in 1910, or by 24 per cent. Of the trade with Europe in 1910 nearly 73 per cent. is recorded against the United Kingdom. It is not remarkable perhaps that Australian trade should be on a large scale with either the United Kingdom or New Zealand, but that it should be on a big scale with both, the one lying near at hand and the other far distant, to the comparative neglect of other countries, does not argue strongly in favour of the contention that the disposition of trade is necessarily geographical. About the close of the last century it was strongly believed in Australia that the marked development of the ensuing decade would be in trading with the East and with America, and that a substantial falling-off in the relative position of the United Kingdom was inevitable. This prediction was wholly in error. Australia has been to considerable expense and trouble to develop her Asiatic trade, and yet during 1910 the total tonnage between the Commonwealth and Eastern countries amounted to only 1,795,000 or 19 per cent. of the whole. This actually showed a decrease of nearly 90,000 tons as against 1906. Possibly this shrinkage is only temporary, but it is of marked interest.

Shipping with South Africa is difficult to set out accurately, because so much of the trade is done with steamers touching at Cape Town and Durban on their way from Great Britain to the Commonwealth. So far, the trade of the Commonwealth with North and South America has been, like that with the East, disappointing. The shipping with North and Central America in 1902 did not exceed 720,000 tons, while with South America

it was even less. Perhaps this position will be changed by the opening of the Panama Canal. But it is not likely to show much change until Australia has further developed her trade in food-stuffs with the American people.

The proportions of British and foreign tonnage which entered and cleared the Commonwealth with cargo between 1906 and 1910, show that British tonnage is more than maintaining its position, for in the former year the percentages were respectively 74·42 and 25·58, while in 1910 they were 77·34 and 22·66.

Coastal services.

The first coastal steamship service was established in Australia in 1851 by the small screw steamer *Express*, which traded between Melbourne and Geelong. About the same time steamboats began to ply between Hobart and Melbourne, and in 1862 a regular inter-state service was commenced between Melbourne and Sydney and Newcastle, and 13 years later between Melbourne and Adelaide. In 1910 no less than 24 companies owning fleets with a capacity of 172,000 tons were engaged in the coastal services. Most of these vessels are built abroad, the great majority of them in British dockyards, but there is now a strong Australian movement in favour of the establishment of local ship-building. This is stoutly encouraged by both State and Federal governments, and with the development of the local iron and steel industry, it is expected that steamship construction will in due course be firmly established.

Ports.

The chief shipping port is Sydney, which in 1910 showed tonnage entered at 7,137,000. Then came Melbourne with 5,314,000, Newcastle 3,270,000, Port Adelaide 2,867,000, Brisbane 2,368,000, and Fremantle with 1,980,000.

Railways: early development.

Railways in Australia were one of the many immediate results of the discovery of gold. In the almost purely pastoral days which continued down to 1851 there was little call for speedier transport than that of the horse and bullock teams and the coaches of Cobb & Co., and no promise of revenue to justify the building and working

of railways. The few farmers were located within short haulage of the towns, and the pastoralists further inland were well enough served by the teamsters for the transport of their wool and their stores, and, when they visited the coast, with the coaches or their own excellent breed of horses. Even after the travellers and the produce on the roads had been increased a hundredfold by the goldfields, the development of railway lines was for many years slow and intermittent. The demand for improved means of travel was strong enough, and the prospect of income from the many lines proposed was attractive. But the necessary capital was wanting. The colonies had few men with sufficient money and industrial enterprise to undertake railway construction; and in Great Britain, then as now the one outside source of Australian loans, the financier knew too little about the new country to advance the necessary capital. Between 1855 and 1861 the mileage of railways increased from 23¼ to only 243, and by 1871 it did not exceed 1,042.

Origin of state control of railways.

During that period the need for lines became pronounced in Victoria, New South Wales, and South Australia, and both mining and agriculture were sorely restricted because of the cost and time of travel and transport. But in the opinion at least of the great majority of Australians to-day the early difficulties had one good effect. The few companies which undertook railway construction at the outset failed owing to the absence of money and labour to complete their contracts, and the state was forced in the public interest to interfere. In this accidental manner began the government ownership of the railways. In 1911, of a total of 18,000 miles worked, over 16,000 miles were the property of the six states, and the indications strongly suggest the government purchase of all, or nearly all, the lines held in private hands.

Results of state control.

Australia both gains and suffers by the fact that her railways have been built by the state. The people have been saved much expensive duplication by the absence of competitive companies, and they have been victimized

by the evils of an always changing political control, both in the building and working of their lines. But if they were tested by a proposal to sell their railways at cost to private ownership, it is certain that they would vote overwhelmingly against it. The government system has been improved by experience: political influence has been almost entirely eliminated from administration, and each year the building of new lines is less subject to the opinions and interests of political individuals and parties, and decided more according to national interests. There has been in all of the states a varying amount of political jobbery in construction. New lines sometimes missed the cheapest and most profitable routes. Dominant city power often led to excessive centralization and unnecessarily long haulage of inland produce to an established centre, as, for example, Sydney, when the obvious economic outlet was often one of the minor ports to the north or south. Governments built expensive lines through great pastoral estates suited for agriculture, and afterwards purchased those estates for re-sale to the farmers at prices greatly enhanced by the railways. Many mistakes were made which would never have been made by private ownership combining land settlement and railway building. And yet in answer to this contention the advocate of state ownership is able to point to the fact that the few land and railway companies which exist in Australia have so far done very little to develop their territories. Briefly, it may be said that the mistakes by the states have been many and serious, but that most of them have been corrected, and that Australia to-day has a system which gives a fair service to the people at reasonable charges, and constitutes the chief asset against the national debt.

Separate systems of the states.

Each colony has followed its own railway policy, and as geographical conditions and individual opinions upon gauge and other important matters have differed widely, the result is a number of distinctive systems, which, as Australia concentrates both politically and industrially, are found increasingly troublesome. On the mainland, with

the exception of Queensland, the capital city is the centre from which the lines radiate; and taking the Commonwealth as a whole, the main lines roughly run parallel to the coast, with feeders running at right angles towards the centre of the Commonwealth. With the completion of the lines now being constructed from Port Augusta in South Australia to Kalgoorlie in Western Australia, and a line from Rockhampton to Cairns in Queensland, a rectangular railway will traverse two sides of the continent. When the system outlined is complete this coastal line will encircle the Commonwealth at a short distance from the coast, and lines of various lengths will penetrate the inland, and, as in the proposed line across South Australia and the Northern Territory, extend from ocean to ocean.

Extension of railways.

The slow growth of railways at the outset is explained by the difficulty in raising the necessary money, and by the heavy cost of construction through the mountainous country close to the coast. But each year as the coastal lands are left behind, and the wide tablelands and plains of the interior are entered upon, the mileage cost substantially decreases. Each year, too, as agriculture is advanced, and the population increased, the revenue prospects are improved. The early lines were overcapitalized, and annual losses were frequently heavy, but as more of the cheap lines are added to the total, the average cost is reduced. The tendency is greatly to accelerate the rate of construction. Between 1902 and 1911 the average annual addition to the total was 360 miles, and, with the Commonwealth now an active railroad builder, that average promises to be quickly increased. The general policy of each state is to duplicate and extend its trunk line system and to drive spurs into every locality which promises a home to new agricultural settlers, while special light lines are in places being carried out to give more convenience and certainty to the lives and incomes of the pastoralists on the light country of the inland. As in all Australian industries, the period of unprofitable pioneering is passing for the

railways, and the systems which have usually been a source of financial anxiety to their governments are now becoming a source of profit, after providing for the people an efficient service at rates which compare well with those of other countries.

State.	Per Mile of Line open.	
	Population.	Area.
	Number.	Square miles.
New South Wales	411	77·1
Victoria	371	24·6
Queensland	141	152·7
South Australia	206	190·7
Northern Territory	23	3,598·8
Western Australia	90	304·2
Tasmania	280	38·8
Commonwealth	249	165·1

Gauges.

A little foresight and co-operation between the colonies at the outset might have ensured that at least the inter-colonial trunk lines should have been built to a uniform gauge. But in the middle of the nineteenth century settlements were far apart, and after a feeble attempt to reach agreement, each colony proceeded along individual lines. The result is that lines in New South Wales have a 4 feet 8½ inch gauge, in Victoria 5 feet 3 inches, in Queensland, Western Australia, and Tasmania 3 feet 6 inches, while in South Australia the gauge is on some lines 3 feet 6 inches, and on others 5 feet 3 inches. The line from Adelaide to Melbourne is on the wider scale, and provides the only inter-state service which is not broken. But while it is regrettable that all the inter-state lines are not uniform, there is much to justify the variation in the local services. The prime object of Australian lines is to make the country available for settlement. A small population with a vast territory to develop is always pressed for money for public works. At the outset a cheap makeshift policy frequently pays. Later, when the population has grown and credit has improved, substitution, if necessary, can be easily afforded. Queensland supplies a good example of the pioneering

value of cheap narrow-gauge lines. With a territory of 500,000 square miles to develop it was obviously impossible for the early colonists to attempt the construction of lines as expensive as those of New South Wales or Victoria. But on the 3 feet 6 inch gauge Queensland was able to complete a greater length of track than her richer neighbours.

Breaks of gauge; speed; services.

In New South Wales and Victoria the country to be traversed, especially in the building of the early railways, was more mountainous and expensive than in Queensland, where the bulk of the construction has been over the pastoral plains of the inland. But the chief factor in the difference of cost has been in the gauge. It is significant that the Federal government, in the construction of the trans-continental line from Port Augusta in South Australia to Kalgoorlie in Western Australia, has decided, after full consideration of existing lines, on the New South Wales standard of 4 feet $8\frac{1}{2}$ inches. Strategic as well as economic reasons make the adoption of a uniform gauge for all the inter-state services desirable, and this may confidently be expected in the early future. At present, in travelling from Melbourne to Brisbane, complete changes have to be made at Albury, on the border of New South Wales and Victoria, and again at Wallangarra between New South Wales and Queensland. Hitherto the Australian trains have not attempted to excel in speed, so that the break is not so important as it might be in countries where travel is quicker. The 1,798 miles between Brisbane and Adelaide are covered at an average speed of only 30 miles an hour, exclusive of one stop of 8 hours 50 minutes at Sydney, and one of 3 hours 39 minutes at Melbourne. Those trains are expresses. Off the main lines the rate of progress is considerably less. The impatient traveller has always to keep in mind that he is in a new land where the traffic does not warrant tracks and rolling stock adapted for the fast travelling of Great Britain, Europe, or the eastern states of America. The trains are fairly comfortable. On the inter-state services the expresses in-

clude dining and observation cars, and on all lines dining and refreshment rooms are to be found at regular intervals. And in all the states the services are rapidly improving in efficiency and comfort. As Australia becomes richer, her people are able to pay for luxury, and an effort is also being made to make the Commonwealth more attractive to the traveller from overseas.

Railway rates.

The rates for passengers and goods compare favourably with those of other countries. Passenger accommodation is divided into first and second class, and the charges are about 2*d.* per mile for first, and 1¼*d.* for second. Concessions are made to travellers over long journeys, and this also applies to produce. The railways are worked primarily to develop the country, and settlers are encouraged by a differential scale of charges in their favour to settle in the districts away from the coast. In Western Australia women of the goldfield districts may travel up to 800 miles for 25*s.* and their children for half-price, to enable them to spend part of the hot summer on the coast. Return fares vary from 1½ times to double the single fares, except in New South Wales, where in 1911 return fares, except in the cities and for tourists, were abolished.

The differential treatment given to the settlers of the back country is illustrated in the following table, which shows the rates charged in the six states for the carriage of agricultural produce :

State.	*Charge per Ton in Truck-loads for—*			
	50 *Miles.*	100 *Miles.*	300 *Miles.*	500 *Miles.*
	s. d.	*s. d.*	*s. d.*	*s. d.*
New South Wales	5 0	7 6	10 6	12 0
Victoria	5 6	8 9	13 4	16 8
Queensland	4 7	8 9	12 0	14 0
South Australia	6 2	8 9	17 1	25 5
Western Australia	6 3	8 11	17 0	24 0
Tasmania	4 5	8 7	—	—
*Average	5 4	8 7	14 0	18 5
*Average per ton-mile	1·28*d.*	1·03*d.*	0·56*d.*	0·44*d.*

* Exclusive of Tasmania for hauls of 100 miles and upwards.

Finance and control.

While every state endeavours to make its railways pay at least interest on the capital expended, after all allowance for working expenses and depreciation, it is properly recognized that this is not always possible. Many of the early lines were built at an excessive cost, due in part to the dearness of money and labour, and in part to inadequate means of construction. There has been a rapid decrease in the cost per mile of construction. In the period between 1855 and 1872 the average cost was £24,500; between 1883 and 1892, £10,286; and between 1903 and 1911, £9,641. But although the total average is falling, many of the new lines now being built cannot return profits for some time. Nevertheless, the railways taken as a whole have now for some years shown a profit after paying interest and all expenses, the surplus in 1910–11 amounting to £1,424,000. The net return in that year amounted to 4·44 per cent. on the total capital of £152,855,000 expended on construction and equipment. It must be pointed out, however, that these years have been attended by good seasons and a high rate of production, although with closer settlement advancing so rapidly and production relatively increasing, the present position should be maintained.

At the outset the systems were under the direct control of a member of the government, and the result, as might have been expected, was far from satisfactory. Then commissioners were appointed to act under the minister, but still the political influence was dominant, and the construction and administration inconsistent and generally unsuccessful. Not until the state governments adopted the present arrangement of appointing commissioners with supreme power did the railways begin to work efficiently and economically. In New South Wales there is a chief commissioner supported by an assistant commissioner for railways and an assistant commissioner for tramways, and with slight alteration this system prevails in all the states. The tendency all through is to free the building and working of the lines from political influences, and to work upon strict business lines. The commis-

sioners are paid high salaries, and have been drawn from both the United Kingdom and America.

New construction and recent development.

New lines are now being laid down upon an unprecedented scale. All the states, with the exception of Tasmania, have marked the opening years of the century with bold schemes of construction, upon which Queensland, New South Wales, and Western Australia have been especially busy, while South Australia is also opening up large areas of agricultural land, and Victoria is building lines to facilitate and cheapen the administration of lines already opened. An improved spirit has also been apparent between the states: more common sense and less parochialism is being shown in dealing with the proper service of the country about the borders; and in the states themselves there is a disposition on the part of the capital cities to permit of decentralization and the building of lines direct to other coastal ports, so as to save long and expensive haulage to a common centre. In short, everything points to the more economical working of the railways, and to speedier and cheaper services. Electrification of the suburban lines is under serious consideration in Melbourne and Sydney.

Federal trans-continental lines.

The decision of the Commonwealth parliament to embark upon the building and ownership of railways is a matter of the first importance. The Trans-Australian line from Port Augusta to Kalgoorlie was agreed upon in 1911, and the work was begun in the following year. The distance to be covered is 1,065 miles, and the estimated cost £4,000,000. Following the example of some of the states, the Federal government decided to carry out the work by day labour, without the employment of contractors, a decision which reflects the experimental disposition of Australian legislatures in the direction of state socialism. A second federal line is also contemplated across the continent from south to north through South Australia and the Northern Territory, and whether or not the proposed route from Oodnadatta to Pine Creek is followed, a north to south line is regarded as inevitable within the next few years. It is demanded both for

defence purposes and for the development of the Northern Territory, a vast rich wilderness of 500,000 square miles, at present held by less than a thousand white people and a handful of Asiatics. In 1912 the Commonwealth parliament decided to construct an extension of the 75 miles of track, which up to that time was all the railway the region possessed. These federal beginnings are important in themselves and still more important because the federation has power under its constitution to take over the railways from the states, and the possibilities of this power being exercised are certainly strengthened by the events of 1911 and 1912.

The growth of the state systems in the new century is illustrated by the increase in the number of railway employees, whose numbers swelled from 42,000 in 1901 to 68,003 in 1911, a gain of over 60 per cent.

Tramways.

Tramways are found in all the capital cities and in other towns where the population is sufficient to demand them. In tramway construction and control the state has not been so active as in dealing with the railway, but the tendency now is to take over the lines from private ownership. The systems of Sydney and the rest of New South Wales are already almost entirely in the hands of the government. The Melbourne service is on the eve of transfer, while in the other states the nationalization of those lines still privately owned is regarded as inevitable. In 1911 the Commonwealth contained 480 miles of track, of which the government owned 240, municipalities 74, and 166 were under private control. The services are rapidly being changed from steam and cable and horse power to electricity. Generally speaking, the services are cheap and efficient.

Posts.

Taking into consideration the large area of the country and the sparseness of the population, the post and telegraph services, all of which are owned and worked by the Commonwealth government, are good, although the charges are necessarily higher than those ruling in some of the more closely populated countries. Australia possesses upwards of 5,500 post offices, and with the

spread of rural settlement the number is rapidly increasing. Obviously large numbers of the inland services do not pay, and this raises the average expenditure. Nevertheless postal charges are uniform. The letter rate is 1*d.* per half-ounce, irrespective of distance. An interesting point is that in the carriage of books, magazines, and other reading matter, differential rates are charged in favour of matter which is printed within the Commonwealth, a preference aimed at the encouragement of local industry, which is noticeable in all government departments. The mails are carried as far as possible by the railways and the inter-state and coastal steamship services, while in the isolated districts they travel by coach and sometimes by pack-horse.

Overseas mails.

The government subsidizes various shipping companies for the carriage of overseas mails. The chief subsidy is paid to the Orient line for the transport of postal matter between Australia and Great Britain, the annual amount under a contract which began in February 1910 being £170,000. Some interesting conditions are attached to this subsidy. The company undertakes to employ only white labour upon its steamships, a concession to the Australian policy of discouraging the employment of the cheap alien in competition with the white worker. The company also contracts to provide on each vessel of not less than 2,000 tons 40 cubic feet of insulated space for the transport of fresh cargo from the Commonwealth. The freights, too, are fixed by arrangement, and must not exceed $\frac{1}{2}d.$ per lb. for butter, and 60*s.* per ton for fruit. The flag of the Commonwealth must be flown, and the Commonwealth possesses the right to purchase the company's vessels at valuation at any time.

The total revenue of the post office amounts to about £4,000,000, and since the inauguration of penny postage the department has worked at a slight loss. The whole service is under the direct control of the Commonwealth government, and is administered by the postmaster-general, who is a member of the cabinet.

Telegraphs.

The telegraph services extend as far as there is settlement. The stations in 1910 numbered nearly 4,000, and the lines extended 44,000 miles, and carried about 97,000 miles of wire. The six capital cities were connected in 1877. The rates charged are: city and suburban 6*d.* for 16 words, including the address; within the boundaries of a state 9*d.*, and inter-state 1*s.*, each additional word costing in all cases 1*d.* In 1871 cable communication was opened between Australia and London via Port Darwin and the East, and in 1872 the South Australian government connected Adelaide and Port Darwin with the first trans-continental wire at a cost of £500,000. Since then there has been a rapid development in communication with the outside world. The Eastern Extension Company, which owns the cable which starts from Port Darwin, now works a second service from Broome, on the north-west coast, to Singapore and Madras, and also a third line opened in 1901 running from Australia by the Cape of Good Hope to Great Britain. In 1902 the governments of New South Wales, Victoria, and New Zealand, co-operating with Great Britain, opened the 'All-Red' Pacific Cable, which runs from Australia via Norfolk Island, Fiji, and Fanning Island to British Columbia, and connects with New Zealand by Norfolk Island. In 1872, when messages began to be sent over the Port Darwin cable, rates were as high as 9 guineas for 20 words, but they have been gradually reduced.

Telephones.

Telephones are general in the cities, and are rapidly coming into use in all the inland towns and among the settlers. They are all owned and worked by the Federal government.

CHAPTER VIII

THE PEOPLE OF AUSTRALIA

By P. Evans Lewin

Distribution

Numbers and nationalities.

According to the census of 1911 the population of Australia was 4,455,005. In race and nationality this population is fundamentally British. Moreover, fully 82 per cent. can claim to have been born in the Common-

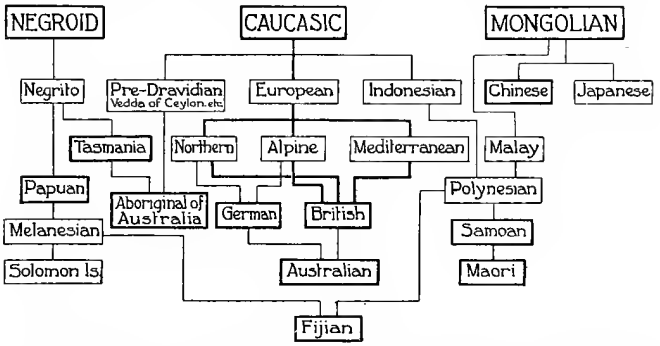


Fig. 59. Diagram to illustrate Descent of Australian and Pacific Peoples.

wealth, and of the remainder 13 per cent. came from the British Isles. The foreign-born population, therefore, is small. Of such, only about 1·5 per cent. were born in European continental countries, and of these nearly one-half (32,990) came from Germany. The population is preponderatingly white. The aborigines, like the Asiatic inhabitants, are continuously decreasing in number; the decrease among the former being due to natural causes, whilst amongst the latter it has been due to economic and political factors intimately connected with the national policy of a 'White Australia'. Although the number of Asiatics is still larger than it was in 1861, when there were 38,298 Chinese in the Commonwealth as compared with 39,740 Asiatics at the present time, the relative

decrease has been large, especially since 1901, when the Asiatic population stood at 45,478. In 1861, 3·4 per cent. were Asiatics. In 1911 the percentage had fallen to 0·9. With regard to the distribution of the population one fact stands out prominently: although Australia is largely a pastoral and agricultural country, the urban population is comparatively large. Nearly two-fifths of the population are settled within the five chief metropolitan areas. In New South Wales more than 38 per cent. of the population are congregated in and around Sydney, whilst in Victoria 44 per cent., in South Australia 46 per cent., in Queensland 23 per cent., and in Western Australia 38 per cent., are settled in and in the vicinity of the metropolitan cities. In this connexion, it must be remembered that the metropolitan areas usually consist of a number of parklike suburbs, in which the population is by no means closely confined, and that the evils of over-crowding, so prevalent in European cities, only exist to a small extent in the Australian capitals. During the decade 1901–11 the population increased by 18·05 per cent., an increase almost the same as that during the previous ten years. This falls considerably short of what might be anticipated in a new country with no more than fifteen inhabitants to every ten square miles of territory. The greatest relative increases have been in New South Wales and Western Australia. The natural growth of the population accounts for all but about 10 per cent. of the increase; but the comparatively slow immigration, due in no small measure to the drought at the beginning of the twentieth century, and to certain political and sociological factors, gave place in more recent years to a more rapid increase, fostered by an active immigration policy, and attracted by the flourishing condition of all branches of industry. The death-rate of 10·7 per mille leaves only a small margin for reduction, whilst the birth-rate of 26 shows, if anything, the same tendencies as in other countries. The average population of 1·5 per square mile is determined by the 14·97 in Victoria and the 5·31 in New South Wales. In no other

state save Tasmania is the general average reached. In fact, 70 per cent. of the population inhabit 14 per cent. of the total area, and the large states of Western Australia, South Australia, and Queensland, with the Northern Territory, cover 85·7 per cent. of the continent, but support only 29·2 per cent. of the population.

Distribution of population: controlling factors.

The distribution of the people has been dependent upon three main factors: the geographical structure of the continent and its climatic conditions; the economic development of its natural resources; and the opening of avenues of communication between the chief centres of economic production and the seaports that form the gateways of intercourse between Australia and the rest of the world. The first of these factors has been described in detail elsewhere, and it is only necessary to mention briefly the geographical features that so strikingly differentiate Australia from other portions of the globe, so far as these have affected the flow of population. The second factor is so closely related to the first, that it is unnecessary to do more than allude to the essential interdependence of the two; while the third, the provision of means of transport and communication wherever, as is largely the case in Australia, natural avenues of communication by means of inland waterways are lacking, so naturally precedes and follows the successful exploitation of the agricultural and mineral wealth of the country, that its influence upon the introduction of a settled population can be clearly discerned wherever railways have been pushed into the interior.

Isolation of Australia.

Geographically, the settlement of Australia has been retarded by its isolation from the great centres of population in Europe and Asia. Shut off from the rest of the world by the Pacific and Indian Oceans, its discovery by the colonizing races of mankind was delayed until the eastern coasts of America had been explored. Historically, the late colonization of Australia was due to three important considerations: the fact that the then leading maritime nations were fully occupied in adventures and discoveries in portions of the globe much closer to the

metropolitan countries than any portion of the southern seas; the unwillingness of the Dutch, whose voyagers had visited its western shores, to extend their trading operations beyond the limits they had marked out as peculiarly their own; and the almost uniformly unflattering opinions expressed by the early explorers regarding the capabilities and resources of the newly discovered continent.

Discovery and first colonization.

The western coasts were largely explored by Dutch seamen sailing under the auspices of the Dutch East India Company. In 1616 Dirk Hartog sailed down the coast, reached Sharks Bay, and discovered the island that still bears his name. In the half-century following, many voyages were made in Australian waters, Pieter Nuytz, Pieter Carpenter, Francis Pelsart, Pieter Pieterz, and Abel Jansen Tasman entering upon the new field of discovery and reporting to the Dutch authorities. Pieter Nuytz found the country 'a foul and barren shore'; the commander of the *Pera*, Jan Carstens, stated that 'shallow waters and barren wastes were everywhere found, with islands altogether thinly peopled by divers cruel, poor, and brutal nations'; and even William Dampier, the first Englishman to engage upon maritime adventure on the Australian seaboard, reported that 'the land was not very inviting', and that 'the natives were the miserablest in the world'. It was not until the eastern coasts were discovered by Captain Cook, who sailed into Botany Bay on April 29, 1770, that the story of Australian settlement can be said to begin. Although their opinion of the country was much more favourable than the despondent views of the western littoral expressed by the Dutch, Cook and his companions were not enthusiastic about their discovery. Sir Joseph Banks, and a young midshipman named Matra, alone formed a just estimate of the country. Cook found the natives dirty and repulsive, and although he spoke of 'deep black soil which we thought capable of producing any kind of grain', he also stated that he believed that the country was 'in general sandy'. How mistaken was this estimate of the fertile lands they had discovered has been abundantly proved. Eighteen years

passed before the first settlement was made in Australia. The colony founded on January 20, 1788, when Captain Arthur Phillip and his batch of 565 male and 192 female convicts, together with 18 children, sailed into Botany Bay, was designed to be a penal station. Perhaps it was inevitable that Australia should first have been colonized by the riff-raff of the population of Great Britain. Many factors prevented the flow of a free population to the unknown and distant shores of New Holland. The first settlers were not all mild-mannered gentlemen convicted of petty crimes that would be lightly punished under a less severe code. They were, on the contrary, mainly of the criminal classes, as is testified not only by the records of their convictions but by the drab expanse of misery and crime, of vice and depravity, that marked the early days of the settlement. But the transportation period is no more the story of Australia than is the Newgate Calendar the story of England. The leaven of free settlers, men of sturdy stock and independent character, soon leavened the whole and formed the nucleus of the new nation, from which were drawn the pioneers and founders of new settlements, who began to make their way inland to the rich agricultural and pastoral lands of New South Wales and Victoria.

Geographical factors controlling settlement.

It will be well here to describe the geographical influences that were at work in the settlement of Australia. The first batch of convicts had arrived at Botany Bay; Governor Phillip, however, almost immediately removed his colony to the neighbouring harbour of Port Jackson, where the surroundings were more suited for a permanent settlement. As fresh batches of convicts arrived and free settlers began to find their way into the country, economic necessity compelled the foundation of new settlements. The distribution of population proceeded upon slow and leisurely lines. The mountains lying west of Sydney proved a formidable barrier against colonization that was not surmounted for some years, partly owing to the inadequate means at the disposal of the Governor and partly owing to the fact that the situation of the ranges

gave rise to numerous rivers, so that settlements could more easily be founded at some point near where they entered the sea. For this reason the new colony at first spread coastwise rather than towards the interior. The mouth of the Hunter River, for example, formed a suitable station for the desperate Irish convicts who were transported thither in 1805, although the district of which Newcastle is the flourishing centre was not thrown open to free settlement till 1821. Further settlements were made at Parramatta and places within easy reach of Sydney by water. An abortive settlement under David Collins was made at Port Phillip, the harbour that had been discovered in the present state of Victoria. Collins, however, thought the neighbourhood unsuitable, and believed that 'the country cannot nor ever will be resorted to'. He removed his charges to Tasmania and thus missed the honour of being the founder of the city of Melbourne.

But as soon as the Blue Mountains had been crossed in 1813 by Gregory Blaxland and William Charles Wentworth, and the open grasslands to the westward discovered, the western foothill country was explored and a settlement formed at Bathurst, the earliest of Australia's inland townships. The incoming population followed the natural lines of traffic. The main roads were constructed along the mountain ridges and were usually carried from one river basin to another by natural gaps in the watershed. Settlement almost inevitably took place at suitable points along the river valleys, either at the furthest limits of practical navigation, or at some point giving easy access to the capital city. At a later period when railways were introduced they almost invariably followed the already clearly defined routes of commerce.

Penetration of the interior.

As settlement proceeded inland it was found that there was a great contrast between the central and coastal districts. The most easily settled and certainly the most attractive districts were all on the margin of the continent. Inland exploration soon demonstrated that the fertile lands lay at no great distance from the coasts and that the interior offered an arduous life to the

settler, who would be constantly engaged in a fight with drought and famine to maintain his position away from the clearly defined fertile districts. The earlier settlers, when not engaged in practical agriculture, were employed in the pastoral industry. Their settlements were naturally founded in districts suitable for their special needs. Bathurst, standing in the centre of a fertile plain, surrounded by hills, and situated on the Macquarie River, became a starting-point for the pastoralists, who with their sheep travelled along the tributaries of the Macquarie and Lachlan rivers in search of suitable pasture-land. In the same way Goulburn, in the centre of a rich agricultural district about 134 miles south-west of Sydney, was founded in 1820 and became another important distributing centre for settlers seeking fertile lands along the tributaries of the Murrumbidgee. The extensive drainage system of the Hunter River and its tributary the Goulburn was settled at this period, and a few hardy pioneers journeyed over the route followed by Allan Cunningham in 1823, near the head of the Goulburn River, and settled on the Liverpool plains or pushed forward to the upper reaches of the Darling River. By the year 1832 Goulburn, Bathurst, and Maitland, the last situated on the lower Hunter River, had been joined to Sydney by good roads, and a few years later roads were constructed to Orange, the centre of a fertile agricultural district to the north of Bathurst, and a southern roadway was made from Goulburn to Yass and as far as Gundagai on the Murrumbidgee River. Settlement in the latter district took place in 1829, and seven years later both Yass and Gundagai became important stopping-places for the overlanders making their way to the newly opened districts in the Port Phillip settlement.

Influence of rainfall on settlement.

As has been pointed out, settlement on any large scale was not possible beyond the area of sufficient rainfall. Although the squatters pushed further and further towards the western limits of the colony, their numbers beyond the area of sufficient rains have not been large enough to make any appreciable difference in the popula-

tion of the continent. A comparison between a rainfall map of the Commonwealth and one showing the distribution of the population shows that, save in the unoccupied districts of the Northern Territory, the practically unoccupied northern portion of Western Australia, and the thinly peopled portion of Northern Queensland, where hitherto climatic conditions have been opposed to any close white settlement, the population is greatest wherever the rainfall is most abundant. It will be found that in Queensland population is densest, if this term can be applied to a sparsely settled country, in the coastal districts, and that with the exception of the extreme north the rainfall is heaviest around the greatest centre of population at Brisbane. In the same way the rainfall is heaviest in the narrow coastal belt running from Jervis Bay to the Queensland borders, in which are situated Sydney, Newcastle, and Maitland. In Victoria the greatest rainfall is not far to the east of Melbourne; in South Australia it is in the districts around Adelaide; whilst in Western Australia both Perth and Albany are in the area of abundant rainfall. The fact that practically all the mountain-masses of Australia are grouped along the eastern coast has profoundly affected the rainfall and has contributed to the settlement of population in this portion of the Commonwealth. The central portion of Australia has a normal rainfall of less than 10 inches, and such irrigation schemes as may be carried out in the future, although they will largely influence the course of settlement, are not likely to change the destiny of the central portion of the continent, which will remain the dead centre of a gradually improving pastoral country stretching away to the more fertile agricultural lands of the eastern and south-eastern littorals and to the south-western coasts of Western Australia. The settlement of the northern portion of the continent depends upon climatic and political factors, the former not yet thoroughly understood and the latter scarcely open to modification whilst Australia remains a portion of the British Empire. The geographical factors being understood, and the main

features of the continent having been described in other chapters, it is necessary to return to the details of the spread of its population.

New South Wales.

Settlement was at first purely agricultural and pastoral, and was practically confined within the present boundaries of New South Wales. The survey of the coasts undertaken by Matthew Flinders in 1801–3 demonstrated that there were other portions of Australia eminently suited for colonization. The discovery of St. Vincent Gulf, backed by the beautiful Mount Lofty range, Lieutenant Murray's discovery of Port Phillip in 1801, and the earlier discovery of Port Dalrymple on the northern coasts of Tasmania by Bass and Flinders, who found that this country wanted 'very particular attention', directed attention to other portions of Australasia. Moreton Bay had been visited nearly thirty years earlier by Captain Cook. The first settlement at Port Phillip having been abandoned, two convict stations were formed in Tasmania, at Port Dalrymple and at Restdown or Resdon, five miles from the present capital, Hobart. Convict stations were also formed at Moreton Bay (1823) in the future colony of Queensland, and at King George's Sound (1825) and Fremantle in Western Australia. Although Governor Phillip had applied again and again for free settlers, their immigration was for some time discouraged. But the supply of farmers and mechanics never entirely ceased, and the men who became the real backbone of the country, the directors and organizers of labour who were to make the wilderness to flourish and were to supply the settlements with the agricultural produce necessary for their maintenance, soon became a strong factor, both politically and socially, in the economic life of the colony. This was specially the case after the policy followed by Governor Lachlan Macquarie (1809–20) had been reversed. He had encouraged the settlement of emancipated convicts on the land, but had not been favourable to the introduction of free settlers. His administration under this limitation was sound and progressive, for he not only fostered exploration but actively

furthered the construction of roads and bridges. The population, however, was exceedingly small. After forty years of settlement there were only 36,598 inhabitants (November 1828). Within five years the number reached 60,794, whilst in 1841 the population was 181,072, including 50,216 in the island of Tasmania. The spread of the pastoral industry, which had so great an effect upon the settlement of Australia, was largely due to the efforts of two men, John Macarthur and the Rev. Samuel Marsden. The former started his experiments in sheep-breeding in 1793. But it was some years before the export of wool was upon any large scale, for as late as the year 1824 only 275,560 lb. were exported to Great Britain. It was still longer before the wealthy squatter community, an aristocracy who acquired immense areas of land, much of which has since been utilized for purely agricultural purposes, obtained the political influence they subsequently wielded. From the first they were of great importance as a social force. They were generally men of some standing and were frequently possessed of private resources which they employed in the stocking of their stations. For the small farming community who gradually became established in their midst, the 'cockatoo' farmers, as they were called, who not infrequently settled on an unoccupied corner of their vast domains, they had a somewhat uncalled-for contempt. But it was the farming community which eventually put the country to its best use and soon formed the most numerous class of the population. The poorer settlers and emancipated convicts learned from the farmers how to obtain the best results from their labour. 'With hundreds of cattle', said John Henderson, writing in 1851, the settler had 'no butter, cheese, and very often no milk. With a rich soil he has no garden nor any vegetable or fruit to drive away the scurvy. With grain he has no poultry; with a gun he has no game; with hooks he has no fish.' The attention devoted to agriculture not only changed this state of affairs but proved the capabilities of Australia for other industries than cattle or sheep farming.

South Australia and the Murray River.

With the constant introduction of free settlers and their distribution over the colony came a progressive improvement in social conditions, and when South Australia was founded in 1836 as a free colony without any convict taint a great step forward was made. The foundation of Adelaide marks an important epoch in Australian settlement. The new colony was founded upon the system advocated by Edward Gibbon Wakefield. The site of the capital was well chosen, and although the earlier administration of the colony left something to be desired, such mistakes as were made were largely due to inadequate financial support on the part of the imperial authorities and to the fact that the Wakefield system, sound enough in theory, failed, for a variety of reasons, in actual practice. The city was planned by Colonel Light, who made adequate provision for its growth and reserved large park-like domains for the use of its future inhabitants. The result is that Adelaide is one of the best-planned cities in the world, encircled by a broad belt of park-lands, and traversed by wide and well-kept streets. The early history of the new settlement must be briefly touched upon because the future prosperity of South Australia was brought about, not through the cut-and-dried schemes of Wakefield, who provided for almost every eventuality on paper, but by their almost direct negation through the action of the pioneer settlers. Wakefield's idea that the revenue produced by the sale of land would be made reproductive by expending it on importing immigrants, and that a ready-made English country would blossom into fruition on the Australian soil, with its complement of landowners, architects, engineers, lawyers, and labourers, each with his allotted place in the scheme of corporate existence, unfortunately led to a mad speculation in city lots. As boat-load after boat-load of emigrants arrived they crowded into Adelaide, camped on the site of the unbuilt town, and became speculators and dealers in land. The rich soil of the Adelaide plains was cut up into allotments, which became sources of profit to their owners so soon as they changed

hands at an enhanced price. The bubble soon burst, and the end of the land boom was that many of the pioneers were poorer than when they had arrived. They were compelled to cultivate the soil or starve. But in the long run the failure of Wakefield's scheme had a beneficial effect. The colonists spread over the country in search of suitable land for farming; they occupied the Adelaide plains and pushed further afield; and prosperity returned so soon as the dispersal of the inhabitants became an accomplished fact. In South Australia is to be seen the best example of an Australian State thriving almost solely upon agriculture.

Distinctive geographical conditions in South Australia.

The gold deposits which subsequently attracted such numbers to New South Wales and Victoria, and at a later period to Western Australia, contributed only in an indirect degree to the prosperity of the middle State, though both copper and silver have directly facilitated the building up of the province. The interior formation of South Australia differs from that of the eastern states. The Mount Lofty Range running parallel to St. Vincent Gulf is joined by the Flinders Range, the beginnings of which form the backbone of Yorke's Peninsula, and run inland until they end abruptly in the swamps and salt-lakes, of which Lakes Eyre and Torrens are the principal. The result has been that settlement has proceeded to the east and west of these ranges, starting from Adelaide and gradually spreading northwards and southwards at no great distance from St. Vincent Gulf or from the western shores of Spencer Gulf. The comparative aridity of the western districts having deterred settlement in that portion of the state, the centre of population remains in and around the capital. Within a ten-miles' radius of Adelaide is a thriving population, many of whom are engaged in fruit culture, and the district is a combination of township, gardens, and vineyards where the inhabitants enjoy many of the delights of rural life, and the advantage of being in close touch with a large city. Unlike most portions of the Commonwealth, South Australia owes much to German settlers, who began to arrive in the

German settlement.

colony as early as 1838, and founded several small agricultural and fruit-growing settlements, such as those at Blumberg, Concordia, Grunthal, Hahndorp, and Lobethal. In fact these German settlers form the one considerable foreign element in the Commonwealth. Settlement has also proceeded along the Murray River, where important irrigation colonies have been founded. Although these settlements belong to a later period than is here described they must be briefly alluded to. At a time when Australia was suffering from a period of depression attention was directed to the communistic schemes advocated by some of the more advanced followers of William Lane, who, finding at the time no opportunity in his own colony, emigrated to Paraguay with a number of enthusiasts in order to found a 'New Australia' in that country. The village settlements founded on communistic principles showed much the same defects as the disastrous enterprise in Paraguay. The government set aside large tracts of land for the new enterprise, and in the first year of the experiment there were eleven such settlements. In 1910 only three survived, of which two were to be abandoned, and the settlers had dwindled from 1,700 to 182. The flourishing irrigation colony at Renmark, however, situated on the banks of the Murray, is a testimony to the value of state-aided co-operation when carried out upon business-like principles. The district has been transformed from a barren waste into one of the most promising fruit-growing centres in the Commonwealth, and like the fruit colony at Penola, in the extreme south-east of the State, demonstrates the peculiar suitability of South Australia for the growing of fruit.

Influence of the Murray River on settlement.

The Murray River, being the great natural drainage line of the south-eastern portion of Australia, naturally has had considerable influence upon the settlement of the country. It has been stated how settlers crossing the Liverpool Plains had reached the head-waters of the Darling, the principal tributary of the Murray. When Bourke, the chief centre of the northern portion of the western plains of New South Wales, and situated on the

Darling at a distance of 1,390 miles from the mouth of the Murray, or of 503 miles by rail from Sydney, was first established, it was fondly predicted that it would become the Chicago of Australia, the centre of a great system of rail and water transport. As South Australia forms the natural outlet of the Murray it has been the desire of that State to preserve the navigation of the Murray. In good seasons the Murray is navigable for 1,366 miles, as far as Albury, and the Darling for 1,180 miles, as far as Walgett, and South Australia has always protested against the action of Victoria and New South Wales in constructing irrigation works that would hold back the flow of water and thus interfere with the navigation.

Communications and settlement, Murray region.

It was many years before the practical navigation of the Murray was undertaken. On February 11, 1830, Sturt and his companions, after having journeyed for thirty-three days down the Murrumbidgee and the Murray, reached its outlet into the sea. But it was not before 1853 that Captain Francis Cadell made the first successful voyage up the river and brought back the first cargo of wool. The Lieutenant-Governor of South Australia, Sir Henry Young, who was on board, foresaw the valley of the Murray teeming with a wealthy industrial population, and prophesied that Port Elliot at its inconspicuous outlet into the sea would soon become 'the New Orleans of the Australian Mississippi'. Neither the new Chicago nor the New Orleans has yet taken its place in the industrial economy of the Commonwealth. But the fact was demonstrated that a certain amount of wool and other products could be carried on the river, and Goolwa, the oldest established port connected with the Murray River trade, has been provided with extensive storage and wharfage accommodation. The vexed question as to whether the river should be used for navigation in view of the fact that the chief centres of population along the course are served by railways, cannot be considered in the present chapter. It can only be pointed out that the interests of South Australia and the other states are not diametrically opposed; for the locking of the river at

various points might not only make it an efficient means of transportation but, in the event of the flow of water proving sufficient, would also enable extensive schemes of irrigation to be carried out along its course. The Murray is now tapped by railways at Murray Bridge and Morgan in South Australia, and in New South Wales and Victoria railways reach the river at Mildura, where there is an extensive irrigation colony, Swan Hill, Koondrook, Echuca, Cobram, Yarrawonga, Corowa, and Albury, an important town on the direct line between Melbourne and Sydney, and it will not be long before the river is tapped at several other points. On the Darling, Wilcannia, Menindie, and Wentworth, small settlements that may some day support a larger population, remain unconnected with the railway systems of New South Wales. The future of these waterways therefore seems to lie with irrigation rather than navigation, and the coming generation will witness a vast industrial change in this portion of Australia. On the whole the population settled along these waterways is not so large as might have been expected. The Murrumbidgee, upon or near to which are situated the towns of Hay, Narrandera, Wagga Wagga, Gundagai, and Tumut, which are all on railways running through the oldest wheat district—the Riverina—alone supports any considerable population along its banks.

Agricultural settlement in South Australia is practically confined to the south-east and to the irrigation settlements along the Murray. The vast arid plains of the northern districts are only suitable for pastoralists, while the barren deserts to the north of the Great Australian Bight will never be suitable, in all probability, for any kind of settlement. A glance at the map shows how small an area out of all this vast territory is ever likely to be closely populated. It has been estimated by Mr. Griffith Taylor that out of the present area of 380,000 square miles only 15,000 are suitable for close settlement. It must be borne in mind, however, that this comparatively small area is capable of a very high development. It is, in fact, an oasis that will

Agricultural settlement.

be the fruitful agricultural centre of a vast pastoral country. The Adelaide plains are the core of this oasis, but other parts of the south-eastern division are equally fertile. One of the earliest of these districts to be settled is around Gawler, a small town about 25 miles north-east of Adelaide. Gawler itself is the centre of a rich agricultural and vine-growing district, as is Mount Barker, about 22 miles east of the capital. Mount Gambier, in the extreme south-east of the State, 305 miles from Adelaide, is the thriving centre of an agricultural population; while Gordon, about 256 miles from Adelaide, marks the northern limit of effective agricultural settlement, villages to the north of this point depending largely, though not entirely, upon the pastoral industry. To the west Streaky and Fowlers Bays, over 300 miles from Adelaide directly, and much further by sea, mark the extreme limits of effective settlement. Port Augusta and Port Pirie on Spencer Gulf, and Port Wakefield on St. Vincent Gulf, came into prominence owing to their vicinity to mineral deposits (Chapter VI).

Western Australia.

Having thus surveyed the agricultural and pastoral settlement of South Australia it will be well to consider the effect of agriculture upon the settlement of Western Australia. Here, however, a new problem is presented for consideration. It might have been expected that the western State, lying as it does 2,428 miles nearer to England than Sydney, would have been developed at a much more rapid rate than New South Wales. With the exception of the tropical north it has actually been the last of the Australian States to be effectively occupied. So late as 1881 the total population of the million square miles of territory known as Western Australia was only 29,708, and nine-tenths of this insignificant number were settled in the small area lying between Perth and Albany. Doubtless the unflattering accounts of the early voyagers had something to do with this neglect of Western Australia, but the slow colonization of the State was largely due to the ill repute into which the colony fell owing to the unfortunate depression that prevailed for so many years

after its foundation. Starting forth with high hopes and buoyed up by alluring accounts of the riches of the new country and the prospects of a great trade with China, the colonists who arrived in the year 1829, to the number of 1,300, found that no preparations had been made for their reception, and that years of work were necessary before they could reap their anticipated harvests. Two settlements were founded, the one at Fremantle at the mouth of the Swan River and the other at Perth, 12 miles distant. Unfortunately many of the colonists came with large grants of land in their pockets, and on pushing forward to their new possessions found that the very extent of their territory was an embarrassment, as they were far removed from their neighbours. The scenes that were subsequently witnessed at Adelaide, where the newcomers gathered together in the capital, were not witnessed at Perth and Fremantle. The settlers became widely scattered, and their difficulties were added to by the impossibility of securing enough labour to cultivate their estates. The lavish distribution of free grants of land, by a government that awarded provinces as easily as if they were pennies, was the undoing of the new colony. Even when the initial mistake was rectified and the price of land fixed at five shillings an acre, it was within the power of the labouring immigrant to purchase a few acres and to start operations on his own account. The labour market became starved, the settlers of better class, with many acres of unproductive land, were like Midas in the midst of his gold, and only the humblest were able to weather the economic storm. But though matters gradually righted themselves the struggles of the new colony were remembered elsewhere, and emigrants preferred to pass on to New South Wales and Victoria, where conditions were better understood and the prospects seemed brighter. This was especially the case after gold had been discovered in those States. Thus it was that this vast territory, with an area sixteen times as great as that of England and more than three times as large as that of New South Wales, so long contained a popula-

Early settlements.

tion less than that of a moderate English provincial town.

Small townships were established at Guildford, 9 miles from Perth, at York, 77 miles inland from the capital, and at Albany on King George's Sound, where the military station established by the New South Wales government in 1826 was taken over by the new colony. Further settlements were gradually formed along the south-western coasts in connexion with the jarrah timber trade which was subsequently developed. These timber ports are Rockingham, Bunbury, which was the scene of one of the fiascos in colonization that marked the birth of the colony, Busselton, Karridale, and Augusta, not far from the well-known Cape Leeuwin. To the north of Perth the only coastal towns of importance are Geraldton, 290 miles away, Sharks Bay, 500 miles to the north, Roebourne, with its port Cossack, 1,200 miles from Perth, and Broome. The last is known as the chief centre of the pearling industry.

Regional conditions.

But for the discovery of gold, which has been instrumental in changing the economic future of the country, it is probable that settlement would have been almost exclusively confined to the coastal districts, which are traversed by several small rivers and are fairly fertile. To some extent the configuration of Western Australia corresponds with that of the eastern States. The surface shows two clearly defined areas, the edge of the vast inland tableland rising to a considerable height at or near the coast. But the southern littoral which marks the abrupt termination of the interior plateau is broken by no waterways and is the edge of a great desert country. This desert country literally overhangs the Great Australian Bight, although it has been asserted that a portion of these southern coast-lands is suitable for cultivation. As we are here dealing with the agricultural and pastoral settlement of the State nothing need be said about the remarkable recent developments due to the discovery of gold, except in so far as it has affected the agricultural settlement of the country. The rapid spread of the pastoral

industry was well shown on a map illustrating a paper by Professor J. W. Gregory in the *Geographical Journal* for June 1910. A considerable area in the south-west was shown to be suitable for agricultural purposes, and immense areas in the mid-west and north-west were seen to have been taken under pastoral leases. This new development had been made possible by the discovery of a widely-spread sheet of fresh subterranean water sufficient to supply wells for the maintenance of the stock routes of the interior. So soon as Western Australia's arrested development was ended by the flood of population which was drawn to its shores by the magnet of gold, people began to realize that the south-western portions of the State were capable of high cultivation, and a vigorous immigration policy was initiated. The result was the settlement of numerous rich agricultural districts—the settler following hard upon the heels of the surveyor. These districts lend themselves admirably to irrigation, and their qualifications for supporting a close agricultural population are now undoubted. To the west of Albany the Denmark country is being rapidly occupied, and many districts within easy reach of the south-western ports are playing their part in the agricultural settlement of the south-western corner of Australia. In the tropical north and north-west settlement began in the 'sixties as the result of exploration in those immense territories. The first attempt at settlement in the country around Roebuck Bay, in 1864, was not successful. It was thought that the district was not suitable for sheep-grazing, and the settlement was abandoned. Of late years, after the burning of the grass, both sheep and cattle have thriven in this locality. The exploration of Alexander Forrest in the Kimberley district in 1879 called attention to the capabilities of this great territory, where a certain amount of pastoral settlement has since taken place. The few settlers who landed at Cossack in 1863 opened the first chapter in the settlement of the north, and pastoral settlements were subsequently founded in the Murchison, the Upper Gascoyne, and Kimberley districts. Nearly

Agricultural development.

half the area of Western Australia is within the tropics, and although the population in these districts is still extremely small, it compares favourably with that in the Northern Territory, in spite of the fact that the absence of any great tropical industry, such as the sugar cultivation of Queensland, has hitherto retarded the influx of population. In all there are about 7,000 white settlers in the tropical portions of the western State, of whom not more than 1,000 are women.

Victoria.

The state of Victoria is the most closely settled portion of the Commonwealth. There is only one district, the arid county of Millewa lying in the extreme north-west, that shows a less population than one inhabitant to sixteen square miles. Of the remaining counties, Weeah, immediately to the south of Millewa, Wonnangatta, and the extreme south-eastern coastal county of Croajingalong alone show a less population than one inhabitant to the square mile. The colonization of Victoria dates from 1834, when the Henty family started a whaling establishment at Portland Bay, worked in connexion with sheep farming and agriculture. In 1835 John Batman landed at Port Phillip and founded the Port Phillip Association, which was the first serious attempt at the settlement of Australia Felix. The fame of the new district soon spread, and the ' overlanding ' migration from New South Wales, which quickly assumed considerable proportions, commenced in the following year. The journeys of Sir Thomas Mitchell, who explored the Lachlan, the Murray, the Wimmera, and the fertile plains of the south, had much to do with the new movement, the glowing accounts published in his book, *Australia Felix*, attracting considerable attention.

Batman, whose original settlement was at Geelong, obtained grants of land from the aborigines, one of them including the site of the future city of Melbourne. It was some time before the new colony was officially recognized, and when a grudging recognition was finally vouchsafed, the territory was included as a portion of New South Wales, with which it remained incorporated until 1851.

Settlement: geographical factors.

The settlement of Victoria was effected at a remarkably rapid rate. Quite apart from the gold rush of a few years later there was a considerable immigration into the new districts. Large numbers of pastoralists travelled overland from New South Wales, with their herds and flocks, in search of suitable feeding-grounds, and settled wherever it seemed probable that sufficient water would be obtained. Many others journeyed by sea, both from New South Wales and from Tasmania. They entered the colony at Portland, now about 252 miles from Melbourne by rail, and at Port Phillip, quickly spreading over the surrounding country. By the year 1840 it was estimated that there were 14,000 inhabitants in the country. The early settlement of Victoria proceeded mainly along the river valleys. The territory drained by the tributaries running northwards from the Hume Range and the Pyrenees to the Murray River offered suitable grazing-grounds for the overlanders from New South Wales. Thus settlers arrived on the Goulburn as early as 1837, the Campaspe Valley was first occupied about 1840, and the Loddon districts were settled at the same time, settlement gradually extending along the river till by 1845 the valley was occupied as far as the junction of the Loddon and Murray. Further west the Avoca Valley became the scene of pastoral enterprise in 1842, and land along the Glenelg in the extreme south-west was settled as early as 1840, although the head-waters of the river were not reached till 1843. To the north-west of Melbourne the Bacchus Marsh district was occupied as early as November 1836, and the Pentland Hills, further west, early in 1837, the whole of this country being quickly stocked with sheep. In July 1837 land about forty miles from Geelong was taken along the river Barwon, and in September of the same year settlement was proceeding in the Colac district around the lake of that name. To the east of Melbourne many colonists settled along the Yarra, and within a few years settlement had taken place throughout the province with the exception of the mountainous country of Gippsland, the Cape

Otway Ranges, the north-eastern counties, and Croajingalong.

Movements of pastoral population.

In fact the Port Phillip territory resembled a great trek, pastoralists travelling over the country in all directions, taking up land, and, frequently, having sold it to some later comer, pressing forward into new and untenanted regions. This movement of population is of great importance in the history of Australia, and can only be compared with the gold-rush of the early 'fifties, when the moving population was confined to much more restricted areas. At the present time the pastoral lands thus occupied are being divided into smaller areas for agricultural purposes. Geelong remains the main outlet for the wool and agricultural produce of the western plains. The agricultural and dairying industries, which were established at a later period, have been greatly fostered by the development of the railway system. Ararat, 131 miles north-west of Melbourne, is an important agricultural centre, as are Bairnsdale on the Mitchell River, the chief port of the East Gippsland lakes, Beechworth, the principal town in north-eastern Victoria, Kyneton, on the Campaspe River, and Warrnambool, the chief port of western Victoria. Bendigo, Ballarat, Creswick, Stawell, and Castlemaine, owe their chief importance to the rich mines in their neighbourhood, although they are also centres of considerable agricultural activity, the two last being specially noted for fruit-growing.

Queensland.

Although no colony existed in Queensland until after the survey made by Oxley in 1823, when a convict settlement was started not far from the present capital, Moreton Bay, discovered by Captain Cook in 1770, had been explored by Matthew Flinders in 1799. Its proclamation as a penal station did not lead to the colonization of Queensland owing to the prohibition of free settlement which it entailed. In 1831 the population was estimated at only 1,241, of whom 1,066 were convicts. The opening of Queensland was due to the wave of pastoral colonization that was rolling steadily northward. Owing to the

occupation of the Liverpool Plains and the enterprise of squatters who occupied land in the New England districts in the north of New South Wales, and subsequently crossed the Macintyre River into the celebrated Darling Downs country, which had been traversed by Allan Cunningham in 1827, and the invasion of the hinterland of Moreton Bay, which was shut off from the western pastoral districts by the ranges running westwards from Point Danger and then turning sharply to the north-east so that they formed a barrier round the whole district, the Government were compelled to revise their original programme of an isolated penal settlement on the Brisbane River. When the convict establishment was disbanded in 1840, settlement proceeded in much the same way as in the Port Phillip districts. Hitherto immigration into the colony had been mainly across the north-western plains of New South Wales, but so soon as the Moreton Bay district was thrown open to colonization direct immigration from Europe and from the coastal districts of New South Wales was established. Brisbane became the natural outlet for the produce of the hinterland, and agricultural industries were gradually established in the coastlands in the southern portion of the State.

Natural divisions and settlement.

Queensland may be roughly divided into three great natural divisions: the coastal districts, where many minor agricultural industries have been established; the Downs country; and the wide plains of the western interior. The sugar industry, after many experiments in the southerly districts, has become firmly established in the tropical portions of the State, and has directly contributed to the prosperity and settlement of this portion of Queensland. Owing to the generally abundant rainfall the coastal rivers are numerous, and although short in their course, owing to the comparatively narrow tract between the mountains and the sea, they have had a most important effect upon the settlement of the country. Colonization has largely proceeded inland from towns established at or near their estuaries, and the penetration of the interior, unlike that in New South Wales and Victoria, has proceeded

from many different points along the coast. Such rivers as the Brisbane, upon which is the capital and near to which is Ipswich, situated on its tributary the Bremer; the Mary, upon which is the important agricultural town of Maryborough; the Burnett, with its port of Bundaberg; the Calliope falling into Port Curtis; the Fitzroy running past Rockhampton, the commercial capital of central Queensland, founded in 1858; the Pioneer, 625 miles from Brisbane, and draining an agricultural district of which Mackay is the seaport; the Burdekin, running into Upstart Bay and draining an extensive sugar-growing country of which Townsville, on Cleveland Bay, is the commercial centre, are most important feeders to the western districts of Queensland. Cairns, nearly 1,000 miles from Brisbane, and Cooktown, where Captain James Cook careened his ship, are both seaports on this coast. Toowoomba, the chief inland town, is situated on the summit of the divide on the Darling Downs. Warwick, in the centre of one of the richest agricultural districts and not far from the border of New South Wales, is the centre for the pastoral stations on the Fitzroy Downs. Normanton, about 25 miles from the mouth of the Norman River, is the capital of Carpentaria and the chief outlet for the gold and copper mines in the vicinity.

Northern Territory.

In the Northern Territory of Australia settlement was first attempted on Melville Island in 1824 and at Port Essington on Port Darwin in 1831. Interesting as were these two experiments in tropical colonization, they had little or no effect upon the settlement of the country. The real occupation of Northern Australia began in 1864, when a party of settlers landed in Adam Bay and were subsequently transferred to Palmerston on Port Darwin. From many points of view the history of this settlement is of great interest. Not only is the Northern Territory the one great attempt at the permanent settlement of a white population on a tropical mainland, but politically, socially, and ethnologically the experiment has given rise to endless discussions, reports, and controversies.

The policy of a 'White Australia' cannot be fully discussed here. Arguments may be advanced for and against the exploitation by means of coloured labour of this immense tropical country. The fact, however, remains that the development of the territory by means of white labour alone has yet to be proved an economic possibility. The result of nearly a century of experiment, under both systems, has been that Northern Australia is untenanted and empty, save for the handful of white settlers around Port Darwin or on isolated stations in the interior, and the steadily decreasing number of Chinese who, with the exception of the blacks, form the sole labour supply of the territory. The proposed tropical white man, born and bred in the country, has not yet entered into his heritage. It would be rash, however, to state definitely that his advent is impossible. The progress of tropical medicine and improvements in hygiene give every hope that the time is not distant when the European may safely occupy these districts. But even then his value as an economic factor will have to be proved before the experiment can be declared a success.

White settlement in tropical territory.

Having thus completed our survey of the agricultural and pastoral colonization of the mainland, a brief reference to settlement in Tasmania is necessary. It was begun in 1803, when two penal stations were formed at Port Dalrymple and at Resdon, the latter five miles from the present capital, Hobart. For many years a double immigration went on. The convict population was being constantly augmented, whilst a free population was being established in the rich agricultural and pastoral districts of this beautiful island. As we have already seen, there was at a later period a considerable migration from the island to the Port Phillip district. How far this was due to bad administration is an historical question that need not be discussed. In 1817 the population of Tasmania was just over 3,000. By 1821 there were 7,400 inhabitants in the colony. In spite, however, of its early promise the population has not increased at a rapid rate, and this island, with an area little less than

Tasmania.

that of Scotland, sustains a population of less than 200,000. The inhabitants have largely clustered in the valleys of the Tamar, Derwent, Mersey, and Leven, settlement having mainly developed in the eastern interior of the country.

Mineral industries and settlement.

The second factor that has closely affected the distribution of population in Australia is the development of the mineral industries of the continent. Although the value of mineral production is considerably less than the amount returned by the agricultural or pastoral industries, it was the discovery of gold in payable quantities that first attracted any considerable population to Australia and laid the foundation of its economic prosperity. Every State in Australia contains vast mineral resources, ranging from coal in all the States except South Australia to gold and silver in all. Coal was first discovered in 1797 in the cliffs to the south of Point Solander. Although the development of the southern coal-field in New South Wales was hampered owing to the absence of suitable ports, a large amount of coal is now produced in these districts. In the same year, 1797, coal was also found at the mouth of the Hunter River. The subsequent development of the mines in the districts around Maitland and Newcastle led to the settlement of a considerable population in the neighbourhood. Lithgow, about ninety-six miles west from Sydney, is the centre of the western coal-field. In the other States coal can hardly be said to have been a determining factor in the distribution of population, nine-tenths of the output coming from New South Wales. Far otherwise has it been with gold. Although its presence was known long before Hargraves's discovery in 1851, it was this and other finds which attracted people to the Antipodes, 'precipitated Australia into nationhood,' and brought about an economic revolution in the country, as has been shown in Chapter V.

Gold-mining settlements: New South Wales and Victoria.

In the period between 1851 and 1861 the population of Australia increased nearly threefold. Every State was carried high on the tide of prosperity. From being a neglected outpost of Empire, Australia became a centre

of world-interest and the magnet that diverted a considerable proportion of emigrants from an otherwise almost inevitable drift towards the United States. During the height of the gold-rush 10,000 to 20,000 settlers arrived at Melbourne in a month, and populous towns, such as Geelong, where the population fell from 8,291 to 2,850 within four months, became almost deserted. The first discovery of gold had taken place at Lewis Ponds Creek, near Bathurst, and this district was the original centre of gold-mining in New South Wales. The discovery of the precious metal at Ballarat and at Mount Alexander and Bendigo in 1851 not only led to the gold-rush of the early 'fifties, but contributed directly to the settlement of Victoria and the distribution of a large population throughout the colony. The flourishing towns of Ballarat, Bendigo, Ararat, Beechworth (the centre of the famous Ovens goldfield), Castlemaine, Creswick, and Stawell owe much of their present prosperity to the gold that has been extracted from the alluvial and quartz mines of which they are the centres. The growth of Melbourne has been due largely to the same cause.

Western Australia.

The presence of gold in Western Australia has been instrumental in attracting immigrants to that formerly neglected portion of the Commonwealth and in settling population in districts that otherwise offered no inducement for permanent residence. The discovery of gold at Southern Cross, in 1887, and the sensational discoveries at Coolgardie, in 1892, led to the establishment of the industry upon a large scale and to the concentration of population in towns in the vicinity of the principal mines. The chief mining towns are Boulder, four miles east of Kalgoorlie; Coolgardie; Cue, the chief centre of the Murchison goldfield, which was discovered in 1891; Kalgoorlie, which was at first called Hannan's, after the miner who discovered gold there in 1893; Kanowna, and Menzies, the principal centres of the North Coolgardie and Mount Magnet goldfields.

Small mining settlements are scattered over a great portion of Western Australia, from the Kimberley goldfield

in the north to the Phillips River goldfield in the extreme south. The comparatively late discovery of these areas was largely owing to unfavourable reports on the possible gold resources of the colony, among which a paper written by Edward Hargraves, who, in 1862, was requested to report upon the mineral deposits, is entitled: *On the non-auriferous Character of the Rocks of West Australia.* A great irrigation plant has been established to supply water to the arid eastern goldfields, 350 miles from the source of the water.

Queensland: South Australia.

Finally, the discovery of gold in Queensland led to the establishment of centres of population at Charters Towers and Mount Morgan, at Gympie, where gold was found in 1867, and other small settlements; while the celebrated silver mines at Broken Hill, in New South Wales, have been a source of profit to the neighbouring state of South Australia, where Port Pirie was connected by rail with the mines, and became the natural outlet for the mineral wealth of this portion of Australia. In South Australia copper deposits have been found over a large part of the State. The Kapunda mine, discovered in 1842, is the oldest in the State, while the Burra Burra mine, found in 1845, was at one time the greatest centre of mining activity in the Commonwealth. Other copper mines at Wallaroo and Moonta have attracted population to South Australia. In Tasmania the famous Zeehan silver mines led to the settlement of that district, and the distribution of population has been affected by mineral deposits in other parts of the island.

Railways and settlement.

It will not be necessary to describe here the third factor that has determined the distribution of population in Australia, because the development of the railway systems belongs more especially to the province of economics. It must be stated, however, that although the building of railways has had a profound effect upon the subsequent distribution of population, railways did not, as a rule, precede the entry of pastoralists into the regions served by this indispensable means of transport. With few exceptions they have been built in districts

where a certain number of settlers had already established their farms and stations. In this, and other notable respects, they have differed considerably from some of the great railway enterprises in the Dominion of Canada. The political and economic considerations that have governed the construction of the main arteries of traffic in the Commonwealth have largely accounted for their having followed instead of having preceded population. Although railways have not infrequently been constructed into districts which could not return for many years an adequate interest on the capital outlay—this is specially the case with some of the Victorian lines—the majority have been built where they were likely to bring an early return to the State.

Social conditions, &c.

National characteristics.

The development of Australia has proceeded on different lines from those followed in Europe or in the United States and other new countries of America. Both politically, socially, and economically the continent is advancing upon different courses. Being an island-continent it is essentially one geographical unit, and with a comparatively limited range of latitude and a more or less even surface broken by no great mountain ranges, it has, on the whole, a uniform temperature and climate. These factors tend to create a homogeneous people with similar ideas and ideals. The comparative isolation of the continent has contributed, moreover, to the growth of a national spirit best expressed in the words 'Australia for the Australians and more Australians for Australia'.

Effects of federation.

The fact that the whole of the continent is now one political entity, although the State Governments retain a large measure of control over purely State affairs, has had an important solidifying influence upon the national character. Petty local jealousies that formerly loomed so large in the popular imagination are being relegated to their proper position, and Australians as a whole have become keenly alive to their manifest destiny as the

guardians of European civilization in the South Pacific, and aware of the responsibilities and dangers of their guardianship. The additional responsibilities that have resulted from federation are rapidly transforming the mental outlook of the average Australian. From being a State elector, whose interests seldom extended beyond the limits of his own State, he is becoming a partner in the comity of nations. Stability and assurance are being added to his character.

Modifications of national character induced by environment: by distance;

The Australian is a Briton modified by his environment. Distance, space, and climate have played their part in this modification. Distance has made him more closely localized in his ideas, more apt to regard his own State or city of greater importance than it really is, more ready to misunderstand and resent criticism. The triumphs of modern science in bringing the ends of the earth ever closer and closer together, however, are profoundly modifying this narrowness of outlook, and in his mental attitude the Australian now more nearly approximates to the older nations than at any previous period in his history. And while distance has tended to localize the national interests it has fostered also the growth of self-reliance, initiative, and independence. What the Australian may have lost in one direction has been amply compensated for in another.

by space;

The second factor modifying the Australian's outlook has been space. The 'never-ending plains', the wide and boundless expanse of sparsely occupied territory, the distance of one settlement from another, have created in the rural districts a type of men who seem to have inherited, as it were, some of the characteristics that might be attributed to space—a generous hospitality, a readiness to aid and assist others, joined with a somewhat sensitive aloofness and egoism that have to be understood and overcome by the stranger. The influence of the back-blocks is felt in the cities, and the city-bred Australian, though he loses some of the characteristics of the man from up-country, retains much of the national generosity and hospitality. The third factor that has

modified the Briton in Australia is climate. The characteristic inclination of the Briton towards occupations in the open air has been quickened and intensified. It is always possible for the Australian to be in the open. Climate has turned the Australians into a nation of sportsmen. Sport to-day occupies a prominent place in Australian life. Most Australians devote much time to healthy recreation, and where, as is frequently the case, thousands are attracted to a football or cricket match, the majority of those present will not be mere idle onlookers, 'barracking' for one side or the other, but will be able to enjoy every move because they themselves are either players or have played at some time in their career. The Australian's interest in sport, therefore, so far from being a sign of deterioration, is an evidence that his bodily vitality has been increased rather than diminished by the change in climatic conditions. It has been asserted that the Australian climate has had a weakening effect, and one authority has gone so far as to state that if it were possible to cut the Australian continent off from the rest of the world for a few centuries 'not a single descendant of its 4,000,000 white population would remain'.[1] It is not possible to controvert or support so sweeping a statement. Such evidence as exists, however, seems to support the view that the average Australian is fully equal to the average Englishman in physique and stamina. So far as their physical characteristics are concerned it is as yet too early to state definitely whether the Australians are evolving any distinct physical type. It is certain, however, that, as environment affects the character of a nation, climate also changes its physical characteristics; and it is not difficult to detect amongst Australians, who have lived in the rural districts, and even amongst many who have resided in the cities, a subtle difference in features that can only be accounted for on the assumption that environment and climate are slowly working a change. The average country-bred Australian seems to be slightly more square of jaw and of a somewhat heavier facial

and by climate.

Physical characters.

[1] Dr. Alexander Bultner, of Melbourne.

type than the average Englishman ; but it is impossible to say whether this is due to the hardships of pioneering life or to actual climatic conditions.

Children : measurements, state supervision, &c.

Anthropometric research in Australia has been largely aided by the measurements of the height and weight of school children undertaken in New South Wales and other States. These measurements may be regarded as the beginnings of a systematic attempt to determine what modifications of bodily form are being exhibited. So far they have not disclosed any notable divergences between the children of Australia and those of Great Britain. In the matter of height it is found that, taking an average of all ages between seven and fourteen, in the case of boys, the advantage is in favour of the Australians, the average height being, for Tasmania, 53·66 inches, for South Australia, 52·55, and for England, 52·41. But in England the boots of the children were not removed. At the age of fourteen the respective figures are as follows : 60·78, 59·53, and 59·33. With regard to weight, the respective weights in pounds are 69·68, 67·51, and 69·4, or, at the age of fourteen, 93·7, 92·41, and 92. It is too early to deduce any definite conclusions from these figures, though it seems probable that the advantage on all points rests slightly with the Australians. The open-air life and the training in cadet corps, to which they are now subjected, contribute directly to this result. Australian children develop earlier than is the case in England. They are more impatient of parental control, and not infrequently less disciplined than is the case in older countries. On the other hand, they are more self-reliant and more independent. Their interests are admirably safeguarded by the various children's courts. The State children's departments, which regulate the orphanages and industrial schools for young children deprived of parental training and control, are excellently managed. Legislation affecting the welfare of children is generally well advanced throughout the Commonwealth. On the whole it may be said that the conditions of life are easier and more wholesome in Australia than in England.

Sport, as has been pointed out, plays a large part in Australian life. The people excel in most kinds of outdoor sport. There is hardly a branch of athletics in which representatives from Australia have not won distinction, and the fine records established in friendly international rivalry are only the outcome of the sporting spirit that permeates all sections of the community. The general health of the people, thanks to the healthy conditions under which they live, being good, and the hours of labour being shorter, the working-man has perhaps better chances of following his natural inclinations than is possible in Great Britain. Among the university students and high-school scholars, as indeed with all Australian youths, it is a matter of honour to excel in games. Naturally in a country like Australia horse-racing has taken a great hold upon the populace. The 'Melbourne Cup' is the great national festival, and is a popular demonstration of the interest of all classes in racing. Horse-breeding is one of the large industries. The number of stud farms is large and the interest of the public is naturally centred in all that concerns horses. Much of the interest taken in the national poet, Adam Lindsay Gordon, is due to the fact that, as well as being a poet, he was a lover of horses and a noted rider. By the importation of sires of high class and the careful selection of breeding-mares, the Australian horse, whether of heavy draught, medium weight, or light saddle and carriage variety, compares more than favourably with the product of other countries. There are over 2,000,000 horses in the Commonwealth and the number of race-meetings is very large. Apart from racing most country-bred Australians are excellent riders. On the up-country stations and runs they seem, indeed, born to the saddle. The Australians are also excellent shots. Their skill in cricket is proverbial; in football they have evolved a game which combines the more spectacular points of the games under Rugby and Association rules, while both retain their full measure of popularity; in sculling they have held the world's championship on many occasions,

Sport.

and inter-state eight-oar championships are rowed every year at one or other of the capital cities; in polo the riding skill of the Australians always leads to a good game; golf is gaining adherents every year; yachting is an ever-popular sport, made doubly attractive owing to the excellent waterways that are open to the yachtsman; and snow sports are pursued on Mount Kosciusko, the home of Alpine sport in the Commonwealth. In fact, the Australian excels in all types of sport that require a steady eye, rapidity of judgement, and well-developed muscles. Nor is the interest of the Australian less in the friendly rivalry that is fostered by the numerous competitions that take place in almost every city and town. These competitions sometimes last for weeks together and attract hundreds of competitors, who display their powers in oratory, singing, recitation, and other directions, to large audiences. Ballarat is a noted centre for these competitions, in which athletics frequently play an important part.

Education: state control.

In taking over many important political functions the Commonwealth left others under the direct control of the State Governments. Among these was the superintendence of education. Each State was left to control and develop its own educational system, and consequently there is no uniform system for the whole of Australia. Since the Commonwealth was inaugurated, however, there has been the same tendency towards uniformity in education as in other matters, and during the past few years educational aims and methods have been largely remodelled. In the reform of primary and secondary education the various States have followed the example set by New South Wales, which was the first to reorganize the educational system of the past and to adopt the principle that the pupil and not the subject is the main centre of interest. In 1902 Messrs. Knibbs and Turner were sent to inquire into the conditions of technical education in the United States and Europe, and their report laid stress upon the intimate connexion between elementary and technical education. Moreover, the

public of Australia were convinced of the necessity for the adoption of more modern and progressive methods of teaching. Both South Australia and Victoria have largely adopted the reforms suggested by the New South Wales commissioners and by their own experts, whilst in the younger States of Queensland and Western Australia considerable progress has been made in the reorganization of education. The parent State has long been a leader in educational matters. The schools were at first denominational and were aided by grants from the Government. In the middle of the nineteenth century there was a strong movement towards improvement in elementary education, largely fostered by a book by G. W. Rusden, published at Melbourne in 1853. This book contains an account of the progress of education in Australia up to that period. Since that date the educational system in New South Wales has formed the model for other States.

Primary education.

As far as primary education is concerned Australia holds a high place among the leading countries of the world. Throughout the Commonwealth primary education is compulsory and free, and is within the reach not only of the poorest but also of those who reside at long distances from the larger centres of population. Through the medium of scholarships and bursaries entrance is gained to the secondary schools and universities, and it is possible for every child of more than average intelligence to attain to the highest rung of the educational ladder. In each State the central authority is vested in the Department of Education under the control of a Minister of Public Instruction, who holds office during the continuance in power of his political party, and of a permanent Director of Education. In this manner continuity of method and procedure is assured. Boards of Advice visit the schools and report to the central office, but have no direct authority. The curriculum in the elementary schools affords many points of interest to the educational expert. Religious instruction is not imparted by any of the State-paid teachers, although in certain States duly

authorized persons are allowed to enter the schools to give instruction to children of their own denomination. In all States periodical medical inspection of the children is in force. This inspection is thoroughly systematized in New South Wales and to a lesser degree in Queensland, Tasmania, and South Australia. In the last-named State, following a report published by Dr. Rogers in 1910, a medical officer, two trained nurses, a dentist, and two health inspectors were appointed to carry out the recommendations of the educational authority. In all the States the results of this medical inspection are extremely valuable, both from the scientific and hygienic points of view, and will have an important effect upon race-culture in the Commonwealth.

Number of scholars; illiteracy; teaching in sparsely settled areas.

The number of State schools in Australia is nearly 8,000, with about 630,000 scholars, giving an average of 88 pupils to each school. The proportion of illiterates among the rising generation is small. Out of 428,000 children between the ages of ten and fifteen, only 2,500 are unable to read. Illiteracy, where it exists, is mainly due to the impossibility of bringing educational facilities to the homes of children who live at a great distance from the nearest settlement. But wherever possible provision has been made for the needs of sparsely-settled districts. In such cases provisional schools are established which are merged in the ordinary school-list when the attendance reaches the minimum of about a dozen. Moreover, itinerant teachers are also provided who visit from house to house within a certain radius; and in New South Wales so-called 'travelling' schools have been established, the teacher journeying in a van and being provided with a tent to be used as a school. Of recent years the American system of central schools has been extensively adopted. One well-equipped school has been found to be more useful than several smaller ones. In such cases children are carried free on the railways, or where these do not exist the parents club together to provide a conveyance, towards the cost of which a subsidy is contributed by the State. From the admirable kindergarten schools

established in the most crowded parts of the large cities to the secondary schools the system of primary education is thoroughly well organized and equipped. In the country schools special attention is frequently devoted to nature study and the elementary principles of agriculture. In Victoria and some other States travelling teachers of nature study visit the schools and give advice in methods of horticulture and experimental agricultural work. The lessons of order and love of nature then inculcated frequently lead to a desire on the part of the pupils to enter one of the agricultural colleges that are springing up all over the country. Once a year the young Australian has a practical demonstration on the value of trees to the community, a much-needed lesson in view of the sad havoc that has been made with the timber resources of many sun-blinded districts. This occurs on the local Arbor Day which is devoted to planting trees and shrubs and beautifying the grounds. Patriotism is also taught to be a virtue. Empire Day, celebrated on May 24, is everywhere observed as a national festival by the children. They then assemble in their thousands for games and the singing of patriotic songs. The children have naturally good voices. The bright, clear atmosphere seems to be productive of good voices—it is only necessary to remember in this connexion the number of great singers coming from the Commonwealth. In the schools singing and breathing-exercises are systematically taught and this national talent assiduously fostered.

Special subjects.

The higher State schools and the secondary divisions of many of the elementary schools have been greatly improved during recent years. Many have a high standard of education and are largely staffed by university graduates. With these schools may be classed the different high schools and grammar schools which, while receiving State subsidies, are not under the direct control of the State. Among these the Sydney Grammar School, with nearly 500 boys in attendance, takes a high place. The Anglican, Roman Catholic, Presbyterian, and Methodist Churches have large secondary schools under their care, and the

Secondary education.

Roman Catholics support their own primary schools apart from the State. There are also numerous agricultural schools and colleges where scientific and practical agriculture is taught to pupils who have passed through the ordinary schools. This development of secondary education is comparatively new so far as Australia is concerned. There are five agricultural colleges in the Commonwealth. The Hawkesbury Agricultural College in New South Wales is under the control of the Agricultural Department, and provides accommodation for 250 students. In Victoria, the Dookie Agricultural College and the Longerenong Agricultural College provide for 140 students; in Queensland the Gatton Agricultural College, and in South Australia the Roseworthy Agricultural College, provide accommodation for another 100 residential pupils. There are also a number of experimental farms and agricultural high schools. In addition, there are many technical institutions that also provide agricultural instruction. Great efforts are being made to develop this side of education. The Sydney Technical College and Technological Museum is a highly organized institution with over 10,000 enrolments for the various classes. In New South Wales alone there are nearly 100 technical schools, the principal of which are at Maitland, Newcastle, Bathurst, and Broken Hill. In most Australian cities liberal provision has been made for technical education. The Working Men's College at Melbourne has an enrolment of nearly 4,500 students; the South Australian School of Mines and Industries, at Adelaide, has 3,400 students; and the Ballarat School of Mines and the Perth Technical School 1,170 and 746 students respectively.

Universities.

At the apex of the educational pyramid are the fine universities with which Australia has been so liberally provided. The earliest was that established at Sydney in 1850. It occupies a commanding site and is surrounded by 128 acres of land, within which are situated the main building with its beautiful great hall, the new medical school, the Fisher Library, the School of Mines, separate buildings for different departments of study, and the

buildings of the various denominational residential colleges and the women's undenominational college. The latter was established in 1892, women having been admitted to the university eleven years previously. The Sydney University is the largest seat of learning in the Commonwealth and has four faculties—arts, law, medicine, and science. The number of residential undergraduates is comparatively small, being about 130 out of the 1,200 men and 200 women students studying at the university.

The Melbourne University was established in 1853, and contains three colleges within the university, the number of residential students being larger than at Sydney. At Adelaide a university was founded in 1874, but neither here nor at the University of Tasmania (founded in 1889) are there residential colleges. A residential college is, however, to be established at Adelaide. A university was established in Queensland in 1911, and an Act establishing a university in Western Australia was passed in the same year. In 1910 the number of students attending the universities was 3,262 and the revenues from all sources amounted to nearly £140,000, whilst over £817,000 had been received from private benefactors since the establishment of the universities. Such a record speaks well for the interest taken in higher education. The university in Australia is essentially democratic. The fees are not high, and students are drawn from all classes of the community. In the past a proper concern has been shown for classical teaching. Both Latin and Greek have been in the Arts course as compulsory subjects, although at Melbourne the latter will probably be abolished as a compulsory subject. Evening classes for those who are unable to attend during the day are general, and post-graduate work is actively encouraged.

Libraries.

The universities are well equipped with libraries. The University Library at Sydney, now known as the Fisher Library, is a notable collection housed in a notable building. The library contains nearly 90,000 volumes and is rich in bibliographical treasures. The library of the Melbourne University and that at Adelaide also contain fine collec-

tions of books. In addition to the various parliamentary libraries, that attached to the Federal Government (containing a unique collection of Australiana) and the various departmental and special libraries, of which there are many in the Commonwealth, there is a number of fine State reference libraries which have been founded as aids to education. These libraries rank with many of the best libraries in Europe and America. The library system naturally originated in New South Wales. So far back as 1834 an Act was passed which vested land and property in trustees for the Australian Subscription Library which had been established in 1826 and was the forerunner of the present fine reference collection known as the Public Library of New South Wales. The library is at present sadly cramped for space. In a separate new building is housed the magnificent collection of Australiana and rare books bequeathed by D. S. Mitchell and known as the Mitchell Library (60,000 books and many manuscripts). The Melbourne Public Library has been provided with a new building with an octagonal reading-room, and is now the finest library in the Commonwealth. Public reference libraries also exist in Adelaide, Brisbane, and Perth. In all centres a high standard of selection has been established, and these libraries form in each State a remarkable evidence of a well-conceived and carefully organized plan for providing the advanced student and literary worker with the necessary books. These libraries are the culmination of the library movement in Australia. They have been founded and administered in different ways, and a mass of library legislation in the different States testifies to the interest that has been manifested in their development. In South Australia alone seventeen Acts relate to the administration of the public libraries. Almost every town in Australia possesses its public library, sometimes known as an institute, an athenaeum, or a school of arts. These frequently form the chief centre of intellectual interest in a country township, and, in addition to providing the community with books, are centres for social meetings and recreation.

They differ considerably both in management and means of support in the different States. In South Australia, although a free public library Act exists, the institutes, as they are there called, are generally supported by subscriptions supplemented by government grants. In Victoria the same system prevails, with the exception that a number of free public libraries supported out of State funds, supplemented by municipal grants, exist, sometimes side by side with subscription institutes. In New South Wales the libraries, generally termed schools of arts, receive grants from the State in proportion to the support accorded by the public. There is also a number of free libraries established by the municipalities. In all the States the libraries are in a measure co-ordinated and subject to a certain amount of governmental control, having to report to the Minister of Education, and in some cases, as in South Australia, sending representatives to a central Institutes Board which supplies them with special books from a repository generally worked in connexion with the State reference library. Travelling libraries forwarded from a central bureau are also a feature of Australian library work. These bring the most distant communities in touch with the latest and judiciously selected literature. These boxes of books were first sent out from Adelaide in September 1859, and from Melbourne in July 1860. Approximately there are 1,600 subsidized libraries in the Commonwealth, containing over 3,000,000 books. In the three States of Victoria, South Australia, and New South Wales nearly £70,000 is received annually from government or municipal grants. In connexion with the schools libraries have also been established. In the parent State there are nearly 1,200 such collections, containing about 140,000 books. The libraries attached to the various learned and scientific bodies and the geographical societies are also very numerous and are generally well-equipped. Australia is also liberally provided with museums. The Australian Museum at Sydney, the National Museum at Melbourne, the Queensland Museum, the South Australian Museum, and the

Museums.

Western Australian Museum are the principal of these institutions. In the matter of higher supplementary education Australia is therefore most liberally provided for, this profusion of excellent institutions being due not only to the great distance between the different centres of population, but also in no small measure to the 'national' (i. e. State) spirit that was fostered in each State in pre-federation days.

Literature.

Of the writing of poetry in Australia there is no end. Poor as most of it undoubtedly is, there is in Australia a small band of poets who are the pioneers of an Australian school of literature. The earlier writers, such as Adam Lindsay Gordon, whose popularity is unfading, and James Brunton Stephens, whose poems are more national in character than those of other writers, were Australian by adoption only. Henry Clarence Kendall was the first native-born poet to add distinction to Australian literature. At the present day, among the almost overwhelming flow of indifferent verse, several men stand apart from and undaunted by this national overflow. Sydney, which has the distinction of being the writers' city (for most of the newer authors have had their start in the pages of the *Bulletin*), and Melbourne are the literary centres of the Commonwealth. Cleverness, impetuosity, and vigour are the characteristics of the best modern Australian verse, and a nationalistic spirit is fully displayed. Three writers only need be mentioned as representative of the new school—Victor Daley, Bernard O'Dowd, and Will Ogilvie. Australian fiction has also taken its place in English literature. Marcus Clarke's *For the Term of his Natural Life* still stands high above any other achievement in Australian fiction and Rolf Boldrewood's numerous books, of which *Robbery under Arms* is the most popular, are the best novels of their kind. Many names of Australian novelists occur readily to mind, such as Ada Cambridge and Mrs. Campbell Praed, whilst of late years clever exponents of the short story have arisen, of whom Henry Lawson is the most brilliant. In more serious literature Australia has secured a place, but the national

instinct seems towards creative literature rather than towards works requiring prolonged study and investigation. In this connexion it is interesting to notice the great want of a serious magazine literature. There is nothing to compare with the university magazines issued in Canada. Such magazines as do exist—the *Lone Hand* and *Life* having the largest circulation—are of the popular variety, and, whilst appealing to a wide circle of readers, do not add much to the intellectual life of the nation. Among newspapers the *Bulletin* of Sydney occupies a peculiar and privileged position, and this weekly journal is nothing less than a national institution. Its extraordinary popularity may be attributed largely to the variety of its contents, which appeal to very different interests and intellects, and to the originality of its articles. It is fearless and outspoken in its criticisms of friends and foes, and is therefore a force in Australian life that can be ignored by no sensible politician. So far as literature is concerned, its pages are always open to young writers of talent. There are some excellent newspapers in the Commonwealth. Without invidious distinction it may be said that the *Age* and *Argus* of Melbourne and the *Sydney Morning Herald* and *Sydney Daily Telegraph* are the best and most influential of the Australian newspapers. The *Age* in particular wields an enormous political influence, and has made and unmade many ministries. In all, nearly 1,800 publications are registered in the Commonwealth, many of which are small country newspapers containing local news. The Australian journals devote much space to sport, and the agricultural and pastoral industries are catered for by a number of special publications, such as *Dalgety's Review* and the *Pastoralists' Review*.

The Press.

In art Australia is well represented, and a distinctive school has sprung up within the Commonwealth. Although good artists are plentiful, it is only of recent years that Australians have learned to appreciate the wealth of talent that lay ready to hand. It was long a reproach that a promising young artist had to seek his fortune in

Art.

Europe instead of enriching his own country with the creations of his brush. In spite of the fact that there were excellent picture galleries in Sydney, Melbourne, and Adelaide (the last containing the best selected collection in the Commonwealth), and collections in almost every provincial city of importance, the popular taste demanded indifferent pictures by well-known European artists rather than the productions of the local schools. Within recent years, however, a steady demand has arisen for works by Australian painters. Many have made a name for themselves far beyond the confines of Australia, such as Hans Heysen, whose characteristic Australian landscapes are now eagerly sought for, Will Ashton, Ambrose Patterson, Max Meldrum, and Norman Carter. Many other young artists have given decisive evidence of their ability. There is something bright and pleasing about Australian art which seems to individualize the brightness and sunshine of the climate. There can be no doubt that so far as art is concerned Australians will take a high place amongst the artistic nations of the world.

Religion. At the last census 95·9 per cent. of the population professed some form of Christianity. Of these 40 per cent. belonged to the Church of England, 12 per cent. were Methodists, 13 per cent. were Presbyterians, 21 per cent. belonged to the Church of Rome, 2 per cent. were Baptists, 1·7 per cent. were Congregationalists, and the same percentage belonged to the Lutheran denomination. There were also 17,287 Hebrews in the Commonwealth. The above figures, however, merely show the number of those who have returned themselves as belonging to one of the chief denominations and by no means represent the number of churchgoers, which, as in the other Christian countries, is much smaller than the census figures represent. In this respect it is probable that in some cases the figures would be reversed; a 'religious census' taken in New South Wales in 1904 which took account only of attendances at some church on a particular Sunday giving very different proportions. The Anglican Church is

governed by an archbishop (at Sydney) who is also primate of Australia, and is divided into the three provinces of New South Wales, Victoria, and Queensland, with a number of independent dioceses. There are three archbishops (at Sydney, Melbourne, and Brisbane) and eighteen bishops, with about 1,200 clergy. The position of the Church of England in Australia in connexion with the Anglican Church of England is not clearly defined. Although there is a number of excellent training colleges for candidates for the priesthood, there is a constant influx of priests from England and there is a tendency to appoint Englishmen to the higher ranks of the clergy. The Roman Catholic Church in Australia has a cardinal archbishop (with a coadjutor bishop) at Sydney, four other archbishops with sees at Adelaide, Brisbane, Hobart, and Melbourne, and thirteen bishops. Both socially and politically the Roman Catholic Church is in a strong position. There is no State Church in the Commonwealth, all denominations being on a footing of equality. On the whole the methods of the various Churches are much more democratic than is the case in England. There is more co-operation between the different denominations, and in the smaller places petty jealousies seldom deter ministers of different denominations from working cordially together in the furtherance of a common aim. Australians, as a whole, are not given to the consideration of nice theological distinctions, and the latitudinarianism of the majority of the people inclines them to be more tolerant and less aggressive in religious matters than is generally the case elsewhere. The churchgoing population is not large and differs considerably in different cities: Adelaide probably holding the highest record for Sunday observance and Sydney possibly being at the other end of the scale. The attendance roughly corresponds with the percentage of ex-nuptial births: in New South Wales the number being 62·8 per thousand, and in South Australia 43·8—a fact for which different moralists will have different explanations.

The Australian Aborigines[1]

Origin.

Although the aborigines of Australia are of no economic importance they are of more than ordinary interest to anthropologists. Their origin presents a problem that has not yet been definitely settled, although several theories have been adduced to account for their difference from the natives of Australasia in general. They differ in many notable respects from the Malays, Papuans, and Polynesians. Unlike these races, they neither cultivate the soil nor build substantial huts or houses. They represent in fact an extremely primitive type, and are probably as low in the scale of civilization as any of the surviving races of mankind. In general type they agree so closely among themselves that they may be regarded as one race, and, although scattered in many isolated groups throughout the continent, all the tribes have almost certainly had a common origin. Yet their languages are different, though many of the root words appear to have been derived from a single source. This difference of language alone seems to demonstrate the extreme antiquity of a race which, so far as can be judged, has always lacked cohesion and has existed in widely scattered communities. The absence of all native traditions regarding their origin or migration seems to point to the same fact, for it is not credible that a race which may have migrated southwards within recent centuries should have entirely forgotten the traditionary tales that in such a case would have been current among them.

Of their origin there are many ingenious theories. Attempts have been made to show that they are closely allied to the African negro peoples. Another theory is that

[1] [See J. Dawson, *Australian Aborigines*, Melbourne, 1881; A. W. Howitt, *The Native Tribes of South-east Australia*, London, 1904; B. Malinowski, *The Family among the Australian Aborigines*, London, 1913; J. Mathew, *Two Representative Tribes of Queensland*, London, 1910; W. E. Roth, *Ethnological Studies among the North-west-central Queensland Aborigines*, Brisbane, 1897; R. B. Smith, *The Aborigines of Victoria*, Melbourne, 1878; Spencer and Gillen, *The Native Tribes of Central Australia*, London, 1899, and *The Northern Tribes of Central Australia*, London, 1912; N. W. Thomas, *Natives of Australia*, London, 1906.]

they are survivals of a primitive race who once inhabited a vast southern continent which included South America, South Africa, and Australia—a highly speculative theory which would attribute to them an antiquity that could scarcely be reckoned in years. Topinard and others concluded that Australia was originally inhabited by a race of the Tasmanian type, which gradually disappeared before a taller race that came from some unknown quarter, and were finally driven into Tasmania, either when it was joined to the continent or at a later period, where they survived until the last Tasmanian died in 1876. This of course premises that the present aborigines are not the true original inhabitants of Australia. Alfred Russell Wallace pointed out their resemblance to certain Asiatic races, the Veddas of Ceylon, the Todas of India, and the Ainus of Japan, and concluded that the Australians were in reality a low Caucasian type. The generally accepted theory seems to be that they are the descendants of a Pre-Dravidian people who were driven from the hills of India at some long distant prehistoric period, made their way southwards by way of Ceylon, leaving a branch, the Veddas, in that country, and were gradually forced by way of the East Indian islands to the continent of Australia. This event, if it did take place, either happened when the northern coast of Queensland was joined to New Guinea, or at the later period when the East Indies had become an archipelago. Arrived in Australia they met a numerically weaker race and drove them from the continent. (See Fig. 59, p. 281.)

Decrease of aboriginal population.

The Australian black fellow is slowly and painfully dying a natural death, due to a number of causes that are fairly well known. The advent of the white man has introduced a number of diseases that were previously unknown. Epidemics of small-pox have almost annihilated whole tribes. Venereal disease, introduced by the overlanders, has acted as an exterminator by making the black women sterile. Consumption, introduced with the blessings of civilization in the shape of clothing, to which they were not accustomed, has been responsible for a large number

of deaths. And lastly, in the earlier days the not too humane treatment of the settlers accounted for a considerable falling off in the native population. It is impossible to state either what their numbers were at the first colonization of Australia, or what they are at the present time. It is generally asserted, on evidence that cannot either be contradicted or supported (for it would have been as impossible to enumerate the blacks as to number the kangaroos), that there were 150,000 aborigines when the white man first entered Australia. The latest census figures show that there were 19,939 in the Commonwealth, of whom nearly one-half were in Queensland, nearly one-third in Western Australia, and the rest in the other states. But these figures only account for natives who were in the employ of whites or living in contiguity to the settlements of whites. The Commonwealth statistician estimates their total number at 100,000, but states that the whole matter 'is involved in considerable doubt'. It is more than probable that the numbers are very much less.

Dampier's account of aborigines.

The first Englishman who wrote of the black fellows, William Dampier, gave a fairly accurate description of them in the following words: 'The inhabitants of this country are the miserablest people in the world. The Hodmadods of Monomatapa, though a nasty people, yet for wealth are gentlemen to these, who have no houses and skin garments, sheep, poultry, and fruits of the earth, ostrich eggs, &c., as the Hodmadods have, and setting aside their human shape they differ but little from the beasts. They are tall, strait bodied, and thin. They have great heads and foreheads, and great brows. Their eyelids are always half closed to keep the flies out of their eyes. They have great bottle noses, pretty full lips, and wide mouths. They are long visaged, and of a very unpleasant aspect, having no one graceful feature in their faces. Their hair is black, short and curl'd, like that of the negroes, and not long and lank like the common Indians. The colour of their skins is coal black, like that of the negroes of Guinea. They have no sort of cloathes, but a piece of the rind of a tree ty'd like a girdle

about their waists and a handful of long grass thrust under their girdle to cover their nakedness. They have no houses but live in the open air.'

General characteristics.

Generally speaking they are a kindly, slothful, and, on the whole, peaceable people, only brutal and vindictive when they consider themselves to have been wronged. Instances are not wanting when they have shown courage and devotion. An aboriginal convict has been presented with the Albert medal for rescuing his gaoler in circumstances of peculiar danger and difficulty. Mentally, in their native surroundings, the black fellows are observant, self-reliant, and quick. Under civilization they lack stability and generally become lazy, but their intelligence when cultivated is not of the extremely low order that is generally asserted. They can speak English chastely and beautifully; when trained in music they can play with skill and precision; and they can read and write as well as their white masters.[1] The reports issued by the Protectors of Aborigines contain a vast amount of information that corrects the general impression as to the inability of the aborigines to acquire the mental accomplishments of the European. The black fellow is a noted tracker, his cleverness in this respect being proverbial. His skill with his own weapons excites wonder and admiration. His short spear used for fishing and fighting is thrown with the utmost precision. The boomerang—a weapon he shares in common with the wild tribes of the Deccan—is thrown with wonderful dexterity. Native customs have been treated exhaustively by Messrs. Spencer and Gillen, and by other writers, and need not be described here. The Corroboree, an almost universal institution, must, however, be mentioned. It is the occasion for all sorts of sports and festivities, when recitations, religious ceremonies, and secret rites are indulged in.

Relations with white population.

Little has really been done to preserve this interesting race from extermination. In 1840, the South Australian *Register* in a leading article said, 'We say distinctly and deliberately that nothing comparatively has yet been done

[1] Dr. Rogers, of Adelaide.

—that the natives have acquired nothing of European civilization but European vices and diseases, and that the speedy extinction of the race is inevitable save by the introduction of means for their civilization on a scale much more comprehensive and effectual than any yet adopted.' With more stress on the word 'comparatively' the same remarks apply at the present day. It is true that a number of mission stations are doing good work, and that there is some measure of State supervision over such aborigines as come into contact with the whites. In South Australia, for example, there are the Point Macleay Mission Station on Cape Alexandrina, the Point Pierce Mission Station on Yorke's Peninsula, and others. In Western Australia the Benedictines have a mission at New Norcia in the north-west, and the Beagle Bay Mission and the Sunday Island Mission have long been rescue homes for the blacks and half-castes. An interesting experiment has been tried at Mount Barratt, on the high plateau near Hall's Creek, where the Government has established the Mulla Bulla Cattle Station and has segregated a large number of blacks. They are fed and engaged on station work. In Queensland there are several missions, including the Trubanawan (Mitchell River) Mission, the Aurukun Mission, the Taroon Settlement, and the Baranbah Settlement, Murgon. Here aboriginals have been segregated and good work is being accomplished. The aboriginals have practically no part in the economic life of Australia, except of course where they are employed on distant stations or in farm work. They are seldom seen in the cities, the sight of a black fellow in the streets of Adelaide, Melbourne, or Sydney being an event worthy of notice. In the Report of the Protector of Aborigines for South Australia (1909) it is stated that the half-caste descendants of the black fellow 'in each succeeding generation will undoubtedly become whites, as the children of half-castes are as a rule whiter than their parents, and no doubt the process will continue until the black will altogether disappear. The white blood being the stronger must in the end prevail, especially as some of the women

Mission stations and other native settlements.

PLATE XIII. HAWKESBURY RIVER (FROM THE NORTHERN RAILWAY)
(High Commissioner for Australia)

PLATE XIV. NEW NORFOLK, TASMANIA
(High Commissioner for Australia)

are legitimately and illegitimately mating with white men. From this it is evident that the ultimate end of the Australian aboriginal is to be merged in the general population.' This is an interesting speculation of which doubtless more will be heard. But whatever may be their ultimate destiny they will have left their mark in Australia in the shape of the many native names that form so prominent a feature of Australian nomenclature. But to the bulk of the population they are little more than an interesting survival from prehistoric times, classed with the kangaroo and the platypus.

CHAPTER IX

TASMANIA

By T. Dunbabin

Tasmania is one of the terminal southern lands of the world, the furthest extension southward of Australia. It has not a hundredth part of the area of its continental neighbour, from which it is separated by Bass Strait, less than 200 miles in width, shallow, and broken by many islands, especially in the east. Here a line can be drawn from Australia to Tasmania, passing through Flinders Island, where the sea is nowhere more than 32 fathoms deep.

Connexion with Australia and other lands.

There are many indications that it is not long since there was a land connexion between Australia and Tasmania; for instance, the fact that the mollusca are of different species on each side of the reconstructed Bassian Isthmus. The fact that a peculiar freshwater fish, the black-fish (*Gadopsis*), which has no near relations elsewhere, is found only in the rivers running into Bass Strait, may point to a time when these rivers were the northern and southern tributaries respectively of a great river flowing from east to west along what is now the floor of the strait. The similarity of the geological formation

of the land on each side of the strait, and of the islands, points to a former connexion. The general similarity between the fauna and flora of Tasmania and that of the mainland of Australia also favours this hypothesis. There are marked differences, however, and Tasmania is not a mere province of Australia. There are certain elements in the fauna and flora of Tasmania which point in another direction, indicating a former connexion, probably through the Antarctic Continent, with South America. The flora, too, has some striking points of similarity with that of New Zealand. Tasmania is rather rich in monotypic forms of plant life, and also possesses two forms of animal life found nowhere else in the world, while its exceedingly primitive human inhabitants were quite different from those of Australia. It seems reasonable to suppose that the marked differences which exist between Tasmania and the mainland of Australia were not caused by the recent separation but existed before it, and were conditioned long ago by other factors, one of which may have been a direct connexion to the south with now submerged portions of Antarctica, from which it received certain forms which never spread to the mainland or obtained but little footing there.

Physical characteristics.

Tasmania is largely a highland region, made up of rocks of great geological antiquity, and apparently much of it has existed as a land area from a very remote period. Both its geological and its surface features are complicated, and as there has been nothing like a complete geological survey, and as even the surface features of many parts are but imperfectly known, what is said in this connexion is based partly on generalizations.

The west.

In the west is a broad belt of very old rocks, crystalline and metamorphic schists, clay slates, quartzites, and sandstones of Archaean, Cambrian, and Silurian age. This region shows abundant traces of glaciation on a large scale and at comparatively low altitudes, whereas elsewhere in the island only doubtful traces, near the highest summits, are found. In the north-west there are considerable outcrops of granite and porphyry, associated

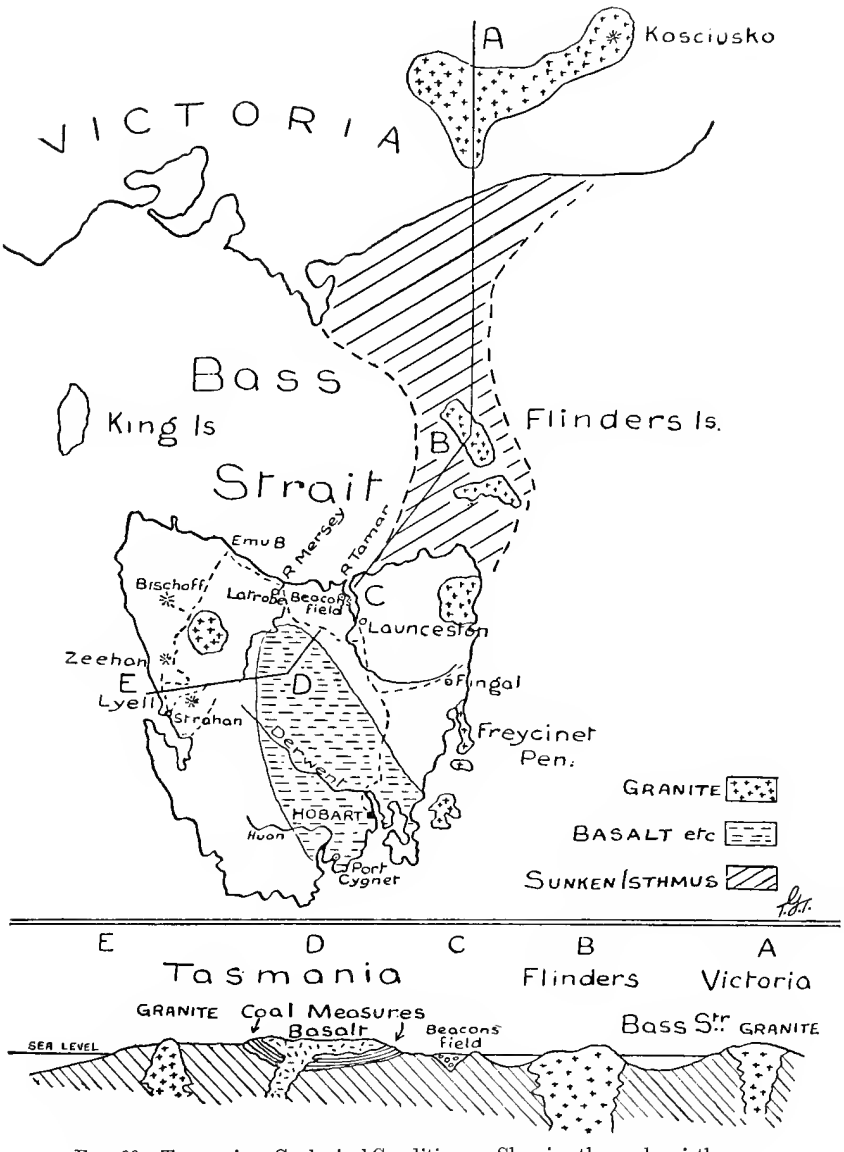


FIG. 60. Tasmania. Geological Conditions. Showing the sunken isthmus; and below a section along the line A–E. (Chief railways as broken lines.)

with tin deposits, and in the extreme north-west and towards the north coast there are considerable areas covered by basaltic outflows. The mountains trend for the most part north and south, and some of them rise to nearly 5,000 feet in height.

Central plateau.

Abutting on this western region and occupying most of the centre of the island is a plateau of greenstone or diabase, ranging from 2,000 to over 3,000 feet in height, from the north-western corner of which Cradle Mountain, the highest summit in the island, rises to just over 5,000 feet. The greenstone of which this plateau is composed also covers large areas in the east and south-east of the island. It is an igneous but not an eruptive rock, and was thrust upward after the Palaeozoic marine strata were deposited, but has been laid bare in many parts by the denudation of the surface rocks. It was this agency probably that raised much of central and eastern Tasmania permanently above the sea. To the north and north-east the plateau rises steeply from the lowlands; its edge, appearing like a mountain range, is called the Great Western Tiers. To the south and south-east it slopes away more gradually to a 'drowned land' with an intricate maze of bays, estuaries, channels, peninsulas, and islands, among which may be mentioned the two double islands of Bruni and Maria, and the double peninsula of Tasman and Forrestier.

North-east highlands.

In the north-east corner is a highland region resembling in character that of the north-west, with a core of granite and other Archaean rocks, associated, as in the north-west, with tin deposits and areas of basalt and other volcanic rocks. Northward this region is continued in the islands of the eastern end of the strait, while isolated areas of granite and porphyry occur for more than a hundred miles to the south. There are two outcrops on the coast of the mainland to the south of the main mass, and then a long narrow strip forms the wild rugged eastern coast of Freycinet Peninsula and the adjacent Schouten Island; the fourth makes up the picturesque eastern coast of Maria Island, rising direct from the sea in great

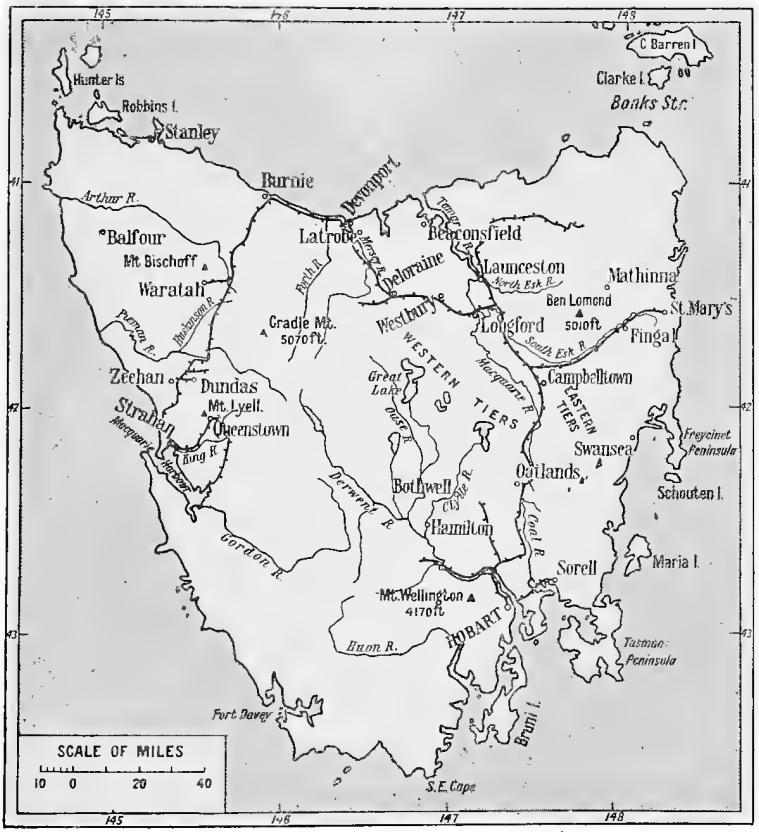

145
146
147
148
C. Barren I.
Clarke I.
Banks Str.
Hunter Is.
Robbins I.
Stanley
Burnie
Devonport
Arthur R.
Balfour
Mt. Bischoff
Waratah
Latrobe
Tamar R.
Beaconsfield
Launceston
North Esk R.
Mathinna
Ben Lomond
5010ft
St. Mary's
Forth R.
Deloraine
Westbury
Cradle Mt.
5070ft.
Pieman R.
Huskisson R.
Longford
South Esk R.
Fingal
Zeehan
Dundas
Mt. Lyell
Queenstown
Great Lake
Ouse R.
WESTERN TIERS
Macquarie R.
EASTERN TIERS
Campbelltown
Strahan
Macquarie Harbour
King R.
Swansea
Freycinet Peninsula
Bothwell
Derwent R.
Clyde R.
Oatlands
Schouten I.
Gordon R.
Hamilton
Sorell
Maria I.
Mt. Wellington
4170ft.
HOBART
Huon R.
Tasman Peninsula
Fort Davey
Bruni I.
S.E. Cape
SCALE OF MILES
10 0 20 40

Fig. 61

cliffs, while finally off the eastern coast of Tasman Peninsula the granite reappears in the wave-worn rocks of the Hippolytes.

The east.

Down the eastern coast runs an irregular belt of elevated land mainly of greenstone, which forms a watershed and leaves but a narrow space between the hills and the sea. An outlier of this region in the north is the flat-topped greenstone mountain of Ben Lomond, the highest in the eastern part of the island, which reaches a height of 5,010 feet. Westward of this region is a depression separating the eastern hills from the central tableland, and through this the railway from north and south is carried at a height of 1,300 feet.

Northern lowland.

In the north along the shores of Bass Strait lies the chief lowland area of the island. It reaches its greatest breadth about the middle of the north coast. To the east it runs up against the north-eastern massif, while towards the west the north-western uplands gradually approach nearer to the coast. This region varies a good deal in geological formation. Along the north-west coast are large areas with a rich chocolate soil made up of the débris of volcanic eruptions, which form the most fertile part of the island. Further east, where the lowlands are broadest, there are Tertiary and post-Tertiary deposits apparently laid down in a large freshwater lake stretching southward and south-eastward from what is now the estuary of the Tamar, and sending out to the north-west a long gulf between the foot of the north-eastern scarp of the central plateau and the isolated greenstone area west of the Tamar. These deposits are for the most part fairly fertile, and towards the west provide some of the finest agricultural land in Tasmania.

This region is a lowland, rather than a plain, since the area of plain country proper is comparatively small, groups and ranges of hills or isolated peaks occurring almost everywhere. In the north, near Perth and Evandale, and further south near Campbelltown, there are 'islands' of basalt covering considerable areas. It is stated that at the 'Big Hill' near Evandale traces of

volcanic agency in the shape of warm springs are still to be found. Smaller patches of basalt occur at various points in the south-east and centre of the island, and some of these volcanic areas provide a very rich soil.

Coast. The coast-line on the whole resembles that of Australia in being fairly regular. The island is shaped something like a heart, and is broadest in the north, where the coast is concave. There are a number of bays and some of the river-mouths afford fairly good harbours, but the only deep indentation is the long winding estuary of the Tamar, which penetrates for nearly 40 miles into the land. The long regular line of the western coast, facing a stormy sea, is broken by but two indentations of importance—the broad, brackish inlet of Macquarie Harbour with its narrow bar-bound entrance about the middle of the coast, and the harbour of refuge of Port Davey, with its long fiord-like arms, near the south-western corner. The eastern coast is the most unequal and broken of all, and its southern end is an extraordinary maze of estuaries, channels, and bays with peninsulas and off-lying islands, providing an extent of practically inland navigation not equalled elsewhere in Australia. The short stretch of southern coast rather resembles the western coast.

Regional division. Speaking generally the island may be divided into three distinct regions, differing not only geologically but climatically, and distinguished by a somewhat different fauna and flora and also in regard to the human activities to which they give scope. These are :

(1) The greenstone region of the centre and east, with a high tableland sloping down to a very broken and irregular coast.

(2) The highland region of the west, made up of ancient rocks, often highly mineralized.

(3) The lowland region of the north, in some respects a transition region, but possessing special features of its own and with a varied geological formation, characterized by large volcanic deposits in the north-west and north-east and a plain of Tertiary deposits in the centre.

Climate. The climate is conditioned largely by two circum-

stances : (1) the fact that the island lies in the west wind belt of the southern hemisphere ; (2) the configuration of the surface. Westerly winds prevail for nearly two-thirds of the year, more especially in the winter half. They blow over vast stretches of ocean, and the exposed western coast and the mountainous western region generally have a wet windy climate with a very heavy rainfall. The rainfall increases with the elevation; Gormanston, 20 miles from the coast and 800 feet above sea-level, has an average of 110 inches a year, and on the higher levels the precipitation ranges up to and above 150 inches a year.

The eastern portion of the island, to which the westerly winds come robbed of most of their moisture, has a much drier climate, though owing to the irregular nature of the surface there are great local variations. The western portion of the plateau has a heavy rainfall, and, owing to its elevation, a severe winter, with heavy falls of snow. The region further east gets most of its rain from the east and south, and hence the wettest portions are the south and south-east. The driest portion of the island is the midland depression between the central plateau and the eastern ranges, where the average fall is below 20 inches per year. Hobart, in the south-east, has an average of 23.57 inches.

The climate of the northern region is intermediate. The broad entry of Bass Strait provides access for the westerly winds. In the extreme north-west the rainfall is very heavy, but it diminishes eastward till it reaches a minimum of about 25 inches in the lowland area round Launceston. The rugged and mountainous north-east has a much higher rainfall and sometimes receives very heavy rains from the north-east.

The climate is less affected than might be expected by the nearness of the great Australian land-mass. Hot northerly winds occasionally blow across the strait in summer, but their influence is short-lived. The extreme ranges of temperature are from 105° to 24° at Hobart, and the average is about 54° F. Snow seldom falls at the sea-

level, but the higher mountains, especially in the west, are snow-capped for a great part of the year.

Rivers.

The river system falls into the threefold division already mentioned in connexion with the physical features and the climate. The chief hydrographic centre is the north-western corner of the central tableland, where rivers of all three systems rise comparatively near each other.

In a deep valley on the western side of the plateau lies Lake St. Clair, out of which flows the Derwent, the chief river of the south-eastern system, which runs south-eastward in a deep valley along the edge of the plateau for about 130 miles, and enters Storm Bay by a broad estuary. It drains practically all the central plateau and its southern and eastern slopes, and its basin is second in size only to that of the Tamar. Within its basin, too, lie all the larger Tasmanian lakes. The other great river of this system is the Huon, which rises to the west of the lower Derwent, and flows southward and eastward through a heavily-timbered country till it falls into D'Entrecasteaux Channel by an estuary second only to that of the Derwent in size. East of the Derwent the chief river is the Coal River, which falls into the salt-water lake of Pittwater and is of considerable length though of no great size.

The Tamar.

The main feature of the northern system is the great basin of the Tamar. The Tamar is properly an estuary formed by the junction of the North Esk and the South Esk. The former is a short river draining the south-western slopes of the north-eastern hill country, but the South Esk and its tributaries drain a large area extending from within a few miles of the eastern coast nearly half-way across the island at its greatest breadth. The South Esk rises in the north-east and sweeps round in a great semicircle to meet the North Esk at Launceston. Apart from this basin the northern region is drained by a number of parallel rivers which flow from south to north and enter Bass Strait as independent streams. The longest of them are the Forth and the Mersey, which rise close together, not far north of the head-waters of the Derwent.

Western rivers.

Of the western rivers the largest is the Gordon, which carries more water to the sea than any other river in Tasmania. Rising within a few miles of the Derwent, from whose basin it is at one point separated only by a low ridge, the Gordon flows southward to the Great Bend, where it turns abruptly to the west and finally falls into the head of the land-locked Macquarie Harbour. The King River, a smaller stream, which follows a course nearly parallel to that of the Gordon, and cuts through the coastal range in a gorge nearly 1,000 feet deep, also falls into Macquarie Harbour.

Further north the western region is drained mainly by two rivers, the Pieman and the Arthur. The Pieman rises near Lake St. Clair and flows westward and north-westward to the sea, while the Arthur rises in the highlands about Waratah.

River navigation.

The Tasmanian rivers are too short and possess too great a fall to be of much use for navigation, but the estuaries of three of them, the Derwent, Tamar, and Huon, give sea-borne traffic access for some distance inland. The estuary of the Derwent offers one of the finest harbours in the world. The Gordon is navigable for vessels drawing up to 15 feet for some 20 miles from its mouth, and for boats for some 50 miles further, but its basin is almost uninhabited, and the chief use made of the river has been to float timber down it. Macquarie Harbour, however, has played a great part in the development of the western mining fields. The estuaries of several of the smaller northern rivers serve as harbours.

Lakes.

The larger lakes of Tasmania lie in hollows on the central tableland, and the largest of them, the Great Lake, is 3,250 feet above sea-level. It covers an area of about 50 square miles, but is everywhere shallow, and the same is true of the other lakes of the tableland, Sorell, Arthur, and Crescent. Lake St. Clair, lying in a deep valley, is a very deep lake. Small lakes are plentiful, particularly in the glaciated western region.

Vegetation.

The vegetation of Tasmania is mainly Australian in character, except in the west. Trees of the eucalyptus or

gum-tree family are the prevalent type, and give a characteristically Australian aspect to the country. Where the rainfall is heavy, especially in the south-east, north-east, and north-west, these trees form dense forests and sometimes attain heights between 300 and 400 feet.

In the western region the eucalyptus is rare, and the xerophilous type of vegetation which generally accompanies it gives place to a vegetation of the 'temperate rain-forest' type, of unusual luxuriance and presenting decided affinities with the forests of South America and New Zealand, although some of its forms are confined to Tasmania. The chief forest trees are the evergreen beech (*Fagus Cunninghamii*) and various conifers, the so-called pines, Huon pine, celery-top pine, and King William pine, belonging to species confined to Tasmania. An interesting tree confined to this region is the deciduous beech (*Fagus Gunnii*), the only deciduous tree found in Australia. Both this and the evergreen beech are represented by practically identical species in the forests of Tierra del Fuego and the south of South America, and they, with other plants common to the two regions, form a strong argument for a former land connexion between the two land-masses now so widely sundered. One of the greatest obstacles to the prospecting of the mineral areas of the western region has been the extraordinary density of the undergrowth or scrub which covers most of the country, especially towards the north; away to the south-west much of the country consists of open plains covered with coarse sedge-like 'button-grass'.

Tasmania resembles New Zealand in the wealth of ferns which characterizes its vegetation, and one of the species of tree-ferns sometimes attains a height of over 50 feet. Various species of acacia are widely distributed. Of the richea, or grass-tree, a curious palm-like plant, there are nine species in Tasmania, only one of which occurs in Australia.

Fauna.

The fauna of Tasmania is mainly Australian, but in addition to the Australian marsupials, kangaroo, opossum, wallaby, wombat or badger, and smaller animals, it

possesses two carnivorous marsupials unknown in Australia. These are the Tasmanian tiger or thylacine (*Thylacinus cynocephalus*), and the Tasmanian devil (*Sarcophilus ursinus*). The tiger is a wolf-like animal which was formerly very destructive to sheep, but is now scarce. The devil, a much smaller animal, black in colour with a white throat, is not uncommon. The fossil remains of these animals have been found in Australia, and a very close relation of the 'thylacine' occurs in comparatively recent deposits in South America, but both are now confined to Tasmania. The platypus is more common than in Australia, but the emu, once common in some parts of the island, has been exterminated. The larger marsupials have been greatly reduced in numbers owing to the value of their skins.

Fish abound on certain portions of the coast, but the native freshwater fish are few in species. The most interesting are certain little fishes of the Galaxias family colloquially called 'trout', which are widely spread in the southern hemisphere but found nowhere else. One Tasmanian species, *Galaxias attenuatus*, which frequents brackish water, is found in South America, while other species are represented by closely allied forms. This family is common to all parts of Tasmania, as are eels, but the much larger blackfish, as has been mentioned above, is only found in the streams flowing into Bass Straits. In these, too, is found the large freshwater lobster or crayfish (*Astacopsis*), which may attain a length of 2 feet and a weight of 8 or 9 lb. This lobster, as well as another northern freshwater fish, the cucumber herring, is also found in some of the western rivers, but not in the east and south.

Whales of various species were formerly abundant on the Tasmanian coast, and seals were found in great numbers on the islands of the coast, but whaling and sealing, most important industries in the early days of the colony, have long been extinct.

Agriculture.

Agriculture is the most important occupation, followed by mining, while timber-cutting is of considerable impor-

tance. The area under crops, however, is insignificant as compared to the total area. Tasmania and its outlying islands contain in all 26,215 square miles, or 16,777,600 acres, and the area cropped each year is about 300,000 acres, or less than 2 per cent. of the whole. If to this be added the area under artificial grasses and lying fallow, however, we have a total of nearly 1,000,000 acres of arable land. Owing to the moist climate and cooler summers, the proportion of land laid down in pasture is much higher than in the mainland states, though lower than in New Zealand. In the eastern and central region much of the country affords pasture for sheep and cattle in its natural state. It may be noted that the total area of land alienated from the Crown is between 5,000,000 and 6,000,000 acres, or about a third of the island, most of which is used for grazing purposes.

The progress of agricultural settlement has been conditioned largely by climatic factors. In the early days agriculture was carried on mainly in the regions where the rainfall was comparatively light, and the land lightly timbered and easily cleared. Such conditions were found in the valley of the Derwent and of the Coal River in the south and in the basin of the Tamar in the north. At that time wheat-growing was one of the chief agricultural industries of Tasmania, which now does not supply its own wheat requirements. At the present day the most productive agricultural areas in Tasmania are the rich but originally heavily timbered lands of the north-west, and, to a less extent, of the north-east, which yield great quantities of potatoes and other root crops, and of oats and hay. Dairying and the fattening of stock are also carried on to a great extent in the north, and the export of butter, made under the factory system, is steadily increasing.

The midland and eastern region is mainly pastoral and supports the greater portion of the 2,000,000 sheep of Tasmania. The breeding of stud sheep, especially of fine-woolled merinos, has been attended with much success, owing to climatic and other conditions, and

Tasmanian stud sheep are exported not only to all parts of Australia, but to South Africa and even to South America.

Fruit-growing has in recent years come to be one of the leading industries, and this is carried on mainly in the south-east. In all there are some 30,000 acres under fruit, of which over 20,000 are devoted to apples, and by far the greater part of these are in the lower portions of the basins of the Huon and the Derwent. Here are produced about 90 per cent. of the entire apple crop of the island, which now amounts to over 2,000,000 bushels annually, and the greater part of the small fruit—raspberries, strawberries, currants, gooseberries, cherries, and the like. The export of apples, which only began about 1890, has developed to such an extent that nearly 1,000,000 bushels are exported annually to overseas markets, principally to Great Britain, but also to the continent of Europe and to South America, and over 500,000 bushels to Australia, mainly to Sydney. The area under orchards is rapidly increasing both in the south and in the north of the island. Tasmania is noted for the production of hops, which are chiefly grown on irrigated land in the valley of the Derwent.

Minerals.

The western region, owing to the rugged and heavily-forested nature of the country and the severity of the climate, has little pastoral or agricultural activity, but it supplies by far the greater part of the mineral wealth of Tasmania. The only other mining region of any importance is the north-east, which is the chief tin-producing region of Tasmania. In the north of the western region is Mount Bischoff, one of the greatest tin mines in the world, and other tin deposits have been opened up further south. The most important mineral of the western region, however, is copper, which is found in enormous quantities, associated with gold and silver, in the pyritic deposits of Mount Lyell, about the middle of the western region, where the ore is worked in an open quarry.

A little further to the north, round Zeehan, extensive deposits of silver-lead ores are worked. Further inland,

at Mount Read and elsewhere, are deposits containing an extraordinary mixture of metals—copper, silver, zinc, and others. The problem of the treatment of these refractory ores is important for the Tasmanian mining industry. Most of the western region is highly mineralized, but it has been only partly prospected.

Gold is worked at several places east and west of the lower Tamar, but the only mines now of much importance are at Beaconsfield, near the mouth of the estuary. Iron exists in almost all parts of Tasmania, and in several places in the north there are rich deposits, as on the north-west coast near Penguin. Coal exists in many parts, but is worked largely only in the east, near St. Mary's. The island depends to a considerable extent on New South Wales for coal.

Apart from the possibility of new coal deposits being found, it seems likely that Tasmania has a valuable supply of 'white coal' in the streams. The generation of electricity from water-power provides lighting and power for the city of Launceston, and a scheme for using the waters of the Great Lake for this purpose has been initiated for the purpose of supplying light and power to Hobart and other places in the south.

Building-stone of good quality is abundant, especially in the south, and it was at one time quarried in considerable quantities both for home use and for export. The quarries are now little worked, brick and timber having replaced stone.

Timber industry.

The timber is chiefly hardwood, furnished by various species of eucalyptus. In the form of railway sleepers, piles, beams, and the like, this timber is exported to many parts of the world. The chief saw-milling districts are in the south-east, especially along the coast to the southward of the estuary of the Huon, and in the north-east and far north-west. The quantity of timber cut annually is over 50,000,000 feet, and as the trees are of slow growth and the area of the forests is somewhat limited, it seems that unless provision is made for some system of protecting the forests, and especially the young

trees, the production of timber may receive a check. The leaves of the *Eucalyptus globulus*, or blue gum, are used to produce a medicinal oil, and the wood of several species of eucalyptus has proved well adapted for paper-making. The Huon pine and other pines common in the western region yield a valuable timber, but accessible supplies of this have been largely depleted. Several trees, such as the blackwood, yield valuable ornamental timbers, and large quantities of bark, used for tanning, are obtained from the black wattle. This is obtained from the wild trees, and the wattle is not, as in Natal, cultivated for its bark.

Commerce; ports; communications.

The trade of Tasmania consists mainly in the export of raw materials and metals, and the importation of manufactured goods. The chief articles of export in order of value are: copper, wool, tin, fruits (mainly apples) and jams, silver and silver lead, potatoes, timber, and butter. Apples and wool are shipped direct to Europe from the port of Hobart, but the bulk of the trade is done at present through the mainland ports. There is, however, an increasing volume of direct trade between Tasmania and places outside Australia. The capital, Hobart, which stands on the estuary of the Derwent, possesses a harbour which is sheltered, deep, roomy, and easy of access at all times, and has wharfage accommodation for the largest ships. From it practically all the Tasmanian fruit for export is shipped, and it is the chief centre of the timber trade. The second port is Launceston, the chief port for passengers and mails to and from the mainland, which is handicapped by the difficulties presented to navigation by the Tamar estuary, though it is more centrally situated than Hobart. There are several ports on the north-west coast from which large quantities of produce are shipped to Melbourne and Sydney. The chief are Devonport and Burnie, of which the latter is the port for part of the west coast mining region, with which it has communication by railway. It is nearer to Melbourne than Launceston, and has a share in the mail traffic. The natural harbour is not good, and

a breakwater and other works have been necessary. The chief port on the west coast is Strahan on Macquarie Harbour, once the only port for the most important mining fields of this region, but now rivalled by the competition of Burnie.

Railways roads.

Internal communication is a matter presenting considerable difficulties owing to the irregular nature of the surface and the forests that cover much of the island. There are less than 500 miles of railway in the island. From Launceston, which is the centre of the railway system, a line runs southward to Hobart through the depression between the eastern tableland and the central ranges. Another line runs westward as far as Burnie, and a third line eastward into the north-eastern districts. From Burnie a line runs southward to Zeehan and on to Strahan on Macquarie Harbour, from which a line runs inland to the great copper mines at Mount Lyell. The island is, however, provided with an excellent system of roads, especially in the older settled districts.

Government.

Until 1853 the island was a receptacle for convicts transported from the United Kingdom, but in that year transportation ceased, and soon after the island became a self-governing colony. Before that, in 1835 and onwards, the rich pastoral lands around Port Phillip (Victoria) were first settled from Tasmania. A greater exodus to the mainland took place in the fifties, when gold was discovered in Victoria, but the demand for its products in the 'golden days' also caused great prosperity in Tasmania itself.

Tasmania joined the Federation of the Australian colonies in 1901, and is now the smallest state of the Commonwealth, a position which has entailed a certain amount of hardship upon its people. It has a debt of over £10,000,000, incurred mainly for public works, railways, roads, &c., in the past, and more than a third of the revenue raised yearly goes to meet the interest.

Population.

The population at the census of 1911 was 191,000, or just over 7 to the square mile, making Tasmania the most thickly populated state in the Commonwealth,

except Victoria. The birth-rate is very high, and the death-rate low, so that the island has a higher rate of natural increase than any other part of Australasia, but, as in the case of many other islands, there is an excess of emigration over immigration, so that the population increases but slowly.

Aborigines.

The original inhabitants were a black, woolly-haired race, different in their characteristics from the aborigines of Australia, and more akin to the Melanesians of the Pacific Islands. They had apparently been isolated in Tasmania for a long period, and were probably the most primitive race preserved to modern times, more primitive than the inhabitants of other extreme southern lands, such as the people of Tierra del Fuego or the Bushmen of South Africa. They were in the palaeolithic stage of the Stone Age, using tools of chipped stone, while their weapons were wooden spears and clubs. Living without fixed abodes they wandered over the country in small groups or 'mobs', living on shell-fish, animals, and birds, and the few poor edible roots and fruits afforded by the native vegetation. They were never numerous, and contact with the incoming white men proved fatal to them. Outrages by runaway convicts and others provoked retaliation by the natives, and in 1832, when the natives were removed to Flinders Island, their numbers had fallen to about 250. Their numbers rapidly dwindled, and the last pure-blooded aboriginal died in 1876. The so-called half-castes of the eastern Straits Islands, who number about 300 in all, preserve traces of their blood.

Present population.

At present the population is a practically homogeneous one of British and Irish descent, and by far the greater part of the people are native-born. The portion of the population not of British extraction does not amount to 2 per cent. of the whole. There are somewhat under 1,000 Chinese, nearly all men, and a considerable number of Germans and Scandinavians, approaching 2,000 in all, who make excellent settlers, and, in most cases, become so completely anglicized that they are not distinguishable, except by their names, from the people around them.

More recently there has been a small infiltration of Italians and Bulgarians, and latterly of Maltese, attracted to the western mining fields.

Distribution of population.

The distribution of population is very uneven, but owing to the configuration of the surface, there is no such concentration in the capital city as occurs in several of the mainland states. Hobart, the capital and chief port, is not nearly so important proportionately as Melbourne, Sydney, and Adelaide are in their respective states. It has a population, including suburbs, of about 42,000, or one-fifth of the total, and has a rival in the chief northern centre, Launceston, which has over 25,000 people. Of the country districts the most thickly populated is the fertile agricultural region of the north-west coast, and it is here that the population is increasing fastest. The fruit-growing districts of the south-east support a fairly dense population, but outside these and the saw-milling areas, the southern, eastern, and central parts of the island are thinly peopled. Some of the north-eastern districts have a fairly large mining and agricultural population, while the population of the western region is concentrated in the mining districts, notably at Queenstown (Mount Lyell) and around Zeehan and Waratah. About a fourth of the island, in the west and south-west, is without permanent inhabitants.

Education.

Education has lagged somewhat owing to the comparatively small resources and scattered population of the island, but there is now a fairly complete system of free and compulsory primary education provided by the state, which also gives a certain amount of secondary education. Since 1890 Tasmania has had a university at Hobart which, though small and poorly endowed, has done good work.

Literature.

[See A. S. Murray, *Tasmanian Rivers, Lakes, and Flowers*, London, 1900; W. F. Petterd, 'The Minerals of Tasmania,' *Papers and Proc. Roy. Soc. Tasmania*, 1910, pp. 1–221; L. Rodway, *The Tasmanian Flora*, Hobart, 1903; H. Ling Roth, *The Aborigines of Tasmania*, 2nd ed., Halifax, 1899; G. Smith, *A Naturalist in Tasmania*, Oxford, 1909.

County maps of 1 in. and ½ in.=1 mile, a general map of 8 miles, and a geological map of 15 miles to 1 in. are published.]

CHAPTER X

PAPUA

By J. H. P. Murray

New Guinea, a straggling island, shaped like some grotesque bird, lies to the north of Australia, between the equator and 11° S. Lat. It has been partitioned between three European powers, Britain, Germany, and Holland. British New Guinea, or, as it is now called, Papua, comprises the south-eastern part with its attendant islands, German New Guinea the north-east, and Dutch New Guinea the west. A lofty range of mountains occupies the centre of the island. Coming right down to the water's edge at the eastern end this range, further west, retreats from the sea, leaving towards the coast, as the Dutch boundary is approached, a wide expanse of flat country drained by the enormous rivers which are fed by the continual rains of the interior.

Fly River.

Of these rivers the Fly is the largest; according to the calculations of Sir William MacGregor it sends down a volume of water equal to 180,000,000 gallons in twenty-four hours. The Fly rises somewhere near the point where the three territories of British, German, and Dutch New Guinea meet, and runs into the sea towards the western end of the Gulf of Papua; in its estuary it widens out to an expanse of more than fifty miles. The Fly and its tributaries, the principal of which, the Strickland, is almost as large as the Fly itself, drain almost the whole of the far west of the territory, for though there are several rivers between the Fly and the Dutch boundary none is of any magnitude. It would appear probable that the Fly formerly entered the sea at what is now Strachan Island, and that the Wassi Kussa and Mai Kussa, the rivers or inlets of the sea which enclose this island, are the remains of what was once the Fly River

mouth. To the east of the Fly is the Bamu, a river of no great size which apparently loses itself in the swamps of the interior, then come the Turama and the Omati, and further on the large and intricate river systems of the Kikori and the Purari, with their curiously involved water-ways and channels intersecting the low-lying mangrove flats through which they flow.

Kikori and Purari.

A hideous but curiously fascinating part of the territory is this delta country of the Purari and Kikori rivers. A solitary hill, known as Aird Hill or Neuri, rises near where the Kikori splits up into the different mouths by which it enters the Papuan Gulf. Neuri is about 900 feet high, and from its summit is obtained a strange, interesting view over the nipa palm and mangrove swamps that here stretch back many miles from the sea ; high mountains can be seen in the distance towards the upper waters of the two rivers, and all around the dull monotonous green of the mangroves is lightened by the occasional gleam of the innumerable water-ways which provide almost the only means of communication in this desolate region. The traveller ascending these rivers of course eventually reaches higher land—mostly rugged limestone country on the Kikori, though intersected by occasional fertile valleys—but the coastal country from the Purari mouths to the west is wholly unfitted for European settlement, though the sago which grows luxuriantly through the district affords a sufficient food supply for a large native population—large, that is, for Papua, which is by no means a populous country.

The Purari is the last of the huge rivers of the gulf; there are indeed other large rivers, such as the Vailala close by, but none of them has anything like an equal volume of water, and further to the east the mountains come closer to the coast and leave no room for large water-courses or deltas like those of the Purari and the Kikori. One river indeed, the Venapa, which runs into Galley Reach about 35 miles to the west of Port Moresby, suggests the delta country of the gulf, for the mangrove flats are there, and the cross channels and the

intricate windings ; but it is all on a smaller scale. Even before the Venapa is reached the character of the country has changed, for near Yule Island, 65 miles to the west of Port Moresby, the ' dry belt ' begins, and it continues for about 100 miles along the coast to the neighbourhood of the Kemp Welch River.

The ' dry belt '.

This dry belt extends into the interior as far as the mountains. Speaking generally the rainfall increases with the distance inland, but even on the coast some places are much drier than others. Port Moresby is probably the driest of all, and has perhaps barely two-thirds of the rainfall of Galley Reach or the Kemp Welch. Although to the east and to the west of the dry belt the country has an abundant rainfall and a luxuriant vegetation, the general aspect of the dry belt during the season of the south-east trade winds, except in a few favoured spots, is that of Australia in a drought. But this is only true of the south-east season, for no sooner have the rains of the north-west monsoon arrived, than the dry belt becomes covered with a garment of green, grass and herbage shooting up almost as soon as the rain touches the ground.

Eastern end districts.

Along the southern coast the mountains continue to approach the sea, and the whole of the south-eastern extremity of the territory (the tail of the bird with which the island has been compared) is a mass of mountains, well watered, but with no large rivers, sometimes rising abruptly from the sea, and rarely, excepting towards the German boundary, leaving any great expanse of level country on the shore. There are, it is true, fertile valleys and flats along or near the coast, enough and to spare for all the settlers who are likely to come to Papua for many a day, but they are not of sufficient extent to change the aspect of the country as a whole.

Mountains.

The highest mountain in Papua is said to be Mount Albert Edward ; Mr. C. A. W. Monckton, who made the ascent in 1906, gives the height as 13,250 feet (by boiling-point thermometer). Mount Victoria, according to Sir William MacGregor's observations, is 13,121 feet, and

there is a mountain called Uduru, a few miles to the west of Mount Albert Edward, which is reported to be as high as that mountain, though its altitude has not been calculated. Mountains of 10,000 feet and over are fairly numerous ; there are, for instance, Mount Essie (12,108 feet), Mount MacGregor (12,058), Mount Nelson (11,984), Mount Chapman (11,676), Mount Chamberlain (11,229), Mount Suckling (11,226), and Mount Yule (10,380). Most of these are found in the eastern part of the territory, but there are some high mountains in the west that have not been visited, and whose altitude can only be conjectured.

So far it is the eastern part of the country that has attracted most settlement, partly because such good country as there is in the west is generally cut off by thick belts of mangrove swamp, partly because the absence of a sheltering reef makes it difficult, and indeed often impossible, to land anywhere in the Gulf of Papua except during the few months of the north-west monsoon, and partly from the accident of the discovery of gold in the east. Petroleum, however, has been discovered in the Gulf country, and it remains to be seen what effect this will have on the distribution of population.

The interior.

Almost all the existing European settlement is in the neighbourhood of Port Moresby or further east ; and with the exception of a few miners it is almost entirely on the coast. In fact the interior, from the absence of roads and the consequent difficulty of transport, is practically uninhabitable ; and, even though roads may in time be made, it cannot be supposed that, in the absence of some great mineral development, as, for instance, the discovery of a rich goldfield, the interior of Papua is ever likely to prove attractive to a European population. It is certainly cooler than the coast ; there are, as a rule, no mosquitoes (and therefore there should not be any malaria), and the air, at an elevation of 6,000 or 8,000 feet, is even bracing. But the extreme dampness of the climate, with its continual suggestion of rheumatism, and the general gloom of the surroundings, would

probably to most people prove harder to bear than even the occasional fever of the coast. Ethnologists say that the natural trend of the Papuan is from the interior towards the sea, and, if this is so, the Papuan may be considered to display an admirable judgement. As an occasional sanatorium, a place where women and children in particular can seek a change from the coastal heat, the highlands of Papua are invaluable, but it cannot be thought that they will ever be found attractive to settlers as a permanent place of residence.

Islands. Flat low-lying country in the west, rugged masses of mountains in the east—such, roughly speaking, is the mainland of Papua ; but there remain the islands scattered in various groups and archipelagos at the eastern end of the territory. Some of the larger islands are extremely mountainous ; Goodenough, for instance, in the D'Entrecasteaux Group, rises to a height of 8,000 feet, and there are others, such as Misima, Sud Est, and Rossel, which attain altitudes of from 3,000 to 4,000 feet. The most important, commercially, of the islands is Woodlark, or Murua, the only place in the territory where reef mining is carried on. It is one of the largest of the islands, and is of coral formation, mountainous, and thickly wooded. The island scenery, as a rule, presents the typical characteristics of tropical islands ; there is the blue sky, the deep blue sea, changing to green in the shallower depths, so clear that it is almost possible to distinguish the grains of sand many fathoms below, the amazingly variegated colours on the reefs, the bright white beaches and the waving palms.

Economic Conditions

Discovery of gold. 'Island of Gold' (Isla del Oro) was the name given to New Guinea by the Spaniard Alvaro de Saavedra, who coasted along the northern shores between the years 1525 and 1530, and it was gold that brought settlement to Papua. The first rush was to Port Moresby in 1877 ; it was a failure, but gold was discovered in the Louisiades in 1888, on the Mambare in 1895, and on Woodlark Island in

1896. Gold-mining has ever since been a staple industry of the territory, though nothing has been discovered that in any way justifies the name that Saavedra bestowed upon the island.

Except on Woodlark Island the mining in Papua is all alluvial, and though in the aggregate a fair amount of gold has been found, the expenses of finding it have been great. It has been divided among a number of men, and there has so far been no instance in Papua of the typical lucky miner who makes enough in a few weeks to keep him in luxury for a lifetime. There are seven goldfields: the Gira and Yodda in the north-east, Milne Bay or Gibara, Keveri near the south coast, Lakekamu in the Gulf, the Louisiades, and Murua or Woodlark Island. No accurate returns are available, but Murua is estimated to have produced gold to the value of more than £500,000, and the Yodda and Gira about the same amount between them. The production of the other fields has been much less, and the total for the seven is only about a million and a quarter. Alluvial working.

Difficulties of transport and the consequent high price of provisions make mining expensive in Papua, and prospecting is extremely difficult on account of the roughness of the country and the density of the vegetation. Yet almost every creek will give *colours* of gold, and it is hard to believe that there are not somewhere, perhaps hidden away in the fastnesses of the main range, gold reefs rich enough to justify the enormous expense which would be involved in working them. It is to a great extent this hope that has kept mining alive in Papua, for the returns are surely not sufficient to make up for the hardships and monotony of the life. Expense of working.

In 1907–8 and 1908–9 the output of gold had sunk to little more than £50,000, not much more than half what it had been eight or nine years before, but in 1909 a new field was discovered about ninety miles up the Lakekamu, a river that flows into the Gulf of Papua, and hope revived. The inevitable rush followed from Australia; incapables of all kinds poured into Papua, mingled fortunately with

a certain number of experienced miners, but the field proved disappointing, and in the first six months little more than £10,000 was produced—not a large sum when it is divided among the 228 men who came to the field between January and June, 1910. £30,000 is stated as the amount derived from the Lakekamu in the year 1910–11, but in the succeeding year this had decreased to £6,500.

With the decline of the Lakekamu the fortunes of alluvial mining in Papua sank very low. A few men remained at work on the Gira and the Yodda, but elsewhere gold-mining came to a standstill, except on Murua, and Misima in the Louisiades; there remains, however, plenty of gold on both the northern fields for the small number of alluvial miners in the country, even if the Lakekamu should 'pinch out' altogether, and a scheme has been promoted to sink through the conglomerate on the Yodda in the hope of finding what may be practically a second goldfield underneath. Hitherto all the gold has been found above the conglomerate, and it is hoped that, if the conglomerate is pierced, gold (hitherto untouched) may be found beneath it. In this event the best days of the Yodda may be revived, and in any case it is hardly likely that the last has been heard of the northern fields, for there are still the possibilities of dredging and hydraulic sluicing, neither of which has been tried, though a dredging company or syndicate has undertaken operations on the Waria River in German New Guinea, and their example might be followed if successful.

Reef mining.

Reefs, however, have been found at Woodlark or Murua, and the first ore reduction plant in the territory started crushing here in 1901. The value of the total annual gold yield from Murua at that time was about £25,000, and in later years it has been over £30,000; this, it is true, is no great increase, but at least it amounts to satisfactory evidence of permanence. There are 'shows' on Murua of really great richness, but none of them is sufficiently developed to justify prediction as to their continuing to any depth; the Kulumadau mine has gone down 450 feet,

but, with this exception, there is not a shaft on the whole island that is 100 feet deep. It is possible that Murua might turn out to be one of the great goldfields of the world, but it has suffered from want of the capital necessary to develop its possibilities. The application of capital might work a revolution, not only in the fortunes of the island, but also in those of the territory in general.

Settlement.

The mortality among the early miners in Papua was appalling. The high death-rate was due more to ignorance and recklessness on the part of the men themselves than to anything particularly deadly in the climate, but it had the effect of giving the country a bad name and so discouraging settlement. Men will brave fever and dysentery and any other risk for the sake of gold, but not for the sake of coco-nuts or sisal hemp, and so the agricultural possibilities of Papua remained unknown or neglected while shiploads of miners were pouring in from Australia, most of them only to die without having even the satisfaction of getting much of the gold that had attracted them. Moreover, the system of land legislation was rather cumbrous, and the methods of procedure dilatory, with the result of creating the impression that white settlers were not wanted. Therefore they did not come, especially since there seemed to be nothing to attract them, for the most complete ignorance of Papuan resources was common, not only in Australia, but even in Papua itself. It was, in fact, no easy task to attract settlement to the territory. It cannot be called a 'white man's country', for, though white men and women can and do live there, it cannot be considered a suitable country in which to rear a family; but its reputation was far worse than the reality, and its resources had never been tested. No one had ever grown rich in Papua, so that no one could be induced to take up land there by pointing to the success of others. In order to attract settlers from Australia to Papua the conditions had to be made unusually favourable.

Land legislation.

The land law passed in the latter part of 1906 was therefore very liberal. By the terms of the Papua Act land

cannot be granted in fee simple, but leases were granted for 99 years, rent free for the first ten years ; no survey fees were charged, and only a nominal deposit was demanded, which was afterwards returned. On the other hand improvement conditions were imposed, for, though it was realized that a large amount of land would be taken up for speculative purposes—indeed it would otherwise hardly be taken up at all—it was obviously not desirable that the speculator should keep the land locked up indefinitely.

About this time public opinion in Australia, which had already become interested in Papua through the action of the Commonwealth in definitely accepting it as a territory, was still further attracted by the report of a Royal Commission upon it. It is interesting to trace in the official statistics first the effect of the new land legislation and afterwards that of the report of the Commission. The Land Ordinance passed the local Council in September, 1906, and in the months of October, November, and December 7,000 acres were applied for—a startling increase, for the total land under lease amounted up to June of that year only to 2,089 acres. In January, 14,000 acres were applied for, but there were no applications in February. In this month the report appeared, and then the applications began to pour in ; by June, 1907, there were 48,000 acres under lease ; in 1908 over 240,000 ; and in 1909, 336,803. A large number of leases, however, were held by speculators who never succeeded in floating them into companies, and there were consequently many forfeitures.

Attention had now been successfully directed towards Papua, and there was no further necessity for free surveys, the expense of which was very great. These were, consequently, abolished in 1909, and rents were imposed in 1910. A rent, however small, has a disproportionately great effect in discouraging applications for land, and, as was expected, the result of the rent and survey fees was that the area applied for immediately fell, and, as the forfeitures of the leases continued, there was a

slight decrease in the extent of land under lease. A limit was also placed upon the acreage that might be taken up by one person, for the natural tendency hitherto had been to take up more than the applicant could possibly utilize; and this also had the effect of reducing the area of subsequent applications.

Purchase of land from natives.

The two obvious necessaries for agricultural development are land and labour. Native ownership of land has always been recognized in Papua, and the result is that practically all the land that is wanted for settlement must be purchased from the native owners. The purchase is always conducted by the Government; the settler himself cannot have any land transaction at all with the natives. If he wants land he must apply to the Government. If it is Crown land there is no difficulty, and the lease is granted; but if it is native-owned land, it is necessary to ascertain first whether the owners are willing to sell, and next whether they should be allowed to sell, for, in the terms of the Land Ordinance, no purchase is made until the Lieutenant-Governor ' by sufficient inquiry has become satisfied that the land is not required or likely to be required by the owners '. It sometimes happens that the owner will not sell, in which case he is not forced to do so, and at other times he does sell, and it afterwards turns out that he is not the owner after all—probably he owns part but not the whole—and then, with what is perhaps an exaggerated anxiety to avoid even the appearance of injustice, it has been the practice of the Government to pay all claimants. With such a careful, perhaps even meticulous, regard for native rights, it may appear strange that the Government has succeeded in getting any land at all, but in fact, over a million acres have been acquired, and there is rarely any difficulty in getting any particular block that is wanted, provided that it is thought that the owners should be allowed to sell. Papua is a sparsely populated country, and it is perhaps to this fact that we should attribute the absence of land difficulties which have played so prominent a part elsewhere.

Labour.

As regards labour the case is different. Land will never be the limiting factor in Papuan progress—there is land enough and to spare—but labour may be so. Compulsory labour is contrary to Australian ideas, and the importation of labourers from outside the territory is forbidden in the interest of the Papuans; so that the whole of the labour for the development of the country must be voluntary, and it must all come from the territory itself. The supply has responded fairly well to the demand, and in 1912 there were probably about 10,000 Papuans working, compared with about 2,000 five years earlier, but there must be a limit, for the population is small, and is not sufficient to develop all the resources of the territory unless the development is to be very slow. There is enough, and more than enough, for the plantations and other industries at present in existence, and there need therefore be no fear of a shortage even if the area of recruiting did not increase, whereas the area will, of course, increase very largely with the extension of Government control over the whole territory. It is as well, however, that the land 'boom' of the first years of the territory came to an end when it did, otherwise the labour difficulty might have been very serious, for there has never been much labour to spare. The number of labourers increases, but the area under cultivation increases too: thus, in 1907 there were less than 1,500 acres planted; in 1912 there were nearly 25,000.

Nearly the whole of the labour is recruited from the villages, though occasionally boys come into Port Moresby and Samarai to look for work. The usual wages are 10*s.* a month with rations, and the maximum term of employment is three years; generally it is twelve months. The accommodation of the native labourer and his medical treatment in case of sickness are provided for by regulation, his wages are paid in cash before a magistrate, so far as possible the Government sees that he gets fair value for his money when he spends his wages at the store, and finally he is returned to his village at his employer's expense. Great care is certainly taken of

him—too much, it is often said ; but it really is essential that great care should be taken of him. His numbers are not great, and it is on him that the whole of the economic progress depends.

Hardly any of the plantations in Papua date back before 1906. Coconuts, rubber, and sisal hemp are the chief products ; there are also about 300 acres of cotton planted as a catch crop, and a very small area of tobacco. Most of the rubber planted in Papua is Para (*Hevea Brasiliensis*), but there is also a certain quantity of Ceara (*Manihot glaziovii*), which appears to do well in the dry belt, some hundreds of acres of an indigenous rubber (*Ficus rigo*), and a few of West Africa silk rubber and *Manihot dichotoma*. Indications from the first tapping have proved highly satisfactory. There are about 16,000 acres under coco-nuts, and under sisal hemp about 3,000 acres: the export of both copra and hemp is in its infancy. The quality of the hemp and cotton has been highly spoken of, and excellent cigars have been made from the tobacco. With its variety of climate, soil, and rainfall Papua should be capable of producing any tropical product in the best possible quality. Plantation products.

An industry which may develop into one of importance is timber cutting ; this, too, is in its infancy, but it is growing. The Papuan timbers, both hard and soft wood, were examined and favourably reported upon by Mr. Burnett, of Queensland, who visited the territory in 1907. Besides gold many other minerals have been found in Papua—copper, silver, lead, zinc, cinnabar, iron, and many others, but hitherto only copper has been worked. It is found in the Astrolabe Range near Port Moresby, but, though there is an enormous extent of copper-bearing country, hardly any serious attempt has been made to develop it, and it is difficult therefore to arrive at any opinion as to its value. The ore shipped in 1911–12, valued at £9,681, was all from one mine, the Dubuna, near Tupuseleia. Timber: minerals other than gold.

Minor industries are the collection of pearl-shell and bêche-de-mer, and pearl buying, which is carried on in Minor industries.

the Trobriand Islands. The pearls are found in an oyster known locally as lapi, which is used as an article of food by the natives ; the shell of the lapi is valueless. There is no regular lapi fishery like the pearl fisheries elsewhere, but the pearls are acquired by purchase from the natives, who collect the lapi for food as well as for pearls, and who then sell the pearls they find to licensed pearl buyers.

Petroleum. Petroleum was discovered in 1911 on the Vailala River, which flows into the Papuan Gulf, by Messrs. Thomas and Lett, who had a plantation in that district. The field, which is being developed by the Commonwealth Government, may cause, if successful, a complete change in the destinies of Papua.

Population and Government

Papuans and Melanesians. The native population of Papua is divided into Papuans and Melanesians ; the classification is perhaps, strictly, linguistic rather than racial, and means that some speak Melanesian dialects and others do not. There are tribes, generally regarded as of non-Melanesian race, who speak a Melanesian language, and there may be Melanesians who speak a Papuan language ; but usually the classification appears to be ethnologically correct, though no doubt in very many cases there is a mixture of blood. For instance, in the Port Moresby district the Koita or Koetapu, whose language is Papuan, intermarry with the Motu, who are Melanesians.

Languages. The Melanesian languages of Papua are all more or less related *inter se* and also with the other Melanesian languages, such as those of the Solomons and Fiji, but this is not the case with the Papuan languages, which differ immensely from one another and cannot be referred to a common stock ; in fact, Papuan merely means non-Melanesian. Ethnologically ' Papuasian ' is the term applied to all the native inhabitants of New Guinea. ' Papuo-Melanesian ' means a Papuasian who speaks a Melanesian language, and ' Papuan ' one who does not. Ordinarily, of course, the word ' Papuan ' is used to mean any native of Papua, irrespective of language and race.

Original inhabitants and Melanesian immigration.

The Papuans are regarded as the original inhabitants and the Papuo-Melanesians as immigrants, though possibly the dwarfs who have been described in Dutch New Guinea, and of whose presence traces have been found in Papua, are the true aborigines ; if so they have apparently been either exterminated or absorbed by the Papuans, and may, so far as British territory is concerned, be disregarded. The Melanesian immigrants seem to have come down the north-east coast, for there are no traces of them in Torres Strait, and have settled in the east end of the territory and on part of the south coast, penetrating inland to some extent, but never apparently in sufficient numbers to impose their language upon the Papuans of the far interior. They also occupied the Louisiades, the D'Entrecasteaux Group, Murua, the Trobriands, and the other islands—all except Rossel in the extreme south-east of the Louisiades. Its isolated position rather than the prowess of its inhabitants saved Rossel from invasion, for no hostile expedition ever came there—in fact no one ever came there at all, except occasional visitors from the island of Sud Est. (See Fig. 59.)

Area of Melanesian settlement.

Along the south coast the Melanesians extend as far as Cape Possession, a little to the west of Yule Island, and even now it would be almost possible to draw a line separating the dark-skinned Papuans to the west from the lighter-coloured and smaller Papuo-Melanesians to the east—the men of the bow and arrow from the men of the spear and the club. Melanesians are found as far as Cape Nelson on the north-east coast, but the line of demarcation is not so clearly drawn ; the two races overlap more than at Cape Possession, for the advanced guard of the one has got behind or been cut off by the advanced guard of the other. Nor is the difference in type so marked ; the Papuan Binandeli, who appear even in the last three or four generations to have advanced down the coast from the north, are darker and perhaps rather bigger than the Melanesians of Cape Nelson, but the difference is less obvious than on the south coast, for the so-called Semitic type, which is so frequent among

the Papuans of the Gulf and the west, is not found among the Binandeli, and there is no distinction of weapons—both use the spear and the club.

With the exception of one or two small Papuan communities which have either maintained or seized upon positions on the coast, the whole of the seaboard from Cape Nelson to Cape Possession is occupied by Melanesian-speaking tribes. Probably in many cases the occupation was peaceful, either with the consent of the original owners or without any active opposition from them, for possibly in most instances they were few in number and had more land than they could use. An instance of peaceful occupation by a Melanesian tribe is found in the settlement of the Motu on the shores of Port Moresby; the Koetapu were certainly there first, but did not attempt to oppose the Motu, regarding them probably as useful allies in their perpetual struggle with the Koiari of the interior. The general movement of the Papuans is from the interior to the sea, and, if the white man had not come, the question might have arisen whether the Melanesians could have held their own against this advance. Judging from the terror with which the coastal Melanesians regard the mountain men, one would be inclined to think that they could not.

General characteristics.

It is difficult to generalize about the natives of Papua, so much do they differ from one another, and any general statement must be subject to large qualifications. There is, as might be expected, more general resemblance among Melanesians than among Papuans, not only in appearance and disposition, but in customs and cultural characteristics. They are, speaking generally, divided into clans, sometimes combined with totems, and they practise exogamy. Where there are no clans actually in existence, traces of an original clan system can, with some imagination and a little goodwill, often be discovered.

There is a strong temptation to set the Papuan and Papuo-Melanesian entirely apart, and to say, for instance, of the Papuan that he is a tall black man, with a hooked nose, dolichocephalic, and addicted to cannibalism, and

of the Melanesian that he is exactly the reverse. Unfortunately the facts cannot be twisted to this extent. No doubt as a rule the Papuo-Melanesians are lighter in colour and, on the whole, smaller than the Papuans, but this is not always the case, for there are some very light-coloured people among the Papuans of the interior, and some of the mountaineers, who must be classed as Papuans, are so small as to suggest that they must be the result of an amalgamation with a dwarfish race. Again, the Papuo-Melanesians are usually bright, lively people, much more pleasant in their manners than the somewhat gloomy and reserved Papuans of the west, but to say that these were distinctive traits would be to contradict the experience of Dr. A. Russel Wallace, whose description of the Papuan is exactly the opposite. It is always hard to make facts fit in with theories, and it seems to be particularly hard to do so in Papua. 'I am aware', says Sir William MacGregor, after describing a particularly robust tribe whom he met at the foot of Mount Knutsford, 'that this cannot be reconciled with the theory of writers on this subject, who inform us that the natives of the interior are less robust, and are black and squat. No more can the fact that the lightest skinned people we have met with were in the centre of the island where the British, Dutch, and German boundaries meet.'

Papuan communal houses.

There is no criterion known to the writer except language and geographical position by which the Papuan can be distinguished from the Melanesian. The communal houses, however, form a fairly good test for the south coast, for there these houses are found among all, or very nearly all, the Papuan tribes and not among the Melanesians. They are used partly as dwelling-houses, partly as places for the performance of various rites and ceremonies, which, so far as the writer is aware, have never been seen by Europeans, partly as meeting or club houses for the men, and also for the display of weapons and masks, the heads of pigs and alligators and other spoils of the chase, and human skulls and warlike trophies. In the Purari delta, and perhaps the eastern part of the Gulf,

a woman is not allowed to enter one of these houses, but the writer has often seen women in the communal houses of the Goari Bari district, and further west whole families, men, women, and children, have their ordinary homes in them. The houses are sometimes as much as 200 yards long.

In the communal houses, or Ravi, as they are called, in the Purari delta, there is a screen at the end, and behind this screen are wicker-work figures four or five feet high, in appearance half pig and half alligator. These are called Kaiaimunu, but each has a name of its own; the number varies in the different Ravi. They are accredited with some sort of supernatural power, and, in particular, are consulted before the men of the Ravi start on an expedition. A canoe is brought in front of the Ravi, and the spirit of the Kaiaimunu, which is invisible, is brought out on to the platform before the house. 'Shall we go?' the spirit is asked, and if the canoe rocks from side to side the answer is 'Yes'; if it remains motionless it is 'No'. Some years ago the village of Ukiaravi attacked some white men on the Pie River, with results which proved eventually intensely disappointing to the villagers; after it was all over, some prisoners, asked by the writer whether they had consulted the Kaiaimunu, answered that they had, but that the canoe did not rock, and that they were at fault in making the attack.

Papua before the arrival of Europeans.

The normal state of the Papuan (and in this term are included all the natives of the territory) may with little exaggeration be described as having been, before the arrival of the white man, one of perpetual warfare. Every village was not always fighting every other village, for tribal ties were recognized, but it would probably be true to say that such a thing as a lasting peace between tribes was unknown. This state of things logically followed from the native idea of social responsibility. Starting from the idea, plausible enough to a people without medical knowledge, that a young man or woman could not die from natural causes, they argued that the death of any young person, if not caused by external violence,

must be due to sorcery, and forthwith set to work to find the sorcerer. He was usually discovered in some hostile village, and then the relatives of the deceased proceeded to avenge the death by killing some one belonging to that village—it did not matter whom, for the responsibility, according to Papuan ideas, rests with the community, not with the individual. Then the sorcerer's villagers had to avenge their dead, and the feud was apparently endless, for as a rule each death had to be paid for individually—there was no such thing as striking a balance. Such a feud was a fertile source of bloodshed, but, in addition, the lust for killing, which seems to be innate in even the mildest of these people, the desire for certain tattoo marks and particular ornaments and feathers which were regarded as the insignia of the assassin, and could only be worn by those who had killed, the wish to attract the favourable notice of the women (who would not look at a man whose hands were free from bloodshed), and, lastly, the mania for the collection of human heads, supply a sufficiency of motives to provide *casus belli* for an indefinite period.

Cannibalism is not invariably associated with these murders, for there are many tribes in Papua who are as much shocked and disgusted at the idea as any European could be. An answer often given by cannibals to the question why they eat human flesh is the eminently practical one, 'Because we like it,' coupled sometimes with the question, 'Why should we not eat it?' Ritual is connected in some instances with cannibalism, and indeed in one form or another is rarely absent from any action of native life, but in the majority of cases the answer given by the practising cannibals themselves may be taken as the true explanation. Cannibalism.

One point which supports the ritual theory of cannibalism is the rule that the killer must not eat the man whom he has killed. This principle is not universal, but has been found in widely distant parts of the territory—for instance, in the Purari delta and in the foothills of the main range in the Kumusi division. The argument from

this may easily be overstrained, for the same rule applies to large animals and even to fish, and has therefore no special reference to human flesh. There is a strange exception in the Purari delta, where there is one way, but only one way, in which the killer may eat of the man whom he has killed. He must sit on two coco-nuts, and place one under each heel, so that no part of his body touches the ground, and in that position he may drink the soup made of the heart of his victim, and may even eat a little of the heart itself; but it must be brought to him by his daughter, and he must remain sitting on the coco-nuts all the time.

Native commerce.

In spite, however, of warfare, cannibalism, head-hunting, and other horrors, a brisk trade was carried on among the tribes, especially among the Melanesians of the islands and by the Motu in their annual voyages to the Gulf. In the islands commerce had reached considerable proportions, many of the islanders specializing in particular products or manufactures, and earning their living by bartering these against the products of other islands. For instance, canoes were built at Panaieti, at Murua, and in the Egum group; pots were made at the Amphletts, stone adzes on Murua, native money (a small shell with a red tint, which is cut into disks pierced in the centre and worn on a string) at Vakuta and in the Louisiades, and these were traded for food or other necessaries, credit being even allowed in the case of expensive articles like canoes. The group of islands known as Nada, or the Lachlans, which is situated at the east of Murua, grows practically nothing but poor coco-nuts, but the inhabitants make mats and native dresses, and in the season of the north-west monsoon practically the whole population takes to the sea and cruises round the islands from Murua to the Louisiades, exchanging their mats and dresses for sweet potatoes, sago, and other food, which they bring back to eke out the coco-nuts and fish of their home. For navigation such as this good canoes are necessary, for they must cross the open sea, and many of the island canoes are fine, strong vessels, often forty feet long or

more, and thoroughly seaworthy. They are not hollowed out of a log like the dug-outs of the coast, but are built up with lines of planking from a hardwood keel.

The Hiri trading expedition.

The best known and most extensive of all the trading expeditions is the Hiri—the annual expedition of the Motu to the Gulf of Papua. The Motu live in the dry belt on or near Port Moresby, and their gardens are, consequently, not very productive; but they have good clay, and are skilled in making pots. The people of the Gulf, on the other hand, have plenty of sago but no pots. Consequently the Motu sail to the Gulf in large canoes called *lakatoi* about the end of the south-east season, carrying with them thousands of pots, and these they exchange for sago, returning home with the north-west monsoon. A detailed description of the Hiri is given by the Rev. James Chalmers (who sailed in one of the *lakatoi*) in his *Pioneering in New Guinea*, and by Dr. Seligmann in his *Melanesians of New Guinea*.

Native relations with Europeans.

Dangerous as it is to generalize about Papuans, it may be said that they are, on the whole, easy to deal with; they appear to have a keen appreciation of justice, and are quick to adapt themselves even to such novel ideas as that of individual responsibility for crime. By the exercise of tact and patience it has generally been possible for Government parties to avoid the necessity of resorting to violent measures, and the general experience is that native communities show far more readiness than could have been reasonably expected in abandoning the practice of such customs as cannibalism and head-hunting, so soon as they realize that the Government is determined to put them down.

Like other primitive races the Papuans are bound at first to suffer from the contact with a higher civilization, for the gulf is not easily crossed; strange diseases attack them, new habits of thought make their old tribal customs look trivial and foolish, their old ambitions are forbidden and even punished as crimes—life must seem strange and aimless to the Papuan native who is suddenly brought into touch with civilization. To take this aimless-

ness and this confusion out of his life should be the object of those who wish the Papuan well ; epidemics of disease are dangerous enough, but more dangerous than all is the despair which seizes on these inferior races when they see that their old world is gone and that there is apparently nothing in its place.

It is here that the services of missionaries are so useful; the native's old beliefs are gone or going, for they cannot survive indefinitely in the presence of the white man, and he is left without guidance, unless the missionary is there to substitute new ideas for those which have been lost. In the same way a new aim in life must be found for him by substituting an industrial ideal for the old ideals of bloodshed and murder. If this is done, if the Papuan takes to work and finds therein an object of existence, he will survive in spite of epidemics.

Government: the Papua Act.

In 1900, when the Commonwealth of Australia came into existence, what is now Papua had been a British possession (British New Guinea) for nearly twelve years. It was administered by a lieutenant-governor under a sort of general superintendence from the governor of Queensland, and the cost of administration (up to a total of £15,000) had been guaranteed by the colonies of New South Wales, Queensland, and Victoria. In 1902 letters patent were issued which placed British New Guinea under the authority of the Commonwealth, and conferred upon the governor-general the powers hitherto exercised by the governor of Queensland. In 1905 the Australian parliament passed the Papua Act, by which British New Guinea was accepted by the Commonwealth as a territory (the territory of Papua). Under the Papua Act, which came into force on September 1, 1906, the administration is entrusted to a lieutenant-governor, who holds office during the pleasure of the governor-general, and performs his duties ' according to the tenor of his commission and according to such instructions as are given to him by the governor-general '. There is also provision for the issue of a dormant commission to an officer who is to act as administrator during the illness of the lieutenant-governor,

or his absence from the territory, and there is power to appoint 'any person or any persons . . . to be the deputy or deputies of the lieutenant-governor within any part of the territory'.

Executive and legislative councils, &c.

The lieutenant-governor is assisted by an Executive and also by a Legislative Council. The members of the executive are not to exceed six in number, and must be officers of the territory. They are all members of the legislative council, which has also non-official members appointed by the governor-general. The number of non-official members at present is three, but will increase with the European population until it is twelve. When the population is 2,000 there will be four, and thereafter one per thousand. Non-official members vacate their seats after six years, but may be reappointed. Certain ordinances—for instance, those relating to Crown or native lands, to native labour, and to the supply of arms or liquor to natives—are reserved for the governor-general's pleasure, but otherwise the legislative council has full power of legislation 'for the peace, order, and good government of the Territory of Papua', except that any ordinance may within six months be disallowed by the governor-general.

There is also a Central Court, of unlimited jurisdiction, presided over by a Chief Judicial Officer. An appeal lies from the Central Court to the High Court of Australia.

Progress of Papua.

Thus Papua is in the almost unique position of being a colony of a colony—the daughter of Australia and the granddaughter therefore of Great Britain. It will be interesting to see how the experiment succeeds. That it has hitherto succeeded very well must be admitted. The Papuan statistics are a sufficient proof of this, and especially a comparison of the figures relating to the years before the Papua Act came into force with those of the succeeding years. Thus in the four years 1901–2 to 1905–6 the territorial revenue (that is, the revenue apart from grants and subsidies) increased by less than £4,000, or at the rate of not quite £1,000 a year, and the total volume of trade (exports and imports) by a little over £20,000, or about £5,000 a

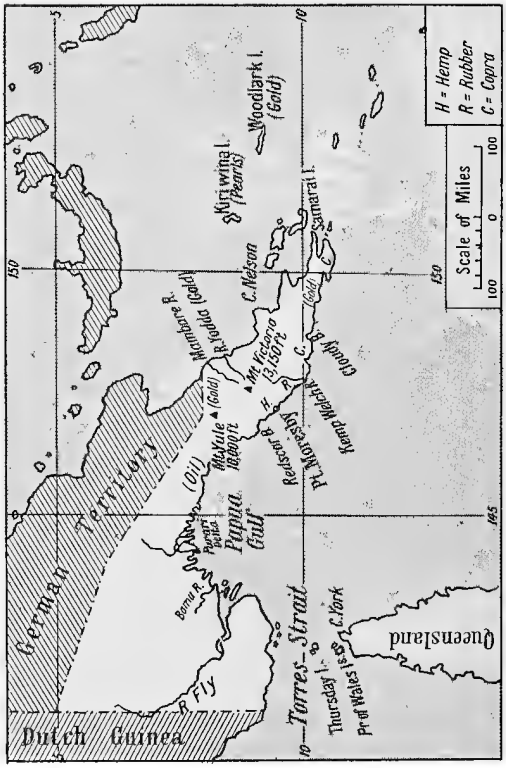


FIG. 62. The Territory of Papua.

PLATE XV (*a*). INNER HARBOUR, PORT MORESBY, PAPUA

PLATE XV (*b*). AIRD RIVER FROM AIRD HILL, GULF OF PAPUA
(High Commissioner for Australia)

PLATE XVI. MOUNT COOK, SOUTH ISLAND, NEW ZEALAND: ST. DAVID'S DOME FROM COPLAND PASS

(High Commissioner for New Zealand)

year. In six subsequent years, under Australian control, that is from 1905–6 to 1911–12, the territorial revenue increased by more than £30,000 (of which part, but only a small part, is the result of increased taxation) or at the rate of over £5,000 a year, and the volume of trade by £175,000, or nearly £30,000 a year. Shipping, which had hardly increased at all during the years 1903–6, advanced during the next six years in the number of ships from 223 to 355, and in tonnage from 104,983 to 275,803. The European population, though still small, increased 50 per cent. in 1909–12. It cannot be expected that this increase of prosperity will be unbroken, but the Australian régime has certainly opened auspiciously. The general improvement of conditions has been caused partly by more liberal land legislation, and also by the greater interest that has been taken in Papua and its possibilities from the fact that the Commonwealth had become responsible for the territory, and also by the publication early in 1907 of the report of the Royal Commission to which reference has been made. Again, the Commonwealth has been more liberal to Papua than the three colonial governments had been to British New Guinea. In 1911–12, for example, the Commonwealth grant amounted to £25,000, in addition to a yearly advance of £5,000 towards the upkeep of Government plantations, and further grants and loans for specific purposes were under consideration. Assistance and encouragement of this kind could hardly have been expected from the governments of New South Wales, Queensland, and Victoria under the old arrangement; the interest and sense of responsibility were less, divided as they were among three, and the means of granting assistance were more restricted.

Native policy.

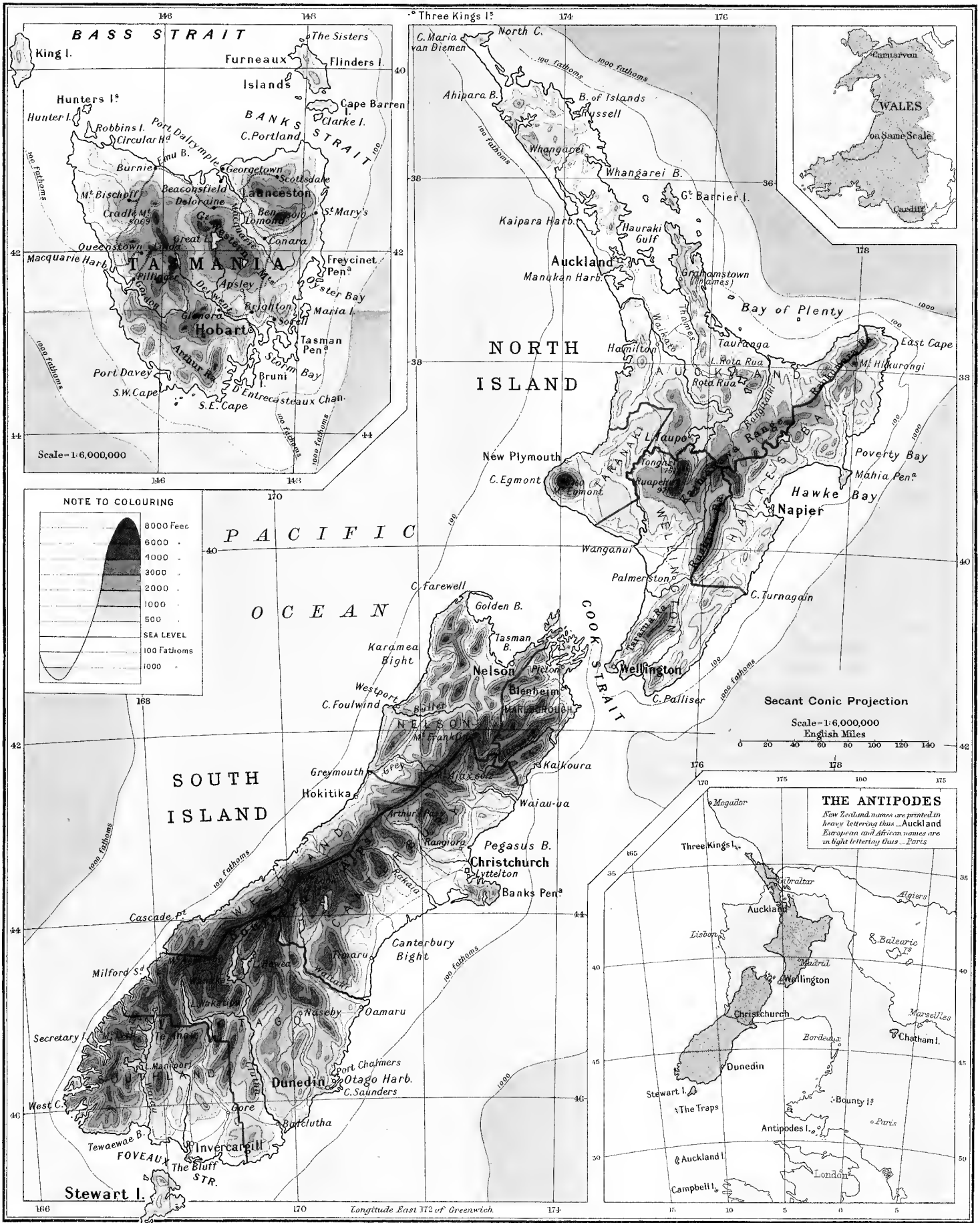
As regards the native population the Commonwealth has adopted the policy which it found already in force when it took over the territory, and, while encouraging the development of Papua, has been careful not to lose sight of the interests of the Papuan himself. This policy dates back to the time of Sir Peter Scratchley, the first Special Commissioner under the Protectorate, who

unfortunately died before he had the opportunity of putting it into effect. It was consistently acted upon by Sir William MacGregor, the keynote of whose administration, as stated by him in a dispatch to the government of Queensland, was to ' deal justly and righteously with the natives, to pacify the country and to develop it into a British colony '—a task which is indeed difficult but by no means impossible. It is, however, a thankless task, for if an administrator succeeds in holding the balance even between the white settler and the native, he is open to attack from the partisans of both, and the applause of either will often be a sign that he is acting a little unfairly to the other. The details of such a policy will rarely commend themselves to the white men who are seeking their fortunes in Papua, or to shareholders in Australia or elsewhere, most of whom, if they were asked, would probably say that the Government was favouring the native unduly ; but there are others whose interests are enlisted rather on the side of the native, and who would be inclined to argue that the Government neglects the native, and attaches too little importance to his standpoint. Probably, therefore, the impartial observer will give the Government the credit of having hit upon the proper mean, and of doing justice to both parties and favouring neither.

Literature.

[See F. Burnett, *Through Polynesia and Papua*, London, 1911 ; A. K. Chignell, *An Outpost in Papua*, London, 1911 ; M. Krieger, *New Guinea*, Berlin, 1899 ; Sir W. MacGregor, *Report of Journey across New Guinea*, London, 1896, and *British New Guinea*, London, 1897 ; K. Mackay, *Across Papua*, London, 1909 ; A. Gibb Maitland, *British New Guinea*, Brisbane, 1893 ; J. H. P. Murray, *Papua, or British New Guinea*, London, 1912 ; W. C. Pritchard, *Papua*, London, 1911 ; C. G. Rawling, *The Land of the New Guinea Pygmies*, London, 1913 ; C. G. Seligmann, *The Melanesians of British New Guinea*, Cambridge, 1910 ; R. W. Williamson, *The Mapulu Mountain People of British New Guinea*, London, 1912.]

NEW ZEALAND & TASMANIA — BATHY-OROGRAPHICAL AND POLITICAL.



The Edinburgh Geographical Institute

John Bartholomew & Co

NEW ZEALAND

CHAPTER XI

PHYSICAL GEOGRAPHY—GEOLOGY—CLIMATE—VEGETATION—FAUNA

By Professor P. Marshall

Position and extent.

The parallels of 34° and 48° S. enclose the main islands of New Zealand, but the extent of the land east and west is relatively small, for the islands lie between the meridians of 166° and 179° E. Within this area the trend of the land is mainly north-east to south-west, though the north-westerly bend in the extreme north brings that part of the land to a longitude that is only eight degrees further east than the extreme south. The main islands are three—North Island (44,468 square miles), South Island (58,525 square miles), and Stewart Island (665 square miles). Thus though the land extends over fourteen degrees of latitude the area is only 147,000 square miles, for everywhere it is narrow. One hundred and eighty miles is the extreme breadth of the South Island, and 280 that of the North Island, which widens considerably in its middle portion. Originally the area of New Zealand, which was proclaimed in 1840, included these main islands only. In 1863 the boundaries were extended to include the Chatham, Bounty, Antipodes, Campbell, and Auckland[1] groups of outlying islands, south and east of the main islands. In 1887 the Kermadec Islands lying to the north-east were added, and in 1901 the Cook and other islands extending as far north as 8° S. were proclaimed as part of the colony of New Zealand.

The islands are the emergent part of a large submarine plateau, which, lying less than 500 fathoms beneath the

[1] On these two last groups, see C. Chilton, *The Sub-Antarctic Islands of New Zealand: Reports of the Geo-physics, Geology, Zoology, and Botany*, Canterbury, 1909.

ocean surface, extends beyond the Chatham, Campbell, and Macquarie Islands in the south and east, and also somewhat to the west in the latitude of Cook Strait. This plateau is further extended at a depth of less than 1,000 fathoms in a long north-westerly submarine ridge to New Caledonia. Another long submarine ridge extends to the north-east, through the Kermadec Islands to the north of the Tonga Islands, though somewhat deeper water (1,400 fathoms) separates this submerged ridge from Cape Runaway towards which it is directed.

General description.

In general the surface of New Zealand is highly diversified. Its lofty mountains of Mesozoic sediments bear the marks of long-continued erosion of streams and glaciers. Over a large portion of the country rocks of Tertiary age form areas of downs which, more youthful and less elevated, have suffered to a less extent from the agents of destruction. Wide-flung gravel plains usually border the high country and their presence attests the power and activity of the streams which are fed by the abundant rainfall. Here and there in the North Island lofty volcanoes dot the surface, while in both islands there are deep and spacious lakes. The coast-line affords some large areas of deep and sheltered water secure from winds from all quarters, although there are also long stretches of beach exposed to the swell of the wide Pacific.

Mountains.

Mountain ranges are most conspicuous in the South Island, and indeed constitute the greater part of its area and form a serrated chain of many parallel ranges directed generally to the north-east. Rising suddenly from the west, but less abruptly from the east side, the ranges throughout the South Island frequently rise above the snow level and in their central portion attain a culminating elevation of 12,500 feet. This elevation is high enough to enable them to accumulate sufficient snow to form the feeding ground of glaciers, one of which is eighteen miles in length. In the North Island the mountain chain is less elevated, and, seldom rising above 6,000 feet, is bare of snow in summer. Here, however, volcanic peaks situated outside the mountain chains have their upper slopes covered with

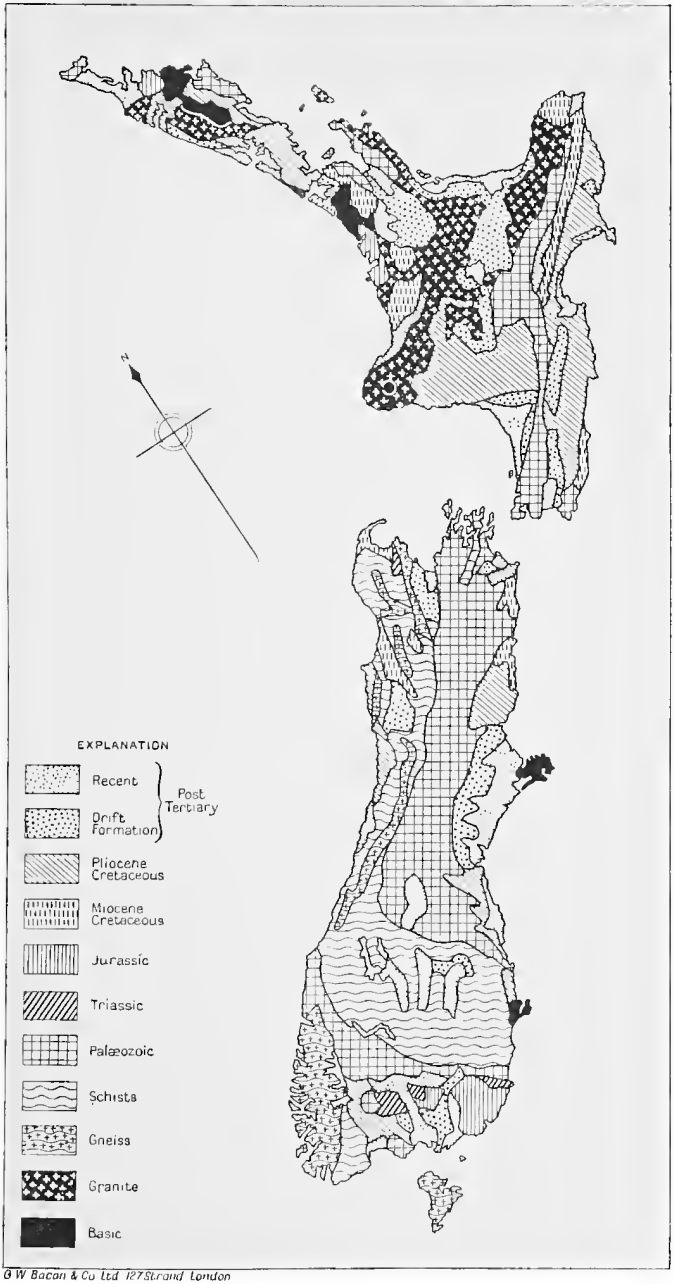


FIG. 63. Geology of New Zealand.

perpetual snow. Throughout the northern part of this island the country is hilly rather than mountainous.

The Southern Alps.

The mountains of the South Island between Lake Wanaka and Cook Strait are generally known as the Southern Alps, with the exception of the Kaikoura Mountains lying to the east, and of the Tasman Mountains which are situated in the north-west, as both of these ranges have an independent character. The general trend of the Southern Alps is that of the South Island itself. There are several parallel ranges, especially on the eastern side of the crest, which lies quite near the western coast, and in places the mountain chain is eighty miles wide. The eastern ranges seldom rise higher than the 7,000 feet of Mount Hutt. Their slopes and even their summits are often formed of scree material consisting of angular fragments of the rocks that have been broken down by the action of frost. The climate of the eastern ranges is often so dry that little vegetation grows on the steeper slopes of the mountains.

Further west the higher rainfall supports a luxuriant plant growth. Forest, shrubs, and grasses clothe the mountain sides up to the snow line, which is 7,000 feet above sea-level. The higher peaks are snow-clad, and in the uncertain climatic conditions their steep acclivities call for much skill and determination on the part of those who wish to ascend them. The 'aiguilles', however, which form such a conspicuous feature of portions of the European Alps, do not occur in those of New Zealand. Accessible passes through the ranges are relatively few, and with the exception of Arthur's Pass have not yet been used as traffic routes.

Geological formation.

The Southern Alps are formed in all their eastern portions of shales and greywacke deposited in all probability during the early portion of the Mesozoic era. The deposition of this material has frequently been supposed to have taken place in the Carboniferous period, but no satisfactory evidence of this suggestion has yet been given. In the few places where the rocks contain fossils they are of early Mesozoic age. On the western slopes of the Southern

Alps the rocks gradually become metamorphic, and by the time the western foot has been reached a complete gneissic structure has generally been developed. In many places on the western border of the range there are large granitic intrusions, but these never rise far up the western slopes, and in no place form an important portion of the mountain chain. In Otago the schistose area of the western slopes expands widely, and in Marlborough similar rocks occur over a small area in Queen Charlotte Sound.

The rocks of the Southern Alps are sharply folded in a direction parallel to the length of the range, and in general the dip of the strata is at a high angle—seldom less than sixty degrees. The nature of the folds has not yet been worked out, but it is certain that there is no special relation between the folds and the mountain crests or the valleys between adjacent ranges. It is probable that the folding causes the strata to be repeated frequently, but the absence of well-marked rock types and of fossiliferous strata makes it extremely difficult to recognize the repetition of any stratum, and we are consequently unable to make even an approximate estimate of the thickness of these mountain-building strata of Mesozoic age. As at present known the structure is probably most accurately represented as a series of steep isoclinal folds. No unconformity has yet been discovered between the greywackes and the schists of the western slopes and it is therefore reasonable to class these schists as Mesozoic also.

The Kaikoura Mountains.

The Kaikoura range is situated in the north-east of the South Island. It has the same physical features as the eastern ranges of the Southern Alps, and indeed is separated from them merely by a relatively low-lying area of country. In composition too the Kaikoura Mountains are similar to the eastern ranges, but in structure they appear to be different. The only information at present available shows that they probably owe their elevation to bodily movement of rock masses from the west along highly inclined thrust-planes.

The Tasman Mountains.

The country lying in the extreme north-west of the South Island where the Tasman Mountains are situated is still most imperfectly known. The mountain range is directed nearly due north and south, and seldom rises to more than 6,000 feet. Though its continuity is considerably interrupted, this range appears to join the main chain near Reefton. The flanks of the mountains are not cumbered with scree slopes to any extent, and are densely covered with vegetation. The Tasman Mountains are formed of a greater variety of rocks than any other mountain range in New Zealand. They are mainly composed of strata of Ordovician age. One of the lowest strata is a limestone which has been completely recrystallized into a marble. Generally the strata have become metamorphic and are schistose. On the west side of the range there is a large granitic intrusion which constitutes some of the highest mountains. Much of this range has not yet been even explored.

The mountains of Otago.

The mountains of Otago are really a portion of the complex earth folds of which the Southern Alps are constructed. In this province the axis of folding turns sharply round to the south-east. The different mountain ranges which it forms have not here the same direction as the folds of which they are constructed, but are in general directed nearly north and south. They are seldom more than 6,000 feet high, and are formed throughout of mica schist, but have some economic importance owing to the gold and scheelite that are found in quartz veins. The ranges have been said to owe their elevation in each case to local upthrust. Until some proof of this theory is advanced, it is more reasonable to regard them as residual mountains carved out of a pre-existing peneplain by the agency of running water. As previously stated the schists are possibly of Mesozoic age.

The south-west and Stewart Island.

In the extreme south-west of the South Island there is a complex of mountain ranges between the fiords and the lakes. Their culminating point is Mount Tutoko, 9,000 feet high, though generally they rise to no more than 5,000 feet. Sublime in their stark and stalwart forms,

sombre in their vesture of forest, the standing rampart of the land to the wet winds of the west, these forbidding ranges are yet untouched save by the foot of the hardiest explorers. The mighty precipices of these mountains, their leaping waterfalls and embosomed lakes are doubtless due to the profound glacial erosion of the Pleistocene period. Throughout its extent as far as known this fiord country consists of Plutonic rocks, usually diorite with a gneissic structure. The foliation planes strike to the north-west, but no details of the folding are yet known. Stewart Island is no more than a partly drowned southern extension of this mountain mass.

Mountains of the North Island.

In the North Island the mountain chain extends almost without an interruption from Cape Terawhiti to Cape Runaway. Intersected by the gorge of the Manawatu River and in other places by relatively low-lying areas, it has become divided into mountain blocks which are somewhat distinct and have been dignified by separate names. This mountain chain has steep slopes and ridges, but is covered with dense forest except on the very tops, where there are grassy uplands. The rocks of which it is formed are greywackes and shales probably of Mesozoic age, though up to the present no fossils have been discovered in them. The strata are intensely folded and almost vertical. Locally the folds are contorted, but in all cases they strike in the direction of the mountain range, that is, almost directly north-east and south-west. Continued to the South Island this line leads almost directly to the Kaikoura Mountains, and authorities are not wanting who regard the mountain system of the North Island as a mere continuation of the Kaikoura Range.

Volcanoes.

The volcanoes of the North Island are isolated mountains which in their highest peak, Mount Ruapehu, reach an altitude of 9,000 feet. Most of them are quite extinct, though Ruapehu, in the centre of the island, still behaves like an immense fumarole, while its neighbour Ngauruhoe is more active and frequently ejects dust and scoria to great heights, and in 1911 molten lava was seen in its crater. Tongariro (6,500 feet) is less active, though its

relatively flat crest is pitted with craters. Mount Tarawera, the scene of a violent explosive eruption in 1886, which destroyed more than one hundred lives, is now quite devoid of apparent activity. The only other active centre, White Island in the Bay of Plenty, is a solfatara. The most impressive of all, Mount Egmont, the lonely sentinel of the west, whose symmetrical tapering cone rises to 8,000 feet, is quite extinct so far as history goes. All of these volcanoes are formed of andesitic rock which is slightly different in the various cones. Those of the centre of the island are of hypersthene andesite, the product of the latest period of activity. North and eastward from these great volcanoes are hot spring areas, geysers, and fumaroles, while everywhere the surface of the country is dotted with lakes.

Though there is at present no volcanic activity in the South Island there are several old volcanic centres that form prominent elevations, especially on the eastern side.

Nowhere in the mountainous areas of New Zealand is found that cultivation of the glades and valleys that is such an attractive feature of mountain regions in other countries. For the greater part they are still as nature made them, untilled, unkempt, and rude. The mountain slopes and summits where covered with grass are used as pasture and support large flocks of sheep. In more remote parts of the country herds of deer lately introduced are the only tenants of the mountains. Of late years, especially in the North Island, the margin of forest has been gradually retreating up the mountain sides as the pioneering settler converts the land piece by piece into upland pasture.

The Downs:

In many parts of the country there is an irregular strip of variable breadth between the mountains and the sea-coast. This strip has generally a hilly surface and can be appropriately referred to as the Downs. It is not infrequently the case that the hills have steep sides and narrow crests, and in these respects they depart somewhat from the usual nature of downs; on the other hand, the hills are low and the country often of an undulating nature, so the use of the term is justifiable. In places

the rocks are locally folded, but this structure does not in many cases account for the elevation of the hills, which are for the most part of a residual nature, and owe their relative height to the action of running water which has removed surrounding material.

(*a*) in North Island;

The downs are nothing more than an elevated sea floor which in consequence of submission to the erosion of running water has acquired a hilly surface. The largest area of this nature extends from the mountain range of the North Island and from the central volcanoes to the west coast, and reaches as far north as Kawhia. Throughout the greater part of this area the land is hilly and steep, but seldom rises to more than 2,000 feet. Clothed originally with dense forest, the land is now gradually becoming grassed, for except along a narrow coastal fringe it is generally too steep and broken for agriculture: though it is eminently suited for pastoral occupation. A similar but narrower downs country extends from the same mountain range to the east coast of the North Island. Here, however, the climate is drier, and the land was originally covered with bracken fern and native grasses, though these are now very largely replaced by a good turf of introduced grasses. All the country lying to the north of the great volcanic plateau can similarly be classed as downs country, though it is in all this northern country rather varied by the peaks and ridges of Mesozoic sediments that here and there pierce through it, and also by the cones and lava flows of volcanic rock which, especially at Auckland and near the Bay of Islands, cover much of the surface.

(*b*) in South Island.

In the South Island the downs are less conspicuous, though they form much of the more fertile areas of North Canterbury, and further south most of the rich country extending along the coast from Timaru almost to Dunedin. In this part of the country the gently sloping hills and their broad crests with frequent escarpments of limestone more nearly correspond with the ordinary definition of downs. Elsewhere, though usually occurring as a narrow coastal fringe, and in some cases in intermontane basins,

the downs country is less important. Everywhere this type of country is composed of Cainozoic rocks. In the North Island a marly blue clay forms the greater part of the material, and because of the great difficulty of obtaining suitable 'metal' for roads, it offers considerable obstacle to the opening up of the country. Everywhere, however, beds of limestone occur, and from them lime is prepared for agricultural use. In many places coal is found in the lowest strata of this Tertiary sequence, and as it is often of good quality, it adds much to the importance of this series of rocks.

General characteristics.

In general the downs country forms good fertile soils, and where level enough it is admirably fitted for agriculture. When more hilly it forms the best of the pastoral country. Exception has to be made of the lower beds associated with the coal. These beds are always sandy or are formed of gravels, and from them arises a very poor soil on which little vegetation will grow. The actual outcrop of these beds, however, is extremely limited. The clay lands of the north—the so-called gum lands—are also extremely poor: their poverty, however, is mainly due to the particularly heavy and tenacious nature of the clay soil that is there formed from the Cainozoic rocks. It is now recognized that these soils are in reality well adapted for fruit-growing. They have acquired the name of gum lands because large quantities of kauri gum have been dug up from the soil. Evidently in earlier times there were extensive forests of the kauri pine growing on what are now barren wastes, and the growth of these trees in the past is often regarded as a contributing cause of the forbidding appearance and sterility of the gum lands.

Plains.

The area of plain surface in New Zealand is not large, but though relatively small the plains are agriculturally the most important districts in the country. The largest area is that of the Canterbury Plains on the eastern side of the South Island. They are more than a hundred miles long with an average breadth of twenty miles. These plains are of recent age and consist entirely of material

that has been brought by the rivers from the mountain ranges. Having been formed in this way they have naturally a considerable seaward slope, and actually rise to a height of 1,500 feet where they border the mountain ranges. In places they are stony and covered with a light soil, but over the greater part of their extent they have a thick covering of loess and are extremely fertile.

Southland Plains.

The Southland Plains in the extreme south of the South Island have a somewhat similar origin, though they are here to some extent due to marine deposition. Again there are patches of lean soil in the prevailing rich ground that forms the surface. Another plain of considerable size is in the North Island in the middle Waikato basin extending from the head of the Hauraki Gulf to the Waipa River. Much of this is still in the condition of swamp, for there is little fall for drainage. A good deal of the drier portion is covered with a coating of pumice, a product of the volcanic activity in the centre of the island. Though light, the soil that is formed from it is suitable for the growth of oats as well as root crops.

There are many other plains of more limited extent situated in the lower portions of river valleys or where they enter the sea. In Nelson the Waimea and Motueka Plains, the Wairarapa Plains near Wellington, the Heretaunga Plains near Napier, and others on the shore of the Bay of Plenty are all of considerable local importance though of limited area. Those that border the Bay of Plenty, like those of part of the Hauraki, are still in need of that drainage which will ultimately convert them into districts of great fertility.

North Island volcanic plateau.

One of the largest areas that is relatively flat is the volcanic plateau which extends from Lake Taupo in the south almost to the shores of the Bay of Plenty and is about fifty miles wide. Though not absolutely flat there is a large expanse of even land from which mainly flat-topped hills arise. Everywhere the surface is covered with pumice lying loosely and almost barren. When rocks are exposed they are for the most part rhyolite. It is thought that if some suitable means could be found for

consolidating the pumice it would provide a soil suitable for the growth of all ordinary crops and garden plants, and at Rotorua there is considerable evidence in favour of this belief, but at the present time the volcanic plateau is almost destitute of population.

Coast-line.

The general direction of the New Zealand coasts is from south-west to north-east. These coast-lines are usually straight and exposed to the roll of the Pacific on the one side and to that of the Tasman Sea on the other, and for the greater part provide few harbours and little shelter for shipping. Even where rivers enter the sea their mouths are obstructed by bars of sand and gravel that obstruct navigation. In general the coast is not steep but is fringed throughout great distances by sand or gravel beaches. Where it fronts the downs country there are vertical cliffs of moderate height with beaches exposed at low tide. Where masses of hard rock of volcanic or other origin occur large projecting promontories are formed, such as Banks Peninsula and Otago Peninsula, and on these coastal projections towering cliffs and precipices face the ocean without the intervention of beach. The dominant fashioning influence on this south-west and north-east stretch of coast-line is the ocean current, which in both islands flows constantly from the south-west. The heavy swell of the ocean acts from the same direction, and these two influences in combination cause an immense drift of sand and gravel to travel along it. Wherever an opposing buttress exists a gravel flat is built up along its weather or southerly side, while on its leeward or northerly side sand slowly accumulates in the sheltered water. Nowhere is this seen better than on the south side of the bold projecting mass of Banks Peninsula, where the gravel flats now extend ten miles outward from rocks against which it might be imagined from their appearance that the waves beat almost yesterday. At Timaru a breakwater was constructed at right angles to the coast some thirty years ago. On its windward side thirty acres of gravel flat have been formed, the material of which must weigh at least 1,500,000 tons. All inlets and

PLATE XVII (*a*). WHANGAROA HEADS, NORTH ISLAND

PLATE XVII (*b*). THE ISLAND, WAIAU RIVER, SOUTH ISLAND
(High Commissioner for New Zealand)

PLATE XVIII (*a*). MANAWATU GORGE, NORTH ISLAND

PLATE XVIII (*b*). LAKE MANAPOURI, SOUTH ISLAND
(High Commissioner for New Zealand)

river entrances are blocked by the formidable bars deposited by these drifts, and it is only on the most projecting promontories of Banks Peninsula, to the end of which the coast-line has not yet been built up, that obstructing bars are absent, and the entrances remain free for navigation all the year. At Manukau and Kaipara, where the coast-line gradually bends to the north-west, the drift is still maintained, and here bars of distressing magnitude stretch out five miles seaward and extend across the entrances of deep and far-reaching harbours. In those places where there are no river entrances to windward and no stretch of coast-line to provide the waste material for drift, inlets and secure harbours are to be found. It is only in the south-western fiords, at Cook Strait, and at Stewart Island that such conditions obtain.

In contrast with these south-west and north-east lines of coast are those that extend from north-west to south-east—that is, the shores of Cook Strait and of the northern side of the North Island from North Cape to Cape Runaway. Here the coast-line crosses the folds of the Mesozoic rocks at right angles. During a late geological period of great elevation these rocks were seamed by rivers with longitudinal valleys, and the depression that has taken place since then has converted these valleys into arms of the sea. The small extent of coast-line here exposed to the action of the sea, the absence of the ocean roll, and the inconstancy of the currents and presence of far projecting points prevent on these coasts the formation of drift material, and in consequence the inlets remain open and form deep and secure harbours accessible to shipping at all states of tide and in all weathers. The coastal population is not large and is almost solely confined to those parts that are frequented by shipping. Though fish of many kinds are abundant the number of fishing hamlets is extremely small.

Tides.

Tides in New Zealand do not rise anywhere to a great height. The rise and fall of thirteen feet in Tasman Bay is the largest. In general the amount is not more than eight feet. The coast is fairly well lighted and outlying

rocks and islands are not generally numerous. Fogs are not frequent; consequently navigation is not attended with unusual difficulties beyond those associated with entering or leaving the bar harbours.

Rivers. The small size of the islands and still more their linear forms naturally do not favour the presence of large rivers. It would be anticipated, however, that some at least of them would provide facilities for navigation. While this, as mentioned above, is largely prevented by the presence of bars formed by the drift along the coast, it is also opposed by the nature of the rivers themselves. Flowing as they do from mountainous country with a steep grade they are in many cases no more than mountain torrents. In the South Island the watershed follows the axis of greatest elevation almost throughout the length of the land. As this is much nearer the west than the east coast, it follows that the rivers that flow eastward have longer courses and are larger streams than those that flow westward. In their upper portions most of these rivers, such as the Rangitata, flow in deep valleys with flat floors sometimes three or four miles wide formed entirely of shingle. Their exit from these mountain valleys is through a narrow gorge whence they flow in steep, ever-changing courses over the plains to the sea. This peculiar nature of the valley must be due either to glaciation or to some other agent that has over-deepened the upper portion, or to the effect of crustal movements which may have raised the land near the eastern margin of the mountain chain or lowered it at the central portion. Of these two suggestions the former is more likely to explain the narrow gorge forming the exit from the mountain range. Other rivers of the South Island, such as the Clutha and the Waiau, flow through lakes in the upper part of their valleys. These regulate the flow of the rivers, and in part replace the wide gravel floors that elsewhere occur so frequently where the rivers course through the mountain valleys. On the eastern side of the island none of the rivers can be used for shipping, though some carry large quantities of water. On the western side the rivers are still shorter

and throughout their courses are mountain torrents, yet in a few cases vessels of little draught can obtain entrance in all ordinary weather, mainly owing to the harbour improvements that have been made.

From the point of view of the agricultural and pastoral industries, the rivers supply all the water that is required, and in many places, as at Waipori near Dunedin, the Rakaia at Lake Coleridge, and the Waikato at Horohoro, supply energy for the generation of electric power. In periods of heavy rainfall many of the rivers flood rather seriously, though little loss of life and property has resulted.

In the North Island the lesser height of the mountains and their less extensive area allow the rivers in general to have more gentle grades and to depart in some measure from the character of mountain torrents. The Manawatu River crosses the mountain range in a profound gorge, and takes the drainage of much of the eastern downs country to the western coast. The watershed therefore does not correspond to the axis of greatest elevation, but for a considerable distance departs far from it and lies within twenty miles of the eastern coast. The rivers of the eastern side are generally of no importance. They are of small size, and have steep courses, and their mouths are obstructed by formidable bars. One only, the Waimata at Gisborne, is used for shallow draught steamers and lighters. In the north of Auckland Peninsula the Wairoa River, which flows into Kaipara Harbour, provides the best facilities for navigation of all New Zealand rivers. It rises within six miles of the east coast and has a gently sloping basin. Its utility, however, is largely discounted by the treacherous bar that extends across the entrance of the harbour.

Lakes:

There is a large number of lakes in both islands of New Zealand. They can be conveniently classed under three heads—(1) those of the glaciated districts; (2) those of the volcanic country; (3) lagoons near the sea-coast.

(1) of glacial origin;

(1) The lakes of the glacial districts are well known because of their impressive scenic surroundings. Lakes Wakatipu, Te Anau, and Manapouri are the most

accessible. Te Anau, the largest, has an area of 130 square miles. These lakes are of great depth : the two that have been adequately sounded, Manapouri and Wakatipu, are 1,465 and 1,266 feet deep, with floors as much as 890 and 176 feet below sea-level respectively. There is little doubt that the floors of Te Anau and Monowai are also well below sea-level, but it is stated that Pukaki and Tekapo, the lakes of Canterbury, are relatively shallow. On all hands it is admitted that the regions in which these lakes occur were heavily glaciated in Pleistocene times, and it is generally thought that the formation of the basins is a result of this glaciation, partly due to the glacial erosion itself, partly to the deposition of heavy masses of moraine which act as a dam in the lower part of the valley where the terminal face of the prehistoric glacier was situated. All these lakes are long in proportion to their breadth ; they penetrate to the heart of the mountain ranges, and their sides are precipitous mountain walls that in many places rise sheer from the waterside. The mountains are used to some extent as grazing ground for the sheep of the settlers, but in most instances the slopes and even the precipices are covered with primaeval forest. The small quantity of flat land in the valleys, the heavy rainfall, and the large area of forest country have so far prevented the vicinity of these lakes from attracting a large population, and they remain almost wholly untenanted except by the inhabitants of a few hamlets where the terminal points of tourist traffic are situated, and of the homesteads belonging to a few estates, which are necessarily of large area as the pasture is so poor and the country so steep that it has to be worked in blocks of many square miles. On some of the most accessible lakes a regular service of steamers is maintained.

(2) of volcanic origin ;

(2) The lakes of the volcanic country are less elongated, and in fact generally tend towards a circular form. Their shores are not generally precipitous, but rise gradually to the level of the surface of the volcanic plateau. In many cases there are volcanic cones in their vicinity. These lakes are not very deep ; Lake Taupo, the deepest,

has been well sounded and in no place does the bottom lie more than 480 feet beneath the surface. In most cases the great basins appear to be explosion cavities. Taupo, also, the largest, is 230 square miles in area, and it is hardly likely that such an immense depression should have been formed in its entirety by an explosion; it is probable that the large amount of fragmentary matter that would be cast into the air by a great explosion would when it fell to the ground block up the outlet to some extent, and thus cause an overflow of the water on the neighbouring low-lying country. An explosion of this nature actually occurred in June 1886, in the basin of the small Lake Rotomahana, which was then only one mile in diameter. A large crateral depression was formed by the explosion, and after the volcanic activity had gradually subsided, the depression became filled with water, and a lake of considerable dimensions was formed, for the explosion formed a basin seven miles long, four miles wide, and 600 feet deep. Thus a lake several miles in length has been formed by a volcanic explosion within recent years. The depth of the adjoining Lake Tarawera was increased by forty feet at the same time, for the large amount of scoria, pumice, and other material that was cast into the lake partially blocked its outlet. Although Lake Taupo is ten times as large as Rotomahana, it is possible that even this great basin, as well as the smaller ones of Rotorua and Tarawera, may have been formed by a similar volcanic effort. It is at any rate certain that immense volcanic explosions have taken place within the volcanic district, for the great masses of pumice rock cannot be explained in any other way. A few of the volcanic lakes owe their formation to the flow of lava across a drainage channel, damming up a stream which afterwards overflows all the low-lying land above the dam. Examples are found in Lake Rotoaira, which lies to the south of Lake Taupo, and in Lake Omapere in the extreme north. The barren nature of the pumice soil near the volcanic lakes has prevented the establishment of numerous settlements. Those that are there really owe their existence to the hot

springs that issue at many places from the rocks. The geysers, fumaroles, and porridge pots attract visitors, while the baths have well-known curative powers. For this reason flourishing townships have sprung up at Rotorua and Taupo, the number of visitors being increased by sportsmen who travel from all parts of the world for the excellent fishing for trout, which have been introduced and have flourished remarkably in these waters.

(3) lagoons.

(3) The lagoon lakes, which are common along many parts of the coast, owe their formation to the drift of gravel and sand. This has formed long spits of gravel extending from point to point. Behind the spit the water supplied by streams accumulates and in time of flood bursts through the spit, but as soon as the level of water within is lowered the gravel drift once more blocks the outlet. The largest of these lagoon lakes are Lake Ellesmere, close to the south of Banks Peninsula, and Lake Wairarapa at the head of Palliser Bay. Always shallow and with an inconstant level these lakes are of little value. Their tendency to flood owing to the blocking of the outlet much reduces the value of the surrounding land, which usually has a remarkably good soil.

Glaciers.

When the relatively low altitude of the mountains and the low latitude of the country are considered, the glaciers have somewhat surprising dimensions. The heavy precipitation and the prevalence of cold winds entirely account for this. The precipitation is certainly not less than 200 inches on the greater part of the elevated portion of the Southern Alps: and even in summer snowfalls are not uncommon above an elevation of 3,000 feet, though the snow-line is not less than 7,000 feet above sea-level. It is only near the culminating peaks of the Southern Alps that the glaciers have any great dimensions. Here are situated the Tasman, Murchison, Hooker, Mueller, Fox, and Franz Joseph glaciers, all more than 8 miles long, and the longest of them, the Tasman glacier, 18½ miles long and 1½ wide. All the glaciers on the eastern slope have their surface entirely covered with moraine for the last few miles of their length, and over this distance no

clear ice is to be seen. This feature is mainly due to the much-fissured and jointed nature of the sandstones and shales of the mountain range. These rocks break down readily under the influence of alternate frost and thaw, and dangerous avalanches are frequent. The incoherent and rotten nature of the rock, combined with the heavy precipitation and the uncertainty of the climate, render alpine work more than usually hazardous.

Geology.

Great differences of opinion have unfortunately arisen among those who have studied the stratigraphical geology of New Zealand. Discussions have mainly ranged around the age of the schists and of the sandstones and shales that are the principal mountain rocks of the country. Other discussions have also revealed the fact that a great variety of opinion exists as to the proper division of the large and widely distributed series of younger rocks that certainly range in age from upper Cretaceous to the upper Pliocene. It is not possible here to enter into the merits of the different views that have been expressed on this matter. A discussion of them will be found in the article on New Zealand in the *Handbook on Regional Geology*, vol. vii, part i (Heidelberg), and also in *The Younger Rock Series of New Zealand* (*Trans. New Zealand Institute*, vol. xl, p. 378).

The whole subject is of unusual difficulty because of the isolated position of the country, the very generally unfossiliferous character of the rocks except the younger series, the folded character of all the older strata, and the scattered and discontinuous occurrence of the younger strata. (See Fig. 63, p. 377.)

The oldest rocks are found in the south-west of the South Island and in Stewart Island. They are gneisses generally of dioritic nature, sometimes granitic, or on the other hand even gabbros and peridotites. The formation is certainly of great thickness ; but the remoteness from settlement, the precipitous nature of the mountainous country, and the extremely heavy rainfall and snowfall have hitherto prevented thorough investigation. These ancient rocks occupy all the area between the basins of

Lake Te Anau and the other lakes south of it and the fiords of the west coast. It is probable that these rocks belong to the Archaean era. Graptolite-bearing rocks are the oldest to which a definite age can be assigned. These are shales in the north-west of Nelson and in the extreme south-west at Preservation Inlet. They are certainly of Ordovician age. In Nelson they are conformably associated with a mass of quartzites, schists, and marbles, which are rightly regarded as of the same geological age. Only a small thickness of Ordovician sediments is known at Preservation Inlet, but at Nelson they form the greater part of the north-west of the South Island. In both localities they are penetrated by large masses of porphyritic granites that are, as far as known, of post-Jurassic age.

At two places—Reefton and the Baton River, a western tributary of the Motueka which flows into Tasman Bay—there are shales and limestones with Silurian fossils. As at present known the outcrops of these rocks are quite small, but further research may much increase the areas over which Silurian rocks are known to occur.

Though Hector, Hutton, and Park have described large areas of Carboniferous rocks, no fossils that indicate such an age are now to be found in the special localities originally mentioned, and the fossils on which the correlation was based have apparently been superficially studied. The latest researches have classed all of these Carboniferous areas of Hector as of Mesozoic age, mainly Triassic. The rocks are chiefly greywackes and shales which have been subject to such intense earth pressure that they have become strongly welded and much folded, while they are now extensively jointed and in many places traversed by a multiplicity of minute quartz veins. These rocks constitute the great mass of the mountain ranges of New Zealand. Though their outcrop is so extensive they are fossiliferous in very few places. The Wairoa gorge close to Nelson, Nugget Point, Mount Potts on the Rangitata River, and Kawhia Harbour, are the best known and most important localities. At all these places the fossils

have a distinctly Triassic character, though at Kawhia and at Nugget Point the Triassic sediments pass upwards conformably into Jurassic rocks that are lithologically similar to them. Hence it is appropriate and convenient to speak of this great system of rocks, locally known as Maitai, as Lower Mesozoic or Trias-Jura. Subsequent research will certainly make it possible to subdivide this great system of rocks, but in the opinion of the author our knowledge is not yet sufficient to allow of it. Locally there is evidence of volcanic action during the Maitai period. Such evidence is found at Nelson, in South Canterbury, and in Southland. There are also granitic intrusions into the Maitai sediments in Westland, and there are well-known intrusions of peridotites at the Dun Mountain and elsewhere in Nelson, as well as some smaller masses of gabbro near the North Cape. In Otago, Westland, and Marlborough there is in association with the Trias-Jura formation a great mass of schist, the main type of which is a muscovite schist. Wherever a traverse has been made across the boundary between the schist and the unaltered Trias-Jura, no unconformity has been made out and no sudden change in rock structure has been found. In all cases there is a gradual variation from the one rock type to the other. The change is most marked in the felspar of the greywacke, which gradually becomes altered into muscovite and quartz. The transition from greywacke to mica schist is generally not complete in a less thickness of rock than 5,000 to 10,000 feet. The accumulation of knowledge has forced the writer in many publications to class the schists as metamorphic Trias-Jura. An additional proof of conformity between the greywacke and the schists is found in the fact that the greywackes never contain any material that could be regarded as derived from the denudation of schistose rock.

The Maitai rocks are practically of no economic importance. At Reefton, it is true that they are penetrated by the auriferous veins of that district, but elsewhere they are almost destitute of minerals and metals. Their highly fissured character prevents them from being used as

building stones, while materials for the preparation of cement appear to be absent from them.

The Oamaru system of rocks rests with much unconformity on the Maitai system. This younger rock system has been the cause of perhaps more controversy than any other geological problem in the country. Coal is often found in the sediments that form the base of the series, and there is good building stone about the middle of the system, and much of the strata are fossiliferous. Much of the confusion that has arisen has been due to the attempts to determine the age of the coal in different parts of the country. Sir James Hector maintained that practically all the coal was of the same age; Captain Hutton has strongly maintained that there were three or four different coal-forming periods separated by unconformities. The latest researches indicate that the younger rocks constitute a perfectly conformable series throughout, and that any coal that is found lies at the base of the system. The rocks were deposited during a prolonged period of subsidence that reduced the land to comparatively small dimensions. The system always has gravels at the base, followed by greensands and then by limestones, an order of occurrence that clearly shows that subsidence was more rapid than deposition of sediment. Such physical conditions must evidently have been associated with a great overlap. Accumulations of vegetation were constantly being formed near the shore line as the lowlands were gradually submerged, and from these lagoon deposits the coal has been formed. Since the different portions of the subsiding area were reduced to the conditions that allowed of the deposition of vegetable matter at different times, in accordance with the greater or less original elevation of the land, so the coal material which was deposited when these conditions obtained must be of different ages. Thus Hector's view correctly represents the facts of stratigraphy, while Hutton's, which was based on palaeontology, correctly represents the different ages of the coal in different localities. When allowance is made for the great overlap these two views

become almost reconciled. The unconformities that have at different times been insisted upon by various observers have been largely based upon collections of fossils that have been made at different localities, and at different horizons. Recent observations show at least that no physical unconformities can be demonstrated.

The physical depression lasted throughout a long period, for the lowest strata of the system contain a fauna that has distinct Cretaceous affinities, while the highest contain an upper Pliocene fauna. The coal (which at Westport and Greymouth is bituminous, though elsewhere a brown coal) and the limestone render this formation of great economic value, and in those places where the coal is plentiful and of good quality towns have arisen.

The Oamaru system forms nearly the whole of the downs country, and as most of the strata, with the exception of the sandstones at the base, weather into good soil, the areas of this system are some of the most important of the agricultural districts of the country. Volcanic action appears to have begun about the middle of the period at Oamaru and at Hicks Bay, where volcanic rocks are interstratified with the limestones. Towards the end of the Oamaru period there was a far more important volcanic activity in various localities, for it was then that the large masses of volcanic rocks of Banks Peninsula and of Otago Peninsula were emitted. There was also a great outbreak in the North Island, for it is certain that during this period the rhyolite plateau was in course of formation, though activity does not appear to have begun until nearly the close of the period. The large and important group of andesitic rocks of which the Coromandel Peninsula is mainly formed was probably of somewhat earlier date than the rhyolite plateau. This volcanic area is of special interest because of the rich auriferous quartz veins which traverse the andesites. Similar volcanic rocks, but without the auriferous quartz veins, are found in many places north of Auckland.

The Pleistocene period was at first a period of considerable elevation. The great depression of the Oamarn

period culminated with the deposition of the limestone; the upper sandy beds and conglomerates show that before the close of the period a general elevation was in progress. The Pleistocene elevation was merely a continuation of this. At the same time the glaciers were much extended. While there can be no doubt that a portion of this glacial extension was due to the greater height of the land it is probable that other causes were also in operation. It is true that there are few evidences in regard to faunal distribution during this period, but the present distribution of the fauna and flora in the New Zealand region does not point to any great refrigeration of the climate in the later geological times.

During the glacial extension ice filled the basins of the lakes of the south and even advanced so far as to deposit an immense moraine at Henley near Dunedin, close to the east coast. This district, however, has been subject to earth movements since this moraine was deposited, and although it now extends below the sea-level it is not possible at present to estimate the elevation of this district during the Pleistocene. The altitude to which the glaciers descended is about 700 feet at Lake Te Anau and Lake Manapouri in the south, and this altitude gradually increases in the northern part of the South Island, and is as much as 4,000 feet in the Tasman Mountains in the extreme north-west. In the North Island it is not yet certain whether there were any glaciers; if any did exist, they were quite small and isolated. Depression took place to a considerable extent towards the close of the Pleistocene, but it was short lived and was succeeded by elevation, which has continued throughout the whole of the Recent period. Volcanic action probably attained its maximum during the Pleistocene. It was at this time that the great andesitic cones of Egmont, Ruapehu, Tongariro, and the many other cones of the North Island were formed. It is probable that volcanic action still continued in the Otago Peninsula and the Banks Peninsula localities, and at Timaru much dolerite was emitted.

During the Recent period volcanic action has been

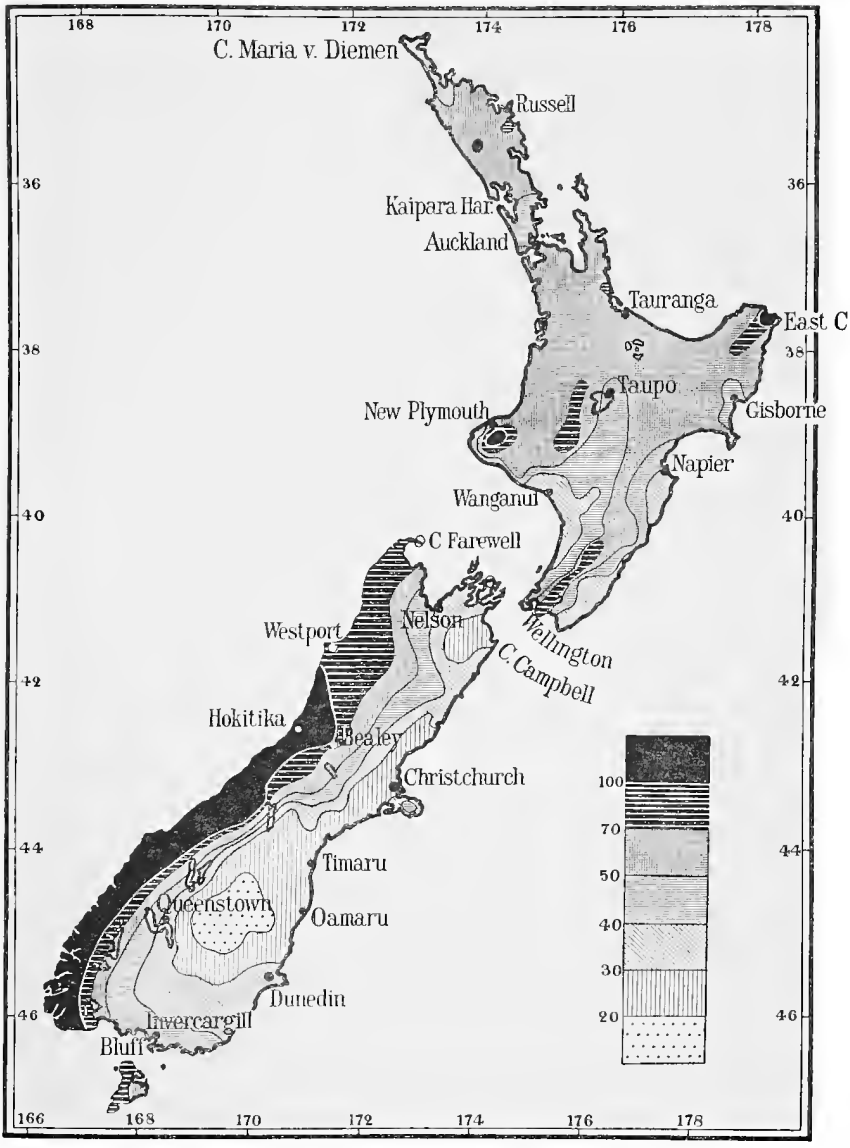


FIG. 64 Mean Annual Rainfall, in inches.

maintained, and one of the results has been the formation of many little volcanoes at Auckland and at the Bay of Islands. All signs of activity have disappeared in these districts, except for a very few hot springs. Activity, however, has been maintained at Ngauruhoe, though there are many reasons to believe that no lava flow has issued since white people have resided in the country. In 1886 there was a violent explosion on Mount Tarawera by which a huge fissure was formed along the flat crest of the mountain. From this fissure a vast quantity of scoria and dust was ejected over the country, and directly afterwards from the larger explosion in the bed of Lake Rotomahana. Activity in this district rapidly dwindled, and now the great fissure on the mountain appears absolutely extinct, and even the hot springs of the district exhibit no unusual activity.

All the gravel plains previously referred to are of Recent or Pleistocene Age, and on the surface of the gravel of the Canterbury plains there is a very general covering of the fine dust deposit which was first classed by Von Haast as loess. Many of the gravels and beaches in Westland are auriferous, and from them in the past a large amount of gold has been obtained. The gravels of the valley of the Clutha River in the schist district of Otago have proved extremely rich, and a considerable quantity of gold is still obtained from them by dredging and sluicing.

Climate. The main features of the New Zealand climate are the equable temperature due to the insular position, the uniform rainfall at nearly all periods of the year, and the large amount of sunshine.

Temperature.[1] Since twelve degrees of latitude separate the extreme north and south points of New Zealand, it is obvious that there must be a considerable difference in temperature between the north and south of the country. There are no stations at which records are taken at either end of the land. The most distant stations between which satisfactory comparisons can be made are Auckland and Dunedin,

[1] All temperatures are given in degrees of the Fahrenheit scale.

PLATE XIX (*a*). NGAURUHOE VOLCANO, NORTH ISLAND

PLATE XIX (*b*). WHANGAREI FALLS, NORTH ISLAND
(High Commissioner for New Zealand)

PLATE XX. LAKE WAKATIPU AND THE REMARKABLES, SOUTH ISLAND
(High Commissioner for New Zealand)

which are almost exactly nine degrees of latitude apart. In 1910 the mean annual temperatures were 60·1° and 51·7° F. respectively, a difference of 8·4°. The comparison is the more satisfactory because both of the stations are situated on the coast. Intermediate stations show a gradation between these records in accordance with their latitude. Thus Wellington, which is almost exactly half-way between these towns, has a mean annual temperature of 56·2°, a result only 0·3° above the arithmetical mean. There is a slight difference between the east and west side of the islands. Thus the mean temperature of New Plymouth is 60·8°, which is 0·7° higher than that of Auckland, which lies as much as two degrees of latitude to the north, and 2·1° higher than Gisborne, which is almost in the same latitude. So also Hokitika has a mean temperature 1·5° higher than Christchurch, though only half a degree of latitude further north. This advantage of the western coast is probably due partly to the north-west and south-east lie of the land, which thus faces the sun much more fully on the western side, and partly to the influence of the warm Australian marine current, which is much more effective on the western side than on the eastern.

Maxima and minima of temperature.

The equable nature of the climate is well shown by the extremely small differences between the mean maximum and minimum temperatures, which are at Auckland 11·5°, New Plymouth 18°, Christchurch 17·5°, Dunedin 14°, and also by the small difference between the extreme temperatures—at Auckland 43°, New Plymouth 47°, Hokitika 53°, and Dunedin 51°. The difference is more marked on the east side of the South Island than elsewhere because of the occasional north-west winds, which there have the föhn character and cause a high temperature, so that almost without exception the annual records show a higher reading on exceptional days in Christchurch and even in Dunedin than in Auckland. In 1910, for instance, 82° at Auckland, 88° at Christchurch, and 82° at Dunedin were the highest readings. In the inland districts of Otago an approach to a continental climate is found, and

there is a far greater contrast between the temperatures of summer and winter. On the coast-line the mean temperature of the three winter months, June, July, and August, is never more than 15° lower than the mean temperature of the summer months, December, January, and February, and is normally less than 12° lower.

Pressure. The great cause of meteorological variations in New Zealand is the passage of atmospheric depressions. These are of two kinds. The more frequent travel from west to east, and in the summer season the average path of the centres of the depressions is somewhat to the south of New Zealand, but in the winter the path of the centres usually traverses the South Island. The approach of one of these cyclonic depressions is heralded by a north-east wind which in the course of a day or so changes to the north-west, and the temperature rises markedly. As the centre passes there is a sudden change to a wet south-west wind—sometimes almost a 'southerly burster'. The strength of this gradually decreases, and the wind soon veers to the south. At the centre of a depression the barometer may sink to 28·5 inches. Generally the isobars are looped and one depression follows so close on another that they are separated by a slight rise only. It is then that the most severe type of weather is experienced, occasionally with snow at the sea-level in the South Island. The other type of atmospheric depression comes from the north-west, but is much less frequent. These cyclones often cross the north part of the North Island. The passage of such a cyclone into the track of the easterly-moving depressions is always accompanied by weather conditions of extreme violence. Heavy seas break on the coast and rains inundate some of the low-lying coastal lands, and often unusually cold temperatures prevail. These depressions affect the North Island more than the South, but throughout the extent of the land their passage is associated with a heavy rainfall in the east coast districts.

Rainfall. Practically all parts of the country receive a supply of rain amply sufficient for all agricultural purposes.

Droughts of any severity are unknown. It is only in parts of the Canterbury Plains and in Central Otago that the rainfall is occasionally insufficient to allow of a good yield from the crops. As would be expected in a mountainous country the distribution of the rainfall is extremely irregular. Almost everywhere on the western slopes of the South Island the fall is more than 100 inches per annum, and in the mountain valleys it rises in places to more than 200 inches. After the crest of the range has been passed the rainfall rapidly diminishes, and in the South Island near the sea-coast it is generally less than 30 inches; while in Central Otago there is a large area where the rainfall is between 15 and 20 inches. In the North Island the rainfall is far more equably distributed. The greater portion has a rainfall of between 50 and 70 inches, but along the narrow mountain ridge and near the great volcanoes it is much heavier—even 300 inches on the higher slopes of Mount Egmont. In several coastal localities, both east and west, the annual fall lies between 30 and 40 inches. Though the rainfall throughout New Zealand is heavy, yet there is a relatively large number of days with a clear sky, and records show that the number of hours of bright sunshine in the year is above the average for the latitude (Fig. 64, p. 399).

Vegetation.

The most striking feature of the indigenous vegetation is the evergreen nature of the forest by which the greater part of the country was originally covered. There was in addition a considerable area of country covered with the tangled growth of fern (*Pteris esculenta*), often mingled with the myrtaceous manuka (*Leptospermum scoparium*) and more sparingly with the poisonous tupaki or tutu (*Coriaria ruscifolia*). This type of vegetable covering was more plentiful in the North Island, especially throughout the area of the pumice land of the volcanic plateau. The upper slopes of most of the mountain ranges, as well as the Canterbury Plains and other drier areas, were covered with native grasses. The commoner kinds of these grasses grow in close clumps, and though belonging to two widely different genera they are always classed

together as tussac grasses. There are, however, smaller and more nutritive grasses growing between the larger and coarser tussacs, and these supply good fodder for the stock, while the tussacs supply good shelter. The system that has been generally followed of burning the native pastures appears to have damaged much of the original grass land almost beyond repair. All the grass land on the flatter country has been ploughed and converted into cropping land or into pasture of introduced grass. The fern and scrub land has also been largely changed into pasture, especially near the east coast of the North Island. The clay gum lands, however, a wide area of native fern and scrub, are still in their original state for the most part, and the same applies to the pumice lands of the volcanic plateau. Much of the forest land is still untouched, but a large portion of it has been felled and grassed, and though it requires time and the expenditure of capital to change the forest land into pasture, the extension of settlement into these 'bush' districts is now proceeding rapidly, especially near the route of the North Island trunk railway and in other accessible districts.

The general character of the indigenous vegetation is distinctly sub-tropical, and the forest in particular is almost impenetrable in its native state owing to the large numbers of lianes which interlace and form an almost continuous mass of vegetation. There are many timber trees in the forest or bush, and of these the kauri pine (*Dammara australis*) is the best known. The rimu (*Dacrydium cupressinum*) and several species of *Podocarpus*, the so-called white and black pines, and totara, are also of great importance. Angiospermous trees are of comparatively little value, though the timber of various species of beech (*Notofagus*), which is universally called 'birch' by the settlers, is used in some districts. The puriri (*Vitex litoralis*) is much used in the north because of its lasting qualities, though it is not suitable for sawn timber.

Natural affinities.

The natural affinities of the New Zealand flora have been carefully studied. It is found that there are

altogether 1,571 species of flowering plants and ferns, and of these as many as 1,143 are not known outside New Zealand. Only 366 species are found in Australia as well as New Zealand, and 108 in South America. As many as 450 species that occur in the South Island are not found in the North, while only 220 North Island species are not found in the South Island. Some of the plants related to South American species are extremely conspicuous members of the New Zealand flora. The kowhai (*Sophora*), veronica, fuchsia, tupaki (*Coriaria*), and the beech all have close affinities to species of the same genera in South America. It is remarkable that although the New Zealand flora shows a greater resemblance to the flora of Australia than to that of any other country, some of the commonest and most notable of the Australian genera have no representatives in New Zealand, notably *Eucalyptus*, *Acacia*, *Grevillea*, and *Hakea*, though introduced species of these genera thrive. Plants introduced from countries that have temperate climates grow with much luxuriance, and fodder plants and cereals from many lands have added much to the produce of the country. On the other hand, many plants that have been introduced by accident have multiplied and become troublesome weeds, invading areas covered with the indigenous vegetation.

There are few native herbaceous plants of decorative value. Such as there are occur for the greater part in alpine situations only. Buttercups are the most prominent. Mountain daisies (*Celmisia*) are of many species and are often highly decorative. Gentians are often abundant. In all divisions there is a preponderance of white-flowered species. Flowering shrubs of attractive appearance are far more numerous. Among them the veronicas, olearias, pomaderris, senecios, and manuka are the most conspicuous. The trees generally have no attractive flowers, but exception must be made of the various species of rata (*Metrosideros*), all of which bear a great abundance of flowers containing numbers of scarlet stamens. The whole tree appears as a blaze of

colour at midsummer, and enlivens the landscape, which is apt to have somewhat sombre tints. Another flowering tree is the puriri (*Vitex*), but its flowers are not so richly coloured and are not conspicuous at a distance. A large white-flowered clematis is attractive.

Economic vegetable products.

Apart from timber little material of economic value is obtained from New Zealand plants. The 'flax' (*Phormium tenax*) is an exception, for from its long sword-shaped leaves a great quantity of strong fibre is prepared. Though abundant in the native state this plant has not yet been systematically cultivated. The 'cabbage-tree' or palm lily (*Cordyline*) is a highly ornamental plant, and its common occurrence in all parts of the country confers on the New Zealand landscape its most characteristic feature.

Fauna: mammals.

Apart from seals and whales the only indigenous mammals in New Zealand are a dog, a rat, and two bats. The two first were almost certainly introduced by Polynesian immigrants. Amongst the native birds a relatively large number of species are flightless, including a parrot, duck, and rail as well as the kiwi (*Apteryx*), a small nocturnal struthious bird which is found in densely wooded districts. Various other birds have relatively weak flight, and nearly all the native species have become rapidly less numerous as civilization has advanced. Some of the species have loud and clear song; but few have any brilliancy of plumage. Gulls and cormorants are numerous on the coast, and the albatross wheels over the New Zealand waters and nests on the outlying islands. The wood pigeon, two ducks, and some smaller birds are native game, but the shooting season is made very short by legislation.

Birds.

Introduced birds have almost entirely displaced the native species in nearly all the settled districts. The sparrow, blackbird, thrush, and starling are now abundant in all parts of the country, and the native hawks, which are quite numerous, seem unable to restrain their numbers. Within the latest geological times a large number of species of moa, a large struthious bird, were abundant, but were certainly extinct before the arrival of the first settlers.

Many kinds of fish are found in New Zealand waters, and afford excellent food. Freshwater fish, except the eel, are few and small, but several species of trout have been introduced and have flourished, so that they are found in almost all the rivers. Mollusca are not particularly numerous or noticeable. There are, however, two species of oyster which are obtained in abundance in the proper season. Reptiles are represented by a few lizards only; but one of them, the tuatara (*Hatteria punctata*), is of extreme interest because of its close relationship to some extinct reptiles of the Mesozoic era. It is now restricted in habitat to a few of the outlying islands. There are no snakes. Insects are not particularly numerous. The rarity of butterflies is noticeable. Mosquitoes and sandflies are exceedingly troublesome in some restricted localities, but are practically absent from all those districts where settlement is of long standing. There are practically no indigenous stinging insects. Houseflies and other species of European insects, including bees, have been introduced and have become abundant.

Fishes, mollusca, reptiles, insects.

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Biblio-graphy.

CHAPTER XII

ECONOMIC CONDITIONS

By the Hon. Sir Robert Stout and J. Logan Stout

Industrial phases of the Dominion.

New Zealand, in its career of less than a century, has passed through many industrial phases. In the early years of the last century it was the centre of the Southern Pacific whaling and sealing industry, and vessels from the United States of America, from Australia, from Tasmania, and from Europe visited its harbours. It was also noted then for its kauri pine trees, and the fame of these forest giants and their suitability for ships' masts and spars attracted many vessels to its shores. A few traders also visited the islands to traffic with the Maoris, and some became settlers, locating mainly in the far north. Missionaries arrived, and in their wake came more traders. Whale and seal oil and kauri logs and other timber became an export of some little value.

Early settlement and industries.[1]

In 1840 the British sovereignty was proclaimed, and many immigrants came from Britain and a few from France. The first settlements proper were in the Wellington and Auckland districts; then followed the coming of settlers to Taranaki in 1841, to Nelson in 1842, to Otago in 1848, and to Canterbury in 1850. Slowly settlement progressed and new productions were available. The gold-diggings in Australia were opened in the early '''fifties', and many New Zealanders, smitten with the gold-fever, crossed the Tasman Sea to try their fortunes. The opening of the 'diggings', as the gold-mining was termed, was a considerable benefit to New Zealand, for agricultural produce found a good and ready market in Australia. Pastoral pursuits began in the ''forties', but in

[1] Cf. R. F. Irvine and O. T. J. Alpers, *The Progress of New Zealand in the Century*, London, 1902.

the north Maori troubles and the absence of roads made development a very slow process. In 1861 gold was found in payable quantities in the Otago district, and a rush at once set in, and immigrants flocked from Australia and Britain. With this increase of population, pastoral and agricultural pursuits were developed and firmly established. Gold was afterwards discovered at the Thames in the Auckland district, and this was the means of opening up that part of the Dominion. In 1867 gold-mining had somewhat languished, and it was then thought that New Zealand would have to rely for its prosperity mainly on its production of wool, the surplus sheep being boiled down for their tallow. Many boiling-down plants were established, and it was predicted that the interior lands would have to be utilized for breeding sheep, and the richer coast land used for fattening stock, and that wool and tallow would become the main exports. A Maori war was in progress on the west coast of the North Island, and there was a restlessness abroad. An eager desire arose for peace and progress. Two years later a universal demand was made for better communication, and in 1870 a comprehensive public works policy was undertaken. With it came the development of the growth of wheat. From Canterbury, which has been called the granary of New Zealand, the production of wheat increased, and agriculture received a great impetus.

Rise of pastoral industry.

In 1882 a new industry arose, the freezing of the carcasses of sheep and cattle for export. From this date must be reckoned the growth of New Zealand's prosperity, for no other event in her history has had such an immense and lasting effect on her industrial progress. The first export of frozen meat was made in that year, and its value was about £20,000. It has continuously and steadily grown in importance, so that now the value has reached the annual sum of about £4,000,000. Land that was formerly used for growing cereals is now used for fattening sheep, with the result that the export of cereals has decreased. With the increase of population and the subdivision of the land into smaller allotments, two other industries have

of recent years made great strides, the production of butter and of cheese. From the earliest days the export of butter and cheese was of importance, and it has become next in importance to wool and frozen meat. These changes in the agricultural and pastoral industries have led to great changes in the mode of dealing with the lands of the Dominion. At one time the largest areas of land were used for pastoral pursuits, and Crown lands were let on pastoral lease, called 'runs'; then came the sale and purchase of these lands, especially of land suitable for cereal production. With the development of the frozen meat industry, a more intensive pastoral occupation has arisen. Food is now grown in many districts for the winter feeding of stock. With the production of butter and cheese, co-operative dairies have been established, small farms have become remunerative, and a system of small holdings has grown up that was unknown in the early days.

Land-tax and 'land-for-settlement' policy.

Two other factors have contributed to the subdivision of the land, the graduated land-tax, and the 'land-for-settlement' policy, the fundamental principle of which is the compulsory purchasing of large blocks of land by the State for small farm purposes. As the Australian colonies have copied New Zealand methods in these two systems, it may be well to give a succinct statement of what has been done. The first land-tax was imposed in 1878. The capital value of all land, less all improvements, was assessed at its selling value, and on this assessment, less a deduction of £500, the owner had to pay a tax of one halfpenny in the pound. In 1879 this tax was abandoned, and a tax upon all property real and personal, save agricultural implements in actual use, and property belonging to churches, public bodies or societies, ships, and policies of life assurance, was imposed. It was at first one penny in the pound. This property tax, with some amendments and at a varying rate, remained in operation till 1892. Provision was made in that year for a new scheme of taxation—land and income taxes. There were two kinds of land-tax, ordinary and graduated. The

ordinary land-tax was imposed on the ordinary value of the land less a sum up to £3,000 for improvements. There was also a deduction of £500 allowed in certain cases. A graduated tax was provided. On land of the unimproved value of £5,000 and less than £10,000, the rate was an eighth of a penny in the pound. This rate increased by a graduated scale, the tax rising to six-eighths of a penny in the pound where the unimproved value of the land was of £210,000 or over. Since then the system of graduation has been maintained, though the scale of taxation has varied, and is now at the following rates :

(*a*) Where the unimproved value of the land of any taxpayer is not less than £5,000 and not more than £15,000, a duty for every pound of the unimproved value assessed at the rate of $\frac{1}{3}\frac{1}{2}d.$ increased by $\frac{1}{3\,2\,\frac{1}{0}\,0\,0}d.$ for each pound of the excess of such value over £5,000.

(*b*) When the unimproved value of the land of any taxpayer is more than £15,000 and not more than £30,000, a duty for every pound of the unimproved value assessed at the rate of $\frac{1\frac{1}{2}}{3\,2}d.$ increased by $\frac{1}{4\,0\,\frac{1}{0}\,0\,0}d.$ for every pound of the excess of such value over £15,000.

(*c*) Where the unimproved value of the land of any taxpayer is more than £30,000 and is not more than £200,000, a duty for every pound of the unimproved value assessed at the rate of $\frac{2\frac{3}{4}}{3\,2}d.$ increased by $\frac{3}{1\,0\,0\,0\,0\,0}d.$ for every pound of the excess of such value over £30,000.

(*d*) Where the unimproved value of the land of any taxpayer is more than £200,000, a duty of $5\frac{5}{6}d.$ for every pound of the unimproved value.

The result has been that the holders of large blocks of land have found it to be more profitable to dispose of their properties than to hold them. Since 1878 land has greatly increased in value, in some districts the increase being more than fourfold.

Government purchase of land.

The first statute providing for the purchase by the Government of large blocks of land for subdivision and settlement was passed in 1892. It enabled a contract to be made between the owners of land and the Government. A Board had to report on the value and suitability of the land. Little progress was made under the 1892 Act, and in 1894 the Government was given power to compulsorily acquire lands. If no price was agreed upon by the owner and the Government, the matter was referred to a Compensation Court consisting of a Judge of the Supreme Court and two assessors, one being appointed by

the Government and the other by the landowner. A modification of this system is still in force, but the purchase price is now ascertained by taking the unimproved value as assessed under the Valuation of Land Act for tax purposes, and adding to that a sum equal to 10 per cent. on such valuation in cases where the total value is £50,000 or under, and where over that amount, adding 10 per cent. up to £50,000, and 5 per cent. on the balance. Improvements are valued in the same way and compensation payable therefor. Estates have been acquired under the system amounting in area to 1,296,942 acres, and costing the Government £5,948,071. These lands have been subdivided, provided with roads, and let to tenants, and the system has been financially successful. In addition to the authority to take land for farm purposes, the Government is empowered to take land for workers' dwellings.

Fruit-farming.

During the past few years considerable attention has been given to the cultivation of fruit trees, and in Auckland, Hawke's Bay, Nelson, and Central Otago extensive orchards have been laid out; shipments of fresh apples have been exported to London, and fruit-canning factories have been established. The success of these ventures encourages the belief that this industry, which is yet in its infancy, can be profitably extended. The Nelson apples are famed for their flavour and carrying qualities. In Central Otago, where irrigation is easily obtained, and where it is necessary as the climate is exceedingly dry, the apricot and peach and other fruit attain great perfection. In Hawke's Bay the peach, the plum, and the cherry are largely grown. In the Auckland district vineyards have been planted, and all kinds of fruit are produced.

Relative importance of manufacturing, pastoral, and agricultural occupations.

The industries pertaining to pastoral and agricultural pursuits, such as the manufacture of soap and candles and the tanning of hides, were started at an early date. The industries also that must be local—those mainly relating to food supplies and other necessaries of life—began with settlement. The manufacture of those

articles which are luxuries rather than necessaries, and for which the demand arises only as wealth increases, is as yet in infancy. In the Government statistical tables, industries have been classed under twenty-six heads. Under these heads are included industries relating to animal food, like meat-freezing, fish-curing, butter and cheese making, to vegetable food, like milling, baking, sugar-refining, sugar-boiling, and fruit-preserving, and to drink, like brewing and the manufacture of aerated water. The minor industries are represented by tobacco factories, soap and candle works, glue works, bone mills, manure works, timber mills, iron foundries, paper mills, gas-works, electric works, brick and lime kilns, glass and metal works, printing works, agricultural implement works, factories for the manufacture of harness, saddlery, leather goods and boots, boat-building yards, chemical works, dye-works, and fibrous material works. It will be seen from the enumeration, which is not exhaustive of these various industrial efforts, that manufactures are well represented in the Dominion.

Inspection of machinery.

The Government is paternal in many of its functions. Human life is regarded, and so as to provide for the safety of the people who may be dealing with machinery, there is an Inspection of Machinery Department. This department grants licences to engineers, electric tram-drivers, marine engineers, examines steam-boilers, steam vessels, and all classes of machinery. It issues certificates to the owners of machines, &c., that the machines, &c., may be used, and there are penalties if unlicensed machinery is used or unlicensed men control the machines.

Live stock and agriculture.

The pastoral and agricultural pursuits, however, overshadow the other industries of the Dominion.

At one time the majority of the sheep were of the merino breed : now there are only 1,500,000 of that kind out of a total of 24,000,000 sheep. Cross-breeds and long-woolled sheep make up the balance. Angora goats have been found of service in utilizing some areas that were infested with special kinds of weeds. The cereals cultivated are oats, wheat, maize, barley, rye. Very large

areas have been sown in grasses, and green crops are extensive. The area in cereals varies greatly from year to year, and depends upon the prices of oats and wheat. There is not now such a large area occupied in growing wheat as formerly.

There is one item in the list of exports which New Zealanders regret to see there, and that is the export of rabbit skins. Rabbits were introduced about 1860, and in about twenty years they had so multiplied that many pastoral properties were seriously damaged. Drastic remedies at much expense had to be applied ; poisoning and trapping were common, especially in Otago and Southland, and in parts of the Wellington provincial district. What were supposed to be the natural enemies of the rabbit—stoats, weasels, and ferrets—have been introduced, and they have been unfortunately greatly destructive of the bird life of the Dominion. Even now the expense of keeping down the rabbit pest is a serious matter to many pastoral tenants.

At present both pastoralists and agriculturists are prosperous, despite the high price of land. One great advantage that New Zealand possesses is that the coast lands are always free from snow ; fields are always green and stock do not require to be put under cover or fed with prepared food in the winter. Efficient farmers find, however, that providing oaten chaff, turnips, or mangolds for stock in winter is profitable, and now green crops are frequently grown for stock, especially in the South Island. This practice is especially prevalent in the dairy districts.

New Zealand flax.

An industry that may be classed as agricultural is the utilization of *Phormium tenax,* or New Zealand flax. It produces an excellent fibre, but for many years no efficient method was discovered for separating the gum or resin from the fibre. Now this difficulty has been fairly overcome, and the export of this flax fibre is considerable. During the American-Spanish war and the fight in the Philippines, there was a great demand for the fibre, and it fetched a high price. After the Philippine war the price fell, and the manufacture of the fibre was not very

profitable, but lately the price has again risen. Formerly the flax growing in its native state was cut and left to grow again without any special cultivation, but now scientific cultivation is being instituted in certain districts.

Another product of the soil, but often classed as a mineral, is the kauri gum, the resin of the well-known kauri pine—*Dammara australis*. It is a valuable resin, and is used for making varnishes. Many thousand tons are exported, and the average value of the yearly export is about half a million sterling. The gum is found at varying distances below the surface. The methods of obtaining it are still simple: a long iron rod is used for locating the deposits of gum, which are then dug up by sinking and mining. Some gum is discovered in swampy places, and to obtain gum in such localities, sinking is more difficult. A great number of Dalmatians have come to New Zealand, and form the bulk of the gum-diggers. Many of them, after saving £200 or £300, return to their motherland. A few have settled and cultivate fruit-trees and vines. Kauri gum.

New Zealand has many mineral deposits. Up to the present time the only minerals that have been worked to any great extent are gold and coal. Mining for gold began in 1856, and up to the end of 1911 the total value of gold obtained from the mines was over £79,000,000. At first the gold-mining was almost wholly alluvial mining; quartz-mining developed later. At present the gold won is produced mainly from quartz reefs and by dredging the beds of rivers or streams. The parts of the Dominion from which gold has been chiefly obtained are the interior of Otago, Westland, Nelson, and Auckland. There has been some gold-mining in Marlborough, but the amount won has been small. The largest output is from the Auckland mines. Minerals and mining: gold.

Coal is found throughout New Zealand. Bituminous coal is principally obtained on the west coast of the South Island; its quality is excellent. There are brown coals of varying quality found in many parts of New Zealand. In Otago, Canterbury, and Auckland brown coal-beds are Coal.

widely distributed. These brown coals are used for stationary engines and for household purposes.

Oil.

Oil in some quantities has been discovered in Taranaki, close to the sea. In the Poverty Bay district of the Auckland province, and also in Westland, south-western Nelson, and in southern Hawke's Bay, traces of oil have also been found. Steps are now being taken to prospect these areas thoroughly, and companies have been formed to work oil concessions. The prospects in Taranaki have been deemed by oil experts to justify the erection of modern machinery. There is no doubt that oil exists, the only question being whether it exists in payable quantities.

Other minerals.

In the early days of the Dominion copper was mined in Nelson and in Auckland, but the mines have been closed as they did not prove to be profitable. It is said that there are considerable areas where copper is abundant, but at the present prices it would not pay commercially to open up the fields. There are many other minerals, the mining for which has been carried on in an unsystematic and desultory manner, such as antimony, manganese, scheelite, cinnibar, hematite. None of these has been either extensively or profitably worked. An attempt was made to work some deposits of tin, but success did not crown the effort. Hematite iron is plentiful in Nelson, and a proposition has been submitted to the Government to work the deposits there. The price of labour in New Zealand, and the cheapness of iron ore in Europe and America, have militated against the utilization of the iron deposits. There are vast quantities of titanic sand, especially on the western coast of the North Island, and several attempts have been made to interest British capital in these ventures. Up to the present, however, these attempts have ended in failure. Deposits of phosphatic rock are worked with success in Otago, and these deposits have proved of great service to agriculturists.

Water-power.

In addition to the coal deposits as store-houses of energy New Zealand has unrivalled water-power; indeed, for its area, no country in the world has such a water-power

available. A glance at the map will show the position of the chief mountains, lakes, and rivers in both islands. Running through the centre of the South Island is a series of large deep lakes situated at considerable altitudes above the sea-level, varying from 700 to 2,000 feet. These lakes are never frozen, and though some of the rivers have not such a large flow of water in winter as in summer, the flow is always considerable. The North Island is also favoured with an extensive water-supply, though not equal to that of the South Island. Lake Taupo, nearly in the centre of the North Island, has an area of 238 square miles and a depth of 534 feet, and lies at an elevation of 1,211 feet. Then there are the large lakes of Waikaremoana, Rotorua, Rotoiti, Rotoma, Tarawera, and Rotoehu, all lying about 1,000 feet above the sea. The harnessing of the water-power has begun. The Government are erecting works to utilize the waters of Lake Coleridge in Canterbury. Rotorua is lit with electricity generated from Okere Falls, some ten miles distant. Dunedin uses the Waipori River for the production of electrical energy for its tramways and for other municipal and manufacturing purposes. A mining company obtains electrical energy from the use of the Huka Falls on the Waikato River; and many other schemes have been formulated, some being in process of development. It has been estimated that if the population of New Zealand were ten times as great as it is now, there is more than enough water-power even without storage to generate sufficient electrical energy for domestic and manufacturing purposes for such a population. The rainfall map of New Zealand will help to demonstrate the potentialities of its water-power (Fig. 64, p. 399).

Communications: railways.

New Zealand, for its size, is well served with railways. The mileage of railways—single lines—open for traffic in the North Island is about 1,200, and in the South Island over 1,600. Various extensions are under construction, and several new branch lines are in contemplation. The total of the capital expenditure on the railways has been about £32,000,000.

There are very few lines which have been duplicated, the duplications being confined to the connexions between seaports and their towns or towns and their suburbs. The gauge is narrow, namely, 3 feet 6 inches. The North Island system connects by railway all the main towns, Auckland, Wellington, New Plymouth, Napier, Wanganui, and Palmerston North. Extensions are in progress to connect Gisborne with Napier, and to join the Bay of Plenty to Auckland. A railway runs from Gisborne inland, and its construction is being pushed forward. The railway to the north of Auckland is being extended, and it is expected in a few years there will be a railway running from Auckland to the Bay of Islands, if not to Mangonui. In the first proposed scheme of railway construction it was intended to have a railway running the entire length of the South Island. There is, however, a considerable break in this contemplated line. There are only 48 miles open for traffic south of Picton, and 35 miles open north of Waipara. About 100 miles separate these termini. Nelson is also isolated from other towns, and the line south of Nelson is not yet connected with the West Coast or the Midland line. From Christchurch to Invercargill the express train runs through from each end daily ; between Christchurch and Dunedin there are two daily express trains each way. On the Auckland-Wellington main trunk line in the summer there are two daily expresses each way. There are two classes of passenger carriages, first and second, and sleeping accommodation is furnished on the Wellington-Auckland express. The ordinary fares are $1\frac{1}{2}d.$ per mile first class, and $1d.$ second class.

Roads.

The construction of roads in the Dominion has shown great development. In the very early days roads were unknown, and the only mode of travelling was on foot. Afterwards tracks were cut and horses used ; small portions of road were then formed but generally unmetalled, and what is called the bullock dray was the most common form of conveyance. As roads were improved and made, vehicles drawn by horses were used, and in recent years

motor-cars and motor-cycles have become numerous. There are now main roads and branch roads all over the Dominion, though in the winter months in the new settlements in forest districts access is difficult if not impossible. To places outside the reach of railways, coach services are maintained, and goods are conveyed in wagons. The coach services cover 6,800 miles.

Inland navigation.

There are no canals, and river traffic is slight. The main river traffic is on the Wanganui River, called the Rhine of New Zealand. It has not the historical associations of the great German river, but in scenic beauty it far excels it. There is slight traffic on the Thames, also on the Clutha, which is the largest river in New Zealand, on the Waikato, and on a few others. The Kaipara Estuary, lying north of Auckland, has several rivers draining into it, and is the most important inland water-way of New Zealand. Vessels of considerable tonnage can traverse the estuary for long distances, and there is deep water communication for considerable distances up the rivers draining into it.

Shipping.

New Zealand has many good and several fair harbours. The chief towns are all situated on or near the coast. The result is that there is a very large sea-borne traffic. There are steam services carried on by several large companies. The main steam-shipping company is the Union Steamship Company of New Zealand (Limited). Its steamers trade to Australia and Calcutta on the west, to Vancouver and San Francisco on the east, and to the South Seas, and maintain, in addition, an efficient coastal service around New Zealand. The coastal traffic is partly carried on by the inter-colonial steamers which visit Auckland, Gisborne, Napier, Wellington, Lyttelton, Dunedin, and the Bluff, and partly by special coastal boats visiting all these ports and also visiting Onehunga, New Plymouth, Nelson, Picton, Westport, and Greymouth. Smaller local boats of other companies ply between Auckland and its many fine northern harbours, Thames, Whangarei, Warkworth, Tauranga, Mangonui; and other local lines keep up communication between

Wellington and the Cook Strait ports, the fine harbours in Nelson and Marlborough, and the bar harbours on the west coast of Wellington and of Taranaki. Similar services are maintained by small steamers plying between the harbours on the eastern and southern coasts of the South Island, and between Wellington and Hawke's Bay and some of the open bays on the east coast of the North Island. Sailing vessels of all types are engaged in carrying coastwise cargoes of timber, stone, and general merchandise.

European shipping trade.

The European, or, as it is termed, the Home trade, is carried on by several steamship lines. The two most prominent are the New Zealand Shipping Company and the Shaw, Savill & Albion Company. There are several other lines engaged in the trade to England and America, namely, the Federal and Shire Lines, the Tyser Line, and the American & Australian Steamship Line. Occasionally sailing vessels load grain, wool, and other cargoes for Home or American ports, but they are fast disappearing before the advent of the steam tramps. In addition to these various steamship lines, tramp steamers and sailing vessels occasionally bring goods from various ports of the world, mineral oil and manufactured goods from America, wool-packs and tea from India, tea from China, and roofing tiles from France. The number of foreign vessels that come to New Zealand, however, is small; an occasional Norwegian vessel, an Italian vessel, and one or two German cargo steamers come every year, but almost the whole trade of New Zealand is done by British-owned vessels.

Posts, telegraphs, and telephones.

All postal, telegraphic, and telephonic communication is under the control and management of the Government, with the exception of a small telephonic system worked by the Maoris on the east coast, which was established by themselves to provide communication between their villages. Wireless telegraphy has been inaugurated, and New Zealand can communicate by wireless with Melbourne, 1,200 miles distant. Telegraph and telephone systems have been extended throughout the Dominion. There are two separate cable communications with

Europe, one via the Pacific, and one via the Tasman Sea, Australia, and India.

Legislation against commercial trusts.

The New Zealand Parliament has recognized the danger to the community of the creation of monopolies in trade or commerce, and it has passed a statute penalizing commercial trusts. The statutory definition of the term commercial trust is as follows :

'Any association or combination (whether incorporated or not) of any number of persons established either before or after the commencement of the Act (November 21, 1910), and either in New Zealand or elsewhere, and

(*a*) Having as its object or as one of its objects that of (i) controlling, determining or influencing the supply or demand or price of any goods in New Zealand or any part thereof or elsewhere, or that of (ii) creating or maintaining in New Zealand or any part thereof or elsewhere, a monopoly, whether complete or partial, in the supply or demand of any goods, or

(*b*) Acting in New Zealand or elsewhere with any such object as aforesaid : and includes any firm or incorporated company having any such object or acting as aforesaid.'

The Act is limited to certain classes of goods, so that all combinations or trusts are not prohibited. The goods to which the statute applies are agricultural implements, coal, meat, fish, flour, oatmeal, and the other products or by-products of the milling of wheat or oats, petroleum or other mineral oil (including kerosene, naphtha, and the other products or by-products of such oil), sugar, tobacco (including cigars or cigarettes). It will be noticed that the specified articles are mainly those in common use. The offences under the Act are the giving of illegal concessions in consideration of exclusive dealing, and the illegal refusal to deal. A person commits an offence under the first head who offers or agrees to give to any other person any rebate, refund, discount, concession, allowance, reward, or other valuable consideration for the reason, *inter alia*, that the latter person deals or has dealt or will deal or intends or undertakes or has undertaken or will undertake to deal exclusively or principally with any person or class of persons in relation to any particular goods

or generally. There are four other clauses defining offences under this first head, and they amount to declaring that any monopoly or trust shall be illegal. An example of the second class of offences is where one refuses to sell to any person or to purchase from any person for the reason that that person will not agree or undertake to deal with him alone. Another class of offences is where a person offers goods for sale at too high a price, if this price has been fixed by a commercial trust, or where, in obedience to a trust, a person, whether he is a member of the trust or not, fixes an unreasonably high price for goods.

The Supreme Court is appointed the tribunal to investigate cases under the Act. On the trial of an action for a penalty under the Act, the court is not bound by strict rules of evidence, but may in proof of any fact admit and accept such evidence as it thinks fit, whether such evidence is legally admissible in other proceedings or not, and no person, whether a party to the proceeding or not, can refuse to answer any question or to produce or make discovery on the ground that it would tend to incriminate in respect of any offence under the Act.

Labour legislation.

New Zealand has obtained some notoriety for its experimental labour legislation. It was thought that if a court was established to settle disputes between employers and employees, the dislocation in trade and the domestic hardships resulting from industrial strikes would be removed. The first statute constituting such a tribunal was passed in 1894, and it was termed the Industrial Conciliation and Arbitration Act. Conciliation loomed large in the statute, and it was anticipated that recourse to the court would be rare. Since 1894 the Act has been several times amended, but the main principle affirmed in the first statute remains. When a dispute arises, a Conciliation Commissioner tries to effect an agreement between the parties. If he fails, the matter is remitted to the court, which consists of a judge of the Supreme Court and two assessors, one appointed by all the employers' associations and the other by all the workers'

trade unions. In the first few years of the existence of this industrial conciliation and arbitration system, great satisfaction was given to the employees; trade unions were recognized; preference was given to members of some unions over non-members, and wages were raised. There is no doubt there would have been a rise in wages even if there had been no Act in existence. New Zealand began to recover from its years of depression about 1892, and had many prosperous years after the inauguration of the system. During the past few years wages have remained mostly stationary. Prices, however, have gone up, and it has been found that the increase of wages has not benefited the recipients to any appreciable extent. The cost of living has increased, and dissatisfaction has resulted from no further increase being granted. Statistics show that if a further increase had been granted it would have been impossible in many trades to carry on at a commercial profit, and articles of local manufacture would not have competed with imported products. Another element, however, has prevented the smooth working of the system. Federation and socialistic societies have arisen, the members of which condemn arbitration as a mode of settling labour disputes. Some of them, perhaps a majority, have as their aim a socialistic régime in which individualistic control of any industry should be abolished. The State, they say, must be the capitalist and the owner of all industries, just as the State owns the railways and manages the post office and other branches of the public service. Workers belonging to some industries have cancelled the registration of their trade unions under the statute. They decline to submit any dispute to the Conciliation Commissioners or to the Arbitration Court. Their remedy is the strike. So far their strikes have had little success, and this fact has created a split in their ranks, and the more moderate federationists are beginning to recognize the advantages of the arbitration system. Peace in industrial matters is yet far from realization, but recent events have shown that labour leaders of extreme views are losing their hold upon many

of the rank and file of the workers, and that a movement towards conciliation is progressing.

The awards made by the court have been very numerous. They contain the conditions on which an industry has to be conducted, such as the hours of labour, the wages, the prices, the different kinds of labour, and other numerous and varying provisions. Any breach of an award by an employer or by an employee is an offence and is liable to be punished. Many who supported the initiation of the system realized that its main benefits would be to guide public opinion as to the merits of labour disputes, and some who have always grumbled at the system fail to realize the part that public opinion plays and must play in all disputes between citizens. The mere penalty is not sufficient to enforce an award unless the justice of an award is apparent. It will be found that the strikes that have failed have generally been those that could not appeal to justice or to a well-informed public opinion for support.

Various other statutes have been passed restricting liberty where the employment of labour is concerned. The hours and conditions of work in factories are fixed by law, and a statute has been enacted dealing with like matters with respect to shops of all classes. There is a compulsory half-holiday for factory assistants and shop employees each week. Child and female labour are specially protected. Sweating is penalized and has almost been abolished. Seamen are carefully looked after, and ships engaged in the coasting trade, though not belonging to New Zealand, must conform to the New Zealand shipping laws.

PLATE XXI (*a*). IN MILFORD SOUND, SOUTH ISLAND

PLATE XXI (*b*). MITRE PEAK AND SINBAD GULLY, FROM ABOVE BOWEN FALLS, SOUTH ISLAND

(High Commissioner for New Zealand)

PLATE XXII (*a*). OTIRA GORGE, SOUTH ISLAND

PLATE XXII (*b*). WANGANUI RIVER, SOUTH ISLAND
(High Commissioner for New Zealand)

CHAPTER XIII

POPULATION AND GOVERNMENT

By the Hon. Sir Robert Stout and J. Logan Stout

Population

The population of New Zealand, other than Maoris and half-caste Maoris living with Maoris, was 1,008,468 at the census taken on April 21, 1911. This number included 2,879 half-caste Maoris living as Europeans, and also 2,620 Chinese. The Maori population was 49,844. Of this number 4,181 were half-castes living as Maoris. The Maori population proper, that is, without any mixture of European blood, was 45,663. It will be seen by these figures that already there has been a certain admixture of white with Polynesian blood. Population: Maoris; Chinese.

The proportion of sexes was, among Europeans, males 531,910, females 476,558. Among Maoris and half-castes living as Maoris the proportion was 26,475 males and 23,369 females. The males were still more dominant amongst the Chinese, for out of the 2,620 Chinese, only 88 were females. The Chinese rarely intermarry with any race save their own, and the aim of the Chinese is to return to their native country after they have made a small competence.

Forming part of the territory of the Dominion of New Zealand and situated in the Pacific Ocean are the Cook Islands which include the Cook Group proper (Rarotonga, Mangaia, Mauki, Atiu, Aitutaki, and Mitiero), the Hervey Islands, Palmerston, Niué, Danger, Rakaanga, Manahiki, Penrhyn, Suwarrow, Pukapuka, Motukoe, Motukauta, and Nassau. These islands lie far apart, for from Penrhyn in the north to Mangaia in the south the distance is about 800 miles, and from Maui in the east to Niué in the west the distance is about the same. Rarotonga, called the 'gem of the Pacific', is the main island, and there is the seat of government. Small islands of the Dominion.

The population of these islands is Polynesian. In physical appearance, in language, and in customs these islanders differ little from the Maoris; and some Maori tribes trace their descent from the same ancestors as do the inhabitants of Rarotonga. The total population of the islands at the census of 1911 was 12,340, the white population being 161. There are some half-castes, but they have not been separately enumerated.

European population of the Dominion.

The white, or as they are more frequently called, the European population of New Zealand, have been drawn almost wholly from the United Kingdom. The census of 1911 will give a fair estimate of the origin of the white people in the Dominion:

British-born numbered	988,118
Foreign-born	19,571
Unspecified	779
	1,008,468

The greater number of the foreign subjects came from Europe. The numbers born in Europe, Asia, Africa, and America, out of the total of foreign-born persons were:

From Europe	14,368
„ Asia	3,042
„ Africa	92
„ America (mainly United States)	2,069

There are a few who bear foreign names, and some whose birthplaces are not specified. Of those born in Europe, the largest number are Germans (4,015); then come Norwegians and Swedes (2,862), Danes (2,262), Austrian-Hungarians—mainly Dalmatians—(2,131). There are only 467 from France and French possessions. There are 1,400 citizens of the United States of America settled in the Dominion.

Of the people from the United Kingdom, about half are of English descent, about one-quarter of Scottish descent, and somewhat less than a quarter of Irish descent. Intermarriages of these various nationalities are of frequent occurrence, though recent Papal decrees may in some instances discourage or prevent marital

unions between Irish Roman Catholics and their Protestant fellow settlers.

Throughout New Zealand one point in this connexion must strike the observer—that those born in New Zealand become intensely patriotic New Zealanders and imperialists. This is the case not only with those whose ancestors come from the United Kingdom, but also with those whose parents come from the continent of Europe. Young New Zealanders of German, Norse, or other foreign origin rarely know the language of their parents. National sentiment.

The population of the Dominion is gradually increasing, as the result of the four last censuses will show: (1896) 703,360; (1901) 772,719; (1906) 888,578; (1911) 1,008,468. This increase is made up of an excess of births over deaths, and of immigration over emigration. The excess of births over deaths was 16,820 in 1911, and of immigration over emigration, 4,200—in all, an increase of 21,020. Growth of population.

The Maoris[1]

In the account of the people of New Zealand reference has been made to the Maoris, the native race whom the first known European explorers found in occupation of the islands. The Maoris are an offshoot, or rather a branch, of the Polynesian people who are found scattered throughout the islands of the Pacific Ocean eastward of Fiji. As a race, physically, morally, and intellectually, they take a high place among the coloured people of the world. In feature they approach nearest to the Caucasians, but are somewhat flatter in the nose and fuller in the lips, while among the Maori aristocracy many show traces of negroid admixture, and a distinct Semitic cast of countenance is not uncommon. They are sturdily built, of medium height, strong-limbed, and well proportioned, their colour ranging from a dark brown to a light olive. Their eyes are dark brown or black and their hair usually of similar colouring and either straight or wavy. Physical characteristics.

[1] [See, among other works, J. C. Andersen, *Maori Life in Ao-Tea*, London, 1907.]

There are instances of individuals with reddish hair and very light complexion, which some ethnologists accept as evidence of the former existence of a white race, of whom Maori fables speak as being in occupation of New Zealand, when the Maori first set foot in the country. It is much more probable, however, that this phenomenon is a recrudescence of some alien blood which has been assimilated by the race in their wanderings.

The Morioris.

The only inhabitants known to have been in occupation of New Zealand before the arrival of the Maori were the Morioris. There are no living descendants of this primitive people in New Zealand proper, but a few survive in the Chatham Islands, which are situated some 500 miles to the eastward and to which the remnants of the people retreated before the advance of the invading Maoris. The Morioris are Polynesians, descendants of stray voyagers who visited and settled in New Zealand long antecedent to the arrival of the Maori in the Great Migration.

The Great Migration.

In speaking of the Great Migration reference is made to the colonization of New Zealand by the present Maori population about 1350 A.D. The traditions of the Maori race speak of visits to New Zealand many hundreds of years before that date, when the race was gradually establishing itself in the Pacific, but in that year, owing to internal feuds in Tahiti and the adjacent islands, certain tribes defeated in the struggle embarked in a fleet of canoes and set out for New Zealand. The main fleet consisted of six canoes named Tainui, Tokomaru, Te Arawa, Kurahaupo, Matatua, and Takitimu, while two others, the Aotea and the Mamari, arrived from different islands about the same time. On sighting New Zealand the fleet dispersed along the coast, the crew of each canoe choosing a landing-place where the aspect of the country seemed to indicate fertility and to promise future prosperity. Most of the tribes existing in New Zealand at the present time trace their descent from these island Polynesians.

Origin of the Maoris.

There has been much speculation, and many theories have been advanced, concerning the origin of the Polynesian

race. It has even been suggested that the Maoris are of Semitic origin, and that the cradle of the race was Arabia, but apart from an occasional Semitic cast of features there is no evidence to support such a theory. At the present day there is no agreement as to the exact location of the homeland of the Maoris. The most popular hypothesis, however, is that the race was originally domiciled in India and was either Aryan or had come largely into contact with the Aryans. Traces of this contact are to be found in the customs and beliefs of the people, and in their language. Another suggestion is that the present islands of the Pacific are the last vestiges of an immense continent which in prehistoric times was peopled by a race from whom the present islanders are descended, but it is more probable that if such a continent ever existed—and geologists are not satisfied that it did—its inhabitants vanished with it, and the present natives spread eastwards from India long after its disappearance, compelled by the advance of a more virile and warlike race. (See Fig. 59, p. 281.)

Present condition of Maori population.

It is impossible in a brief survey like the present to give a detailed account of the ancient customs of the Maoris. It must suffice to state that the division of labour between the sexes, the superstitions and beliefs of the people, did not differ to any great extent, except so far as such differences are the outcome or result of a variance in environment, from those of other primitive peoples in the same stage of civilization. What is of importance, however, is some reference to their present condition. As has already been stated, the present Maori population, inclusive of half-castes living as Maoris, is just under 50,000. The greater number of these are distributed over the North Island of New Zealand, and mainly in the centre and northern portions of that island. The number of Maoris in the South Island is not numerically great, the main centres of population being the Bluff, Otago Heads, and Kaiapoi near Christchurch.

Decay of the race,

The Maori of the present day has suffered much from his adoption of many of the vices of European civilization.

Being of a careless and thriftless disposition he resists but weakly the insidious evils of drink and gambling, and his slothfulness and dislike for anything in the nature of persistent work has weakened him physically and mentally, and allowed disease, both moral and physical, to lay its devastating hand upon him. The great difficulty in the way of regeneration and preservation of the Maoris is the fact that those who choose to live in the old way do not find it difficult to obtain the means of livelihood, while those who have become Europeanized depend not upon their own labours but upon rents derived from native lands leased to Europeans. The problem of how best to utilize the lands still owned by the Maoris whilst at the same time making adequate provision for those dependent upon the revenue derived from such lands, is not easy of solution, and is a matter for practical politics ; and it would be out of place here to detail and criticize the divergent views on the question held by New Zealand statesmen. The European population is increasing, and with it increases the ever-present demand for more land for settlement, and step by step the hold of the Maoris upon their land is weakening. Much valuable pastoral land is at present held by them in an undeveloped state, and it is not to be expected that a race which, until the advent of the white man, subsisted by hunting and fishing, whose main occupation was war and whose knowledge of tillage was scant and crude, can be made a pastoral or agricultural people in less than a century. The early settlers, intent upon their own advancement, made little or no effort to train the Maoris as agriculturists, and the wonder is that they have shown such promise in this connexion.

and efforts towards its regeneration.

Some of the younger generation of the Maoris recognize that some valiant effort must be made if the decay of their race is to be arrested. Many of these reformers are highly educated, and their endeavour, by both example and precept, is to instil into their people the need of work as a means of regeneration, and the necessity of casting aside the beliefs and customs of their ancestors, and

adopting modern sanitation and medical science for the prevention of disease. As a result of this campaign many areas of native land, especially near the East Cape, north of the Poverty Bay district, are now being worked by the natives, and not in a primitive way, but successfully by modern scientific methods. In many instances the most recent agricultural machinery is utilized, and intelligently utilized.

It is recognized that it is only by the younger Maoris that regeneration can be accomplished. The old fighting stock has all but died out, and with it have disappeared the old conditions of life and the need for the warlike exercises which in the past kept the race strong and vigorous ; and it remains for their descendants to change the old ideal and aspiration of attaining fame and pre-eminence as warriors, for the more difficult and practical ideal of race-preservation by becoming the tillers of their native soil.

Government

The government of New Zealand is similar to that of other parts of the Empire where there is representative government. There is a Governor appointed by the Sovereign, who acts as the ' Royal Instructions ' and the statutes of New Zealand direct him. There is now little authority left to Royal Instructions. The Governor's term of office is supposed to be seven years, but it is rare for a Governor to continue in office for such a period. Several have been, however, over six years in office.

General Assembly.

The General Assembly—this is the collective name for the legislature—consists of the Governor, the Legislative Council, and the House of Representatives. The statutes of New Zealand are enacted in this form, viz. ' Be it enacted by the General Assembly of New Zealand.' In many colonies the terms used are different. In the state of Victoria the phrase used is, ' Be it enacted by the King's most Excellent Majesty by and with the advice of the Legislative Council and the Legislative Assembly of Victoria in Parliament assembled,' &c., and in New South

Wales, Queensland, and Western Australia a similar phraseology is used. In South Australia, however, it is, 'Be it enacted by the Governor of the Province of South Australia with the advice and consent of the Legislative Council and House of Assembly of the said Province in this present Parliament assembled.' Though the words of the enacting clause differ, the practice is the same. The Governor may suggest laws and may forward back Bills to either House for amendment. Bills—save money or trade Bills which may be introduced only in the House of Representatives by message from the Governor—may be introduced in either House.

Legislative Council.

The members of the Legislative Council are appointed by the Governor on the recommendation of Ministers, and save those appointed before September 17, 1891, are appointed for seven years. From the inauguration of the Constitution in 1854 up to the time of the passing of the Legislative Act, 1891, the appointment of a councillor was a life appointment. There are at present in the Legislative Council seven members who hold the life tenure. There is no limit to the number of members, but in practice it is usual to have a Council of about half the number of the House of Representatives. At present there are thirty-three members. An attempt was made in a recent session of Parliament to make the members elective, but the Bill was defeated in the Council. The only qualifications of a member are that he be a male, of 21 years of age or over, and a subject of the King. Any such person is disqualified who is an undischarged bankrupt, or who has been attainted or convicted of any treason, any crime formerly known as felony, or any infamous offence, or as a public defaulter, unless he has received a free pardon or has undergone the punishment adjudged to him in respect thereof; or who is a member of the House of Representatives or a contractor with the Crown or a Civil Servant or within the six months next preceding his appointment was a Civil Servant.

House of Representatives.

The House of Representatives consists of 80 members, 76 elected by constituencies termed European electorates,

and four elected by Maori electorates. The colony is divided into 76 electorates. All the constituencies are therefore single-membered electorates. The Maoris are not entitled to be registered on the rolls of the ordinary electorates. Of the four Maori electorates, three are situated in the North Island and one in the South. Maori or half-caste Maoris are eligible to be elected by the Maori electors. All male and female adults are entitled to registration on the electoral roll of their district provided they have been one year in New Zealand, and for the three months immediately preceding the claim for registration have resided in the district. No person can be registered in more than one district. Any male person on a roll of any electorate is eligible to be elected a member of the House, subject to the same disqualifications that have been mentioned in connexion with the appointment of the members of the Legislative Council.

The members of the Council and of the House of Representatives are paid for their services, the former receiving £200 and the latter £300 per annum by equal monthly payments.

Executive.

The Executive consists of eight paid Ministers who are *ex officio* members of the Executive Council. There may be ten members of the Executive Council who are members of Parliament, but not more than eight of these can be of European descent. If ten are appointed, two must be Maoris or half-castes. One Minister may hold more than one portfolio, he may administer more than one department. The following are titles of the Ministers, and these titles will indicate the various departments into which the administration is divided: Prime Minister, Minister of Finance, Minister of Internal Affairs, Postmaster-General, Minister of Lands, Commissioner of State Forests, Native Minister, Minister of Stamps, Minister of Railways, Minister of Marine, Minister of Labour, Minister of Education, Minister of Immigration, Minister of Customs, Attorney-General, Minister of Justice, Minister of Public Works, Minister of Industries and Commerce, Minister of Mines, Minister of Public Health, Minister of Agriculture.

Ministers are each furnished with a house in Wellington, or, in lieu thereof, a house allowance.

The Governor.

The mode of government, as has been said, is representative. The Governor acts like a limited monarch, only on the advice of his Ministers. In cases where imperial interests are directly in issue, he is accustomed to take the advice of the Secretary of State for the Colonies, but in all other matters, save perhaps when dealing with prisoners sentenced to capital punishment, he follows the advice of his advisors. If he does not accept their advice he may of course call in the aid of other advisors and dismiss his Ministry. The refusal of a Governor to assent to a Bill passed by both Houses is unknown. In a few instances he has to refer Bills to the Crown for assent, such as Bills dealing with shipping, with divorce, or with purely imperial matters. The Speakers of both bodies are elected by the members of their respective Houses.

Duration of Parliament.

The term of a Parliament is three years, and at the end of every three years there must therefore be a general election of the members of the House of Representatives. Since the triennial Parliament Act was enacted in 1879, the Parliament, except in the case of the eighth Parliament which lasted some months short of the three years—the Executive having been defeated and having obtained a dissolution—there has been no dissolution until Parliament has performed its allotted legislative functions, holding a session in each of the three successive years.

Local government.

Local government extends throughout the Dominion. In the country districts there are counties, road districts, and town board districts, each with its own governing body; while towns and cities have a special municipal government. The towns and cities are called boroughs, and are governed by mayors and councillors. There are 118 counties, 286 road districts, 54 town districts, and 111 boroughs, including in these boroughs the five cities. These different local governments have the management of roads, drainage, sanitation, and many other local affairs committed to their charge. In boroughs the local administration may perform many

functions not entrusted to county councils or road boards, such as the supply of gas and water, the running of trams, the supply of electric power for lighting and manufacturing purposes, the establishment of public libraries, of museums, of public theatres, of concert halls, the maintaining of ferry services, fire prevention stations, baths, abattoirs, pleasure and recreation grounds, gardens, gymnasiums, recreation facilities, mechanics' and youths' institutes, public weighing machines, rifle ranges, agricultural and other special schools, wharves, jetties, and provide for the inspection of buildings, of milk, of dairies, and other matters essential to good municipal management. In fact, the jurisdiction of a borough council is so extensive that almost nothing of a public nature is free from its interference or control. County Councils and road boards and also town district boards have very complete local power, though not so extensive as those of borough councils. A town district is really a village area cut out of a county. In addition to these main or general local governing bodies, there are many other special institutions for the execution of special local government works, such as boards for harbours, for drainage, for recreation reserves, and for cemeteries. The number of local government institutions is large, and the efforts made to limit their number and so prevent overlapping, and to make their constitution symmetrical, have so far proved abortive.

Charities.

The sick and the poor are cared for by hospital and charitable aid boards, and by private institutions. There are 36 hospital districts, each having a hospital and charitable aid board. There are 56 public hospitals, several of which are small cottage hospitals in sparsely populated districts. Charitable aid is given to those destitute and unable to earn sufficient for their maintenance in two ways—(1) there are homes called either benevolent institutions or old men's homes or refuges; (2) outdoor relief in various forms is given. No one has of right any claim to charitable aid. There is not the elaborate settlement law which exists in the United

Kingdom under the poor law of Britain, but if any one is aided in a district before he has been in the district for one year immediately prior to the relief granted, the board that grants the relief may recover from the board in whose district the person relieved last resided for a period of two years at any time before the granting of that relief, but a board is not responsible if the person relieved had not at any time during the five years immediately preceding the grant resided in its district. The grant of relief is deemed a debt due by the person relieved; if received from a public institution, due to the Crown, and if from a charitable institution, due to the trustees of that institution.

Old Age Pensions.

Closely connected with the aid to the needy is the granting of Old Age and Widows' Pensions. The Old Age Pension Scheme has been in operation since 1898, and has been maintained up to the present with slight modifications. The full amount of the pension is £26 a year, payable by monthly instalments. A stipendiary magistrate decides upon the right of a person to receive the pension. Those eligible are persons (*a*) who are of 65 years of age or over; (*b*) who have resided in New Zealand for 25 years before applying for the pension, and have not been absent for more than 2 years at a time, or beyond 4 years during the 25 years, and (*c*) who have not during the past 12 years been imprisoned for 4 months, or on 4 occasions for an offence punishable by 12 months' imprisonment or more, and have not been imprisoned for any offence for 5 years or over; (*d*) who have not, if males, during the past 12 years deserted their wives or children; (*e*) who have lived a sober and reputable life during the year preceding the application; (*f*) who have not an income of £60 a year; (*g*) who have not property of the total value of £260; (*h*) who have not disposed of their property so as to be able to claim the pension. The following are denied pensions—(1) aliens; (2) naturalized subjects who have not been such for over a year; (3) Chinese or other Asiatics; (4) Maoris who receive pensions under a special provision in the Civil List

Act. The total number of persons over 65 years of age who had been 25 years in the Dominion was estimated, on March 31, 1912, to be 42,772 Europeans. The number of pensioners on the roll was 15,984 Europeans and 665 Maoris ; the number who drew the full pension was 14,209, and the total amount expended by the department for the financial year ending March 31, 1912, was £406,255. This is a large amount to pay, but the expenditure for poor relief or, as it is termed in New Zealand, charitable aid, has been much reduced since the Pensions Act came into force. In 1899 it was over £50,000 ; it is now about £33,000.

Widows' pensions.

In 1911 the Widows' Pension Act was passed, and it came into force on January 1, 1912. It authorizes the payment of pensions to widows in indigent circumstances who have legitimate children under 14 years of age dependent upon them. The scale of payment is (*a*) for one child £12 per year ; (*b*) for two children £18 ; (*c*) for three children £24 ; (*d*) if more than three children £30. The pension is subject to reduction of £1 for every £1 by which the annual income defined exceeds the sum of £30. Income is defined as meaning income from all sources (other than personal earnings and the pension under the Act, not exceeding £100) for the year ending one month before the commencement of the pension year. The children must have been born in New Zealand, and the mother must have been resident in New Zealand for at least six months before the birth of any child for whom a claim is made. The pension is not given to aliens nor to Chinese or other Asiatics.

Government business enterprises.

The Government carries on many business concerns. It is the owner of the railways, which are referred to in the section on communications. It erects and manages lighthouses ; it has post office savings banks everywhere. One of its successful businesses is the Public Trust Office, which has been in operation since 1872. That office has about £5,000,000 of cash on trust. This included about £2,000,000 of sinking funds belonging to various governmental authorities or bodies, and about

£1,250,000 of private trust funds under wills, deeds of trusts, and intestate estates. It has in its custody over 6,000 wills of living persons, in all of which the Public Trustee is nominated as the executor, and over 6,500 private estates are under its management. The Life Insurance Department, which has been in existence since 1869, is another successful Government enterprise. In addition to life insurance, there are two other classes of insurance also under the management of a Government department, namely, fire insurance and accident insurance.

The State owns and works two separate coal-mines. Part of the output is used on Government railways and part sold to private persons or to shipping companies. The mines have not yet returned a commercial profit, but it is claimed that the result of the State's incursion into this field of activity has been the reduction in the price of coal to consumers.

Police. The police are under the control of the general government. There are no local police, and none of the local bodies contributes any share of the cost of the maintenance of the force. This has been the rule in all the Australasian colonies. In addition to the regular force there are a few constables in outside or native districts called district constables, but the whole of their time is not devoted to police duties.

Defence. Internal defence has been, or perhaps it may be more truthfully said, is being provided for. The new scheme is hardly yet complete. The Defence Act passed in 1909 provided for the creation of a new Defence Force. From the earliest days of the Colony the need of compulsory service was recognized, and a scheme of service was established. By the Militia Act of 1845 every one between the ages of 18 and 60 was compelled to be a militiaman. The Defence Act of 1909, with some slight amendments since made, provides that the Dominion may be divided into districts, and in these districts two forces are to be established, a permanent force and a territorial force. The service in the Permanent Force is for eight years, and in emergencies it is to assist the

police. After the end of the first five years' service every member is enrolled into the Reserve, though he may be allowed to continue on active service. There is provision that any member may, during the first three years, retire from the service on paying £10; after the first three years and during the next two years, on paying £5, and after five years he may get his discharge without payment. This permanent force has been in existence for many years, and the Defence Act simply continued the old system.

The militia. The Territorial Force system dispenses with both the militia and the volunteers. Under the oldest Militia Act (1845) every man if a British subject, save judges of the court, members of parliament, and ministers of religion, between the age of 18 years and 60 was liable to be called as a militiaman and to be trained for 28 days every year. Every militiaman was liable to be called out on active service. If he failed to obey the call, and was not labouring under any incapacity such as illness, he was liable to be apprehended and treated as a deserter from the ranks. The militia, while being trained, or on active service, were under the articles of war. The militia are still liable to be called out under the new scheme and to take their place as part of the defence forces, but the exemptions from service under the new scheme are more extensive than existed under the Militia Act of 1845. Various high officials in the Civil Service, medical practitioners in practice, teachers of schools engaged in teaching, and many others are now exempt, and only persons between the ages of 17 and 55 are now liable for service.

Liability to training. The obligation to be trained under the compulsory service provisions is universal. All male inhabitants who have resided in the Dominion for 6 months and are British subjects are liable to be trained (*a*) from 12 to 14 years of age, or to the date of leaving school, whichever is the later date, as junior cadets; (*b*) from 14 years of age or from the date of leaving school, as the case may be, to 18 years of age, or, in the case of those who attaining 18 years are attending a secondary school, then to the date

of their leaving the secondary school, as senior cadets ; (*c*) from 18 years of age, or from any later date at which they cease to attend any secondary school, to 25 years of age, in the general training section ; and (*d*) from 25 years of age to 30 years of age in the Reserve. Provision is also made for incorporating the Scout movement, which has become popular in many parts of the country, in the general training of youths. This universal training system has been approved of almost unanimously. A few anti-militarists (their number is small) who mainly reside in the large towns, and mainly belong to a class of socialists, have raised some objection. As against this, there is an enthusiasm for military training throughout the Dominion. There are, however, a few conscientious objectors, and the authorities have endeavoured to meet their objections by providing that they may serve in ambulance corps instead of in the fighting units.[1]

Judicature.

There are four kinds of ordinary judicial tribunals in the Dominion, and there are two that may be called extraordinary. (1) The Justices of the Peace Court. The Justices deal with petty offences and investigate serious offences, committing persons accused of the latter offences for trial to the Supreme Court, if it is thought there is sufficient evidence to warrant such a procedure. If the court is of opinion that the evidence is insufficient the charge against the accused is dismissed. (2) The Magistrate's Court. This is a civil court ; its jurisdiction is classed under three heads : (*a*) ordinary, (*b*) extended, (*c*) special. The ordinary jurisdiction includes breach of contract or tort where the amount claimed does not exceed £100. There is, however, no jurisdiction to hear claims for libel, slander, false imprisonment, illegal arrest, malicious prosecution or seduction, nor can a suit be brought for breach of promise of marriage. Debt up to £100 can be sued for, and so also can the unliquidated balance of a partnership account provided the amount is within that limit. There may be recovery of tenements

[1] Particulars of the personnel of the military forces will be found in Chapter XV, where the problem of Naval Defence is also considered.

if the rental does not exceed £105 per annum. Another civil jurisdiction conferred is the issue of writs of arrest, to hold debtors to bail who are about to quit New Zealand. (*b*) The extended jurisdiction allows the court to hear all cases that can be heard in the ordinary jurisdiction where the amount claimed does not exceed £200. In the case of a suit for the recovery of tenements, where the rental does not exceed £200, this extended jurisdiction is conferred on all the magistrates who hold courts in the larger towns. The special jurisdiction provided for in the Magistrate's Court Statute has not been granted to any magistrate. The magistrates are stipendiary, and there are thirty-two in office. The magistrates also perform most of the criminal work done in the Justices of the Peace Court. There are, however, large numbers of honorary justices, and many of them take part in the administration of justice in the Justices' Court.

(3) The Supreme Court and its Judges have the same jurisdiction as the High Court in England and its Judges, and in the words of the statute—'All judicial jurisdiction which may be necessary to administer the laws of New Zealand.' There are seven Judges of the Supreme Court, but one of them is Judge of the Industrial Arbitration Court, and his time is mainly occupied with the duties of that court.

(4) The Court of Appeal has the function of hearing appeals from all the decisions of the Supreme Court in civil cases, save when the Supreme Court sits as a Court of Appeal from the decision of an inferior court, when there is no appeal from its decision without special leave. In criminal cases there is a limited right of appeal. The Judges of the Supreme Court are *ex officio* the Judges of the Appeal Court, and two form a quorum.

Procedure and practitioners.

The procedure of the Supreme Court has been codified and is much simpler than the procedure of the High Courts of England, although the compilers of the Code took as their guide and foundation the procedure of the English courts. A statement of claim is filed with a writ of summons, and that is the commencement of an action. A statement of defence must be filed within a limited time

if the defendant desires to deny the plaintiff's claim. If a question of law arises it may be argued on a special case. There are no demurrers. The costs awarded are in accordance with a fixed scale, and are calculated on a percentage system, following in some respects the code of civil procedure of New York. There are two kinds of practitioners, barristers and solicitors, but a barrister may act as a solicitor. Both are admitted on examination only. The examination has to be in general knowledge as well as in law, and no candidate can pass unless he has a knowledge of Latin. The law examination is severe, and is equal in the case of barristers so far as law is concerned to what is required of a Bachelor of Laws in the University. The majority of the law students attend the University College, and a large number of those recently admitted have obtained the degree of Bachelor of Laws. No one can obtain that degree under four years' study. Women as well as men are eligible for the office of both barrister and solicitor, and several women have been admitted as barristers and solicitors.

Special courts.

In addition to the tribunals enumerated, there are two special courts, the Native Land Court and the Industrial Arbitration Court. The former has exclusive jurisdiction to investigate the titles of the Maoris to their land, to partition such land, to grant probate of Maori wills, to appoint successors to Maoris, whether there is a will or not. The administration of this Court is in accordance with Maori law or custom. In ordinary criminal or civil matters, the Maoris are under the jurisdiction of the ordinary tribunals. The Industrial Arbitration Court deals with disputes between employers and employees and also with claims under the Workers' Compensation Act; fuller reference is made to its functions in the section dealing with labour.

Certain of the magistrates are, in addition to their ordinary duties, appointed 'Wardens'—that is, Judges of a Warden's Court which has exclusive jurisdiction in litigation relating to gold-mining, and as to disputes between miners.

The Supreme Court and Magistrate's Court have jurisdiction, according to the amount claimed, to settle claims for compensation made by owners of land, for land taken for public purposes, by the general Government, or by a local body, or for land injuriously affected by any public work. These courts when constituted are called Compensation Courts, and the judicial officers are either a judge or a magistrate, as the case may be, and two assessors, one appointed by the claimant and one by the respondent.

Children's Court.

The hearing of charges against juvenile offenders—that is, persons under the age of 16 years, is taken in private by a magistrate, and the court is called the Children's Court. Special provisions are enacted to secure the attendance of the parent of the child or of representatives of any institution that interests itself in the care of children. It is not necessary for a magistrate, even if a charge is proved against a juvenile offender, to enter a conviction. He may admonish him or order his parents to pay any costs or damages sustained through his offence.

First offenders' probation.

Besides the sentencing of persons convicted of criminal offences to varying terms of imprisonment or the payment of fines, there are three methods of dealing with such persons: (1) the grant of probation to first offenders; (2) the sentencing of youthful or other transgressors to reformative treatment; (3) the declaring of hardened criminals to be habituals.

The First Offenders Probation Act was first passed in 1886, and its results have been very successful. About 86 per cent. of those dealt with under its provisions have not been charged with any further offence. Probation may be given to a first offender—that is, to a person who has not been previously convicted, and whose previous character has been good. It cannot be granted if the person is convicted of certain crimes, namely, murder, attempted murder, burglary, coining, corrosive fluid throwing, demanding money with menaces, extortion of money by threats of accusation of any crime, placing an explosive substance to endanger life or property, rape, or robbery with

actual violence. Nor can it be granted if the offence, whatever its nature, is attended by irreparable or serious consequences, or endangers human life, or is such an offence as shows an established criminal intention on the part of the prisoner. The term of the probation cannot exceed three years. The probationer is subject to certain conditions imposed by statute, and also is subject to such other special conditions as the court may impose. The statutory conditions are, shortly, these: (*a*) he must report himself, where directed, within twenty-four hours of liberation; (*b*) he must thereafter report himself in person once a month where directed; (*c*) he must reside, that is, sleep, at an address notified; (*d*) he must, if he leaves that address, give prior notification to the probation officer, and if he removes to the district of another probation officer, give him notice of his new address; (*e*) he must earn his living by honest means, and at a place and with a person approved of by the probation officer; (*f*) he must produce his probation licence whenever requested to do so by any constable. Various conditions have been further imposed by courts, such as: prohibiting the indulgence in alcohol or the visiting of any place where intoxicating liquors are for sale; restricting the offender to the hours in which he may go abroad—for example, he shall not be out of his residence after six p.m.; prohibiting the offender, if a youth, from the use of tobacco; ordering him to pay the costs of the prosecution and the expenses of the witnesses, and sometimes, in the case of theft, to make good the value of the articles he has stolen. If the offender obeys the conditions, he is deemed to have served a sentence. If he fails to obey the conditions he may be arrested and sentenced to imprisonment for the offence he committed.

Reformatory system.

The reformatory system was inaugurated in 1910. In addition to or in substitution for a sentence for a crime, a detention for reformatory treatment may be ordered. The term that may be imposed must not in the case of a person dealt with by the Supreme Court exceed ten years, and in the case dealt with by a magistrate, it must

not exceed three years. There is a right of appeal to the Supreme Court against any order for detention by a magistrate, on the ground that the term is excessive. Though a term is imposed by the Supreme Court, or a magistrate, the person so sentenced may be released on probation in a way that will be later explained.

Habitual criminal system.

The Statute allowing a Court to declare an offender an habitual criminal was passed in 1906. Any prisoner convicted twice previously of any sexual offence, or of abortion (class i), may, on conviction of any other offence of a similar nature, be declared an habitual criminal. If a prisoner has been at least on four occasions convicted of any sexual offence or of abortion, or of any of the offences included in class ii, which are the offences of wounding, robbery, burglary, house-breaking, theft, false pretences, extortion, forgery, or mischief, or of any of them, he may be declared an habitual criminal on conviction of any offence in class ii. This declaration does not affect the power of the court to sentence an offender for any term of imprisonment. Usually a sentence of imprisonment is given, and the declaration made as an addendum to the sentence. To deal with the cases of offenders sentenced to reformatory treatment, and also with those declared habitual criminals, a Prison Board is constituted. This board meets at least four times a year, and consists of a Judge of the Supreme Court who is President of the Board, two civil servants, namely, the Inspector of Prisons and the Under-Secretary of Justice, and four gentlemen unconnected with the Government service. The board has been in existence since February, 1911. The board can recommend to the Government the release of any prisoner sentenced to reformatory treatment or declared an habitual criminal, if the head sentence, as it is called, that is, the sentence of ordinary imprisonment, has been served. The functions of the board are numerous, but their main duty is to inquire whether a prisoner has shown signs of reformation ; if he has, the board can recommend his discharge or release on probation. When a prisoner detained for reformative treat-

ment or an habitual criminal is released on probation, similar conditions are imposed as on the grant of probation under the First Offenders Act. If the conditions are broken, the prisoner is re-arrested and sent back to prison. This has happened in some instances. Habitual criminals, after serving their 'head' sentence, are almost all confined in a special prison, at New Plymouth, and certain privileges are granted to them.

Reformatory schools.

The Government have also established reformatory schools for youths. Three farms are in operation for this purpose. The inmates are not necessarily children who have been convicted of any offence. Neglected children and those not under proper parental control can be placed in such schools. The Roman Catholic Church has similar schools, and aid is given to the Roman Catholic body in accordance with the number of children who have been committed to those institutions by magistrates.

Prison system.

Another department that is wholly under the control of the general government is that in charge of the prisons. There are no prisons under any local body, and the total cost of maintenance of prisons and prisoners is paid by the general government without any contribution from any local body. There are ten prison establishments. The main prisons are at Auckland, Wellington, New Plymouth, Lyttelton, Dunedin, and Invercargill. Special prison establishments known as 'tree-planting camps' are maintained at Waipa, Waiotapu, and Hanmer, in which prisoners are employed in forest tree planting. To Waipa are sent prisoners who have not been imprisoned before. The camps of Waipa and Waiotapu are only a few miles apart. The work already done by the prisoners in these localities has been the clearing of the land for afforestation, the preparation of pits for the reception of trees, and the planting and re-planting of trees where necessary. The trees planted have been mainly the common larch, Corsican pine, some gums, and two or three varieties of pines. There is a Government nursery, where trees are prepared for transplantation, at Whakarewarewa, some few miles from the Waipa and Waiotapu camps, and there is also

a nursery near Hanmer that supplies the Hanmer plantation. The prisoners live mostly in the open air, and the effect of the life they lead is shown by their robust physical health. They have small cubicles built of wood in which they live, and at each camp there are gardens which supply them with the best of vegetables and with flowers. Their work has been of great commercial value. If their work had been done by free labour the cost would have far exceeded the amount paid for keeping the prisoners and paying the prison warders. A large farm at Waikeria has also been established, to be wholly worked by prison labour. It is 1,200 acres in extent, and adjoins a large reserve that has been set aside for a mental hospital.

Restrictive social legislation.

New Zealand has made and is ever making social experiments. Some of the social evils that afflict all nations have been attacked. The use of opium, alcohol, and tobacco is in some ways restricted. There have been made many other attempts to improve the social life. The manner in which the legislature has dealt with some of the social problems may be briefly considered.

Opium in any form suitable for smoking cannot be imported, nor can it be imported without the permission of the Minister of Customs in a state capable of preparation for smoking. To sell any preparation of opium that may be made suitable for smoking is an offence. The law goes further and enacts that any person found smoking opium even in his own house, or who permits or abets the smoking of opium, is liable to a penalty, and private houses may be searched on warrant to ascertain if opium is being smoked therein.

Licensing legislation.

The restriction of the sale of alcohol is imposed in the licensing legislation. No one can sell alcohol in any form unless the holder of a licence. The Dominion is divided into licensing districts: every country electorate is a licensing district, and in each of the four chief cities, Auckland, Wellington, Christchurch, and Dunedin, the city electorates are united and make one licensing electorate. Once in every three years, on the same day as the general election of the members of the House of Represen-

tatives is held, a local option poll is taken. Every elector on the general election roll is entitled to vote. In districts where licences exist, the elector is given two ballot papers. The first contains two lines, one, 'I vote for continuance,' the other, 'I vote for no-licence.' If the voter wishes no-licence to be carried he strikes out the top line; if he is in favour of maintaining the existing conditions, he strikes out the bottom line. The other ballot-paper permits a vote on national prohibition, by which is meant the prohibition of the manufacture or importation of alcohol save under regulations issued by the Governor for medicinal, manufacturing, or religious purposes. The wording on this paper is, (1) 'I vote against national prohibition'; (2) 'I vote for national prohibition.' If the district is one where no-licence is in force, the first ballot is in this form—(1) 'I vote for local restoration,' and (2) 'I vote for local no-licence.' The voter in all cases strikes out the proposition he does not wish to see carried. The licensing vote is not decided by a bare majority. To carry no-licence, local restoration, or national prohibition, there must be in favour of the proposal not less than three-fifths of all the votes recorded.

In each licensing district there is a Licensing Committee consisting of the Stipendiary Magistrate of the district, who is the chairman, and five elected persons. Any elector is qualified to be a candidate. In a no-licensed district there is no committee.

Since the first inauguration of the local option poll there has been a gradual increase in the no-licence vote, as the following figures will show: For no-licence in 1896, 98,312 votes; in 1899, 118,575; in 1902, 151,524; in 1905, 198,768; in 1908, 221,471; in 1911, 234,566. The vote for continuance was below the vote for no-licence in 1905 and 1908. In 1911 the issue of national prohibition was put for the first time. This tended to weaken the local option issue, many voting for national prohibition in preference to local no-licence as a more logical solution of the liquor question. The total number who voted for national prohibition was 259,943, and against, 205,661.

There was therefore an actual majority of 54,282 for national prohibition. As a three-fifths majority was required, the proposal was defeated. It will be seen from the figures given, however, that there is a strong temperance sentiment in the country, and perhaps as the result of this feeling the amount of alcohol consumed per head is about one-third of the quantity consumed per head in the United Kingdom. There are twelve no-licence districts, and in no instance where a district has voted no-licence has the vote been reversed. There has been a marked decrease of crime and an improvement in the welfare of the people in those districts where no-licence is in operation.

Legislation on tobacco-smoking.

The legislature has restricted the use of tobacco by youths under the age of 15 years, and has made it an offence for any person to sell cigarettes, cigars, or tobacco in any form to such youths. Smoking by a youth in a public place of a cigar, cigarette, or tobacco, is an offence, and renders him liable to conviction for a first offence and for a second or any subsequent offence to a fine, but no imprisonment can be ordered. The only exemption is in the case of a youth who has a certificate from a duly qualified medical practitioner to the effect that smoking tobacco is beneficial for his health.

Finance.

The financial position of the country may be ascertained in many ways. What is the wealth of the inhabitants? What is the debt due by the Government? These are all relevant questions to ascertain the true financial position. There are many more that may be put, but if these are answered, a fair opinion can be formed of the financial strength of the Dominion.

National wealth.

The value of landed property, the amounts on deposit in banks and building societies, and the income of the community will enable the first question to be answered. There is a Government valuation of land, which forms the basis of taxation, and it may be assumed that the taxpayers do not consent to an over-valuation of land without protest, but in such a case avail themselves of the right of appeal against the assessment of the Government

valuers. The value of the private lands, according to this valuation, may be taken to exceed the round figure of £293,000,000. This sum is made up of £184,000,000, being the unimproved value of the land, and £109,000,000, being the improvements on such land. The capital value, adding both these items together, is fixed by what the lands would sell for in open market for cash. There is no valuation of personal property, such as goods, machinery, sheep, cattle, and other movables, and it is therefore impossible to ascertain the value of personal property in the Dominion. The following are approximate amounts on deposit in banks and the value of the assets in building societies: in the ordinary banks £26,500,000, and in savings banks over £17,000,000; the assets of the building societies exceed £2,500,000 and those of friendly societies about £1,500,000. The life insurances in force, including those in the Government Life Department, amount to about £34,000,000.

Income tax.

The income tax is levied as follows: On income from employment or vocation or business, less £300, net income, 6*d.* in the £, when such income does not exceed £400. Between £400 and £600, 7*d.* in the £; between £600 and £700, 8*d.*; between £700 and £800, 9*d.*; between £800 and £900, 10*d.*; between £900 and £1,000, 11*d.*; between £1,000 and £1,250, 1*s.*; between £1,250 and £2,000, 1*s.* 1*d.*, and above £2,000, 1*s.* 2*d.* The income tax on companies is 1*s.* up to £1,250, 1*s.* 1*d.* between £1,250 and £2,000, and over £2,000, 1*s.* 2*d.* There are two classes that escape income taxation. They are the owners of houses who pay no income tax on rents, and farmers who pay no income tax on profits made from farming. All that these two classes pay is the land tax, which is now levied on the unimproved value. In considering, therefore, the amount received from income tax, it has to be remembered that very many incomes earned in the colony are not taxed. The mode of assessing the income tax on banks is to assume that a bank's income is a sum equal to 15*s.* in every £100 of the average of its total assets and liabilities for the four quarters of the

year. The total amount of income on which the tax is levied is upwards of £11,000,000 sterling. It is plain from this figure that for one million people there is considerable wealth.

National debt.

In considering the national debt of New Zealand it has to be remembered that a very large proportion of it has been expended in reproductive works and in interest-bearing loans to settlers and local bodies. The total debt after deducting sinking fund exceeds £82,000,000. That sum includes the cost of purchased lands now leased to Crown tenants, the value of which when purchased amounted to £6,000,000, and which have been improved by roading and subdivision. It also includes the cost of the railways, of electric lines and public buildings. The amount lent on mortgage to settlers and workers totals £14,500,000, bearing interest at rates that more than cover the interest paid by the Government for the loans. A sum of about £1,500,000 has also been advanced to local bodies.

Revenue and expenditure.

A consideration that must be kept in mind is that in 1893–1912 the sum of £7,530,000 out of revenue has been spent upon permanent public works. This is a considerable sinking fund. This large sum was accumulated out of balances of revenue over expenditure, and it has been carried, as has been stated, to capital account. A Public Debt Extinction Act is in operation, and some funds are now in existence for this purpose. In face, however, of the continuous expenditure on railways, roads, and buildings, the inauguration of a scheme of water-power stations for the production of electric energy, and the extension of electric lines, borrowing will continue, and the extinction of the public debt will be relegated to the distant future.

The expenditure compared with the income has of late years always been less in the ordinary general account, or, as it is termed, the Consolidated Account. Reference might be made to the taxable values of local bodies, but that would necessitate an explanation of local finance. That is not necessary, however, to emphasize the fact that the financial position need not cause anxiety to any

one so long as moneys borrowed are expended on interest-earning public works or advanced on mortgage securities, or spent for permanent improvements.

Social Conditions

Social life.

The social life of the people in New Zealand differs little from that of other British countries. What differences there are can be traced to climatic influence, and the effect of changed surroundings. There is more sunshine in these southern islands, and the winter is less severe. Out-of-door life is more pleasant, and tends to foster outdoor amusements and sports. Again, this is mainly an agricultural community, though intensive cultivation is only beginning. Residences in the country are often widely apart. It is not perhaps surprising to find that horse-racing is popular, and the number of licensed race-days in a year is at least 250. There may be many more unlicensed races held, but no record is kept. Parliament has sanctioned at licensed race-meetings the use of a gambling machine called the 'totalisator'. It is similar to the 'pari mutuel' used in France. Ten per cent. of the sums invested is deducted by those who supervise the races, and of this 10 per cent. one-quarter has to be paid to the State. The 7½ per cent. retained goes towards the expenses of the racing clubs controlling the meetings and enables them to give substantial stakes to the winners of the races. The popularity not only of the races but of the totalisator machine may be judged by the fact that about £2,000,000 a year are 'invested' by the public on the machine.

Outdoor sports.

In outdoor sports the national game of New Zealand is football. Every small village has its football club. Both Rugby and Association football are played, but the Rugby game is the more popular. A professional element has unfortunately been introduced which plays the Northern Union game. Another variety of football is the Australian game, which is played mainly by the Australian-born who reside in New Zealand. Cricket, hockey, tennis are also popular games everywhere,

and for the older members of the community, golf and bowling. In the seaports yachting, boating, and motor-boating are common. Auckland is the centre of a delightful yachting region, for the Hauraki Gulf is one vast harbour with scores of inlets and many islands. Deep water is available everywhere, and the genial climate makes it an ideal yachting ground. Indoor games are also common—billiards, chess, draughts, and cards. Theatres, picture-shows, and concerts are well patronized, and the time spent in houses of amusement, while showing that the people live joyfully, may also indicate that serious study is less popular than it might or ought to be.

Orderly character of the community.

The people are orderly. Serious offences are not numerous, and disorderly gatherings are rare, though strikes have been accompanied by some disorder. Death is the punishment for murder, but in five years (1907 to 1911) only three persons suffered the extreme penalty. It is recognized that the consumption of such drugs as alcohol, tobacco, and opium has a considerable bearing on the social life of the people. Applying that test to New Zealand, it will be found that it compares favourably with other English-speaking communities. The consumption of alcohol is about one-third of that in the Motherland. There is a much more keen and prevalent temperance sentiment in New Zealand than in the United Kingdom. An impartial observer versed in the social customs of Europe will be struck by the absence of strong liquor at numbers of social gatherings and places of amusement. The number of men and women who are total abstainers is yearly increasing, and at many public banquets the number who abstain from drinking alcohol is considerable. The consumption of tobacco, however, is larger per head than in the United Kingdom.

Social life and general standard of living.

There is more freedom in social life than in Europe, and less recognition of class or social distinction. As the country developed, the population increased, and as wealth became more diffused, the standard of living has been raised, and the same problem how to check the increasing cost of living is, in New Zealand, as in the

older countries, awaiting solution. Life so far as outward appearances is concerned is on a higher plane. The roads and streets are now well formed and kept, save in what are called 'the backblocks', the new settlements in the forest interior. Paved footpaths and streets and asphalted streets are now not rare, where a few decades ago in fine weather the bullock dray had some trouble in making its journey. Electric trams and motor-cars are common. The surroundings and designs of the houses have improved. Gardens, flowers, shrubs, and trees are everywhere. More important than these comfortable surroundings is the fact that a strong national feeling has been engendered. The emigrant has come to stay; not to struggle to amass some wealth and then to return to his country of origin.

Societies: religion.

All kinds of societies, associations, and institutions have been founded to help to raise humanity, and to promote the benefit of the race. Literary, charitable, musical, health, eugenic, and other such societies are found throughout the Dominion, and so far people of different religious and political views, and of different nationalities, have been able to associate together for the mutual benefit of all. There is no State religion, though no doubt the past training of many in favour of a State Church has not yet been obliterated, and at times a recrudescence of the State religious system is apparent. There is, however, a marked absence of bitterness in theological controversies.

Education.

In New Zealand there is a primary education system—free, secular, and compulsory. There are over 2,000 public primary schools maintained at the expense of the Government. There is no school rate. The total cost of education comes from the General Treasury. The average attendance is about 90 per cent. of the number on the roll. In addition to these public primary schools there are Maori village schools, also maintained by the Government, and private primary schools. Most of the latter are connected with some ecclesiastical organization. The Roman Catholic Church has a large number of primary

schools. Almost all pupils in the Maori village schools are Maoris or Maoris with some admixture of European blood living as Maoris. There are some small private schools not subject to inspection. The syllabus in all these schools is similar to the syllabus of primary schools in England. The Anglican Church has several secondary schools under its control. Some of these schools in the very early days of the colony were endowed with public lands. The Roman Catholic Church has also several secondary schools, and it also received some land endowments in the very early days for educational purposes. Fees are charged at secondary schools, but there are many scholarships; and all pupils who qualify for Education Board scholarships, though they may not obtain a scholarship, are entitled to free tuition at a secondary school for two years. Nearly half of those who attend secondary schools pay no fees. The Government pay the fees, and the cost per pupil is about £11 per year.

There are special schools of various kinds, such as a school for deaf-mutes. This school has been conducted on the lip-speaking method, and has been very successful. There is a school for the blind, partially endowed by the Government, and another Government school has been established for children of feeble mind. Provision for manual and technical instruction has been generously made. There are over sixty well-equipped manual training-schools, and the technical colleges of the larger towns are well housed and well staffed.

The University and Colleges.

The New Zealand University awards scholarships, and grants degrees. Four University colleges, which provide for the teaching of students, are affiliated to it. One is situated in Auckland, one in Wellington, one in Christchurch, and one in Dunedin. The University has no power to grant honorary degrees—all degrees must be granted after examination. There are several scholarships open for competition every year, and about £2,000 annually is spent on scholarships. The individual colleges also have scholarships which they grant to their students. An attempt has been made at specialization in

connexion with the colleges. There is a medical school in Dunedin, a mining school in Dunedin, and also a mining school in Auckland; an engineering school in Christchurch, and a law school in Wellington. There are two professors of music, one in Auckland and one in Christchurch, and it has been proposed to start a conservatorium in Auckland. There is an agricultural school not far from Christchurch, called the Lincoln School of Agriculture, which is affiliated to Canterbury College at Christchurch.

Literature and Art.

Public libraries have been erected in many towns. The four largest towns, Auckland, Wellington, Christchurch, and Dunedin, have libraries of considerable size. The Auckland, Wellington, and Christchurch libraries are free so far as reading-rooms are concerned, but a small charge is made for the lending library. In Dunedin there is a Mechanics' Institute and Athenaeum with a large reading-room and large library, open only to subscribers. There is, however, a free library in the erection of which Mr. Andrew Carnegie assisted. There are considerable libraries in many of the other towns, and it is rare to find any town without a free reading-room. Museums have been established in each of the large cities, and in some of the small towns. There are also several art galleries in the Dominion. The value of books imported on an average for several years is over £200,000. Books are duty free. As many come by post, it may be said that this estimated value of books is understated. The English and American magazines have a considerable circulation. In recent years the sale of American books and magazines has greatly increased. Newspapers are numerous. Many books are published every year in New Zealand: books on history, on science, and also books of the imagination. Culture has not, therefore, been neglected. Various conditions, however, militate against the leading of the studious life. Notably in New Zealand, compared with the Motherland, there are more sunny days and more opportunities for outdoor life. Perhaps also the want of the keen competition for sustenance

that is witnessed in Europe, but is absent here, may lead to a less studious or strenuous life. So far the young New Zealand student, when he goes abroad to Europe and America and engages in the keen intellectual competition to be found in the University institutions of these older lands, has shown that he can hold his own. Many have come back to their native land carrying with them honours and distinctions.

In the early days many of the settlers who came to New Zealand were University graduates full of enthusiasm to found a new nation. Their struggle for culture, even amid their strenuous exertions to make homes, has left its mark on New Zealand. To-day the love of art is growing, thanks to those few who have struggled against the materialism of a new country, with no traditions of artistic achievement, and have fostered the growth of associations having for their object the encouragement of music, painting, and literature.

Political Conditions

Movement for self-government.

In New Zealand, in the past, many political platforms have been promulgated. The first political struggle was for self-government, or, as it was then termed, responsible government. Beginning as a Crown colony, New Zealand was ruled by officials appointed in London who were out of sympathy, because to some extent ignorant of the local conditions, with the early settlers. Many of the pioneers were men of culture who had come to the colony seeking freedom from accepted traditions and hoping to take their part in the founding of a new nation. To such as these a form of government under which they had no part or freedom in framing or in administering their own laws was insufferable. Associations were formed, speeches were made, and literature published broadcast demanding responsible government, but not till 1852 were these efforts successful. In that year an Act was passed by the Imperial Parliament granting representative government to New Zealand. The Act provided for a central parliament and also established a system

of provincial government. The country was divided into six provinces, each with a local governor called the Superintendent, and a Provincial Council or Parliament consisting of one chamber. A fitting corollary to the effective system of self-government which was subsequently developed was the elevation of the colony to the rank of a Dominion in September 1907.

The general or central parliament was called the General Assembly, and it first met on May 27, 1854. It consisted of the Governor, a Legislative Council, whose members were nominated by the Governor, and a House of Representatives, the members being elected by those settlers possessing electoral qualifications. At its first sitting a demand was made for full responsible government, but to this the Governor declined to accede. The House of Representatives was not unanimous. Amongst its members were some who desired to await the development of the new Government institutions. The party who demanded responsible government was led by one of the ablest of the early settlers, James Edward Fitz-Gerald.

Leading political questions.

At the next session of Parliament two parties were formed, those who desired to maintain the provincial institutions, and those who wished to minimize their powers and make them simply municipalities. This division of parties continued down to 1876, when the provincial government system was finally abolished, though in the period from 1856 to 1876 many other questions divided the members of Parliament. At one time there was a war party and an opposing peace party. On another occasion the Parliament was divided into supporters of a progressive public works policy financed by means of borrowed money, and those who were opposed to loans for railways and other public works. There have been discussions on the question of protection or free trade, and labour problems have not been viewed in the same way by members of the House of Representatives. Again, the question arose, what should be the form of direct taxation ? Should it be a land tax or an income tax or a general property tax, or a land and income tax ?

Between 1878 and 1891 there was hardly a session of Parliament held in which this question of taxation was not debated. Since 1891, however, the Parliament seems to have assumed that a land tax and an income tax were the most suitable for the requirements of the country. The most important debates have been perhaps those on the graduated land tax. An effort was made from 1891 to 1893 to make New Zealand independent of foreign loans, and for once in her later history the public debt was reduced, though only by a small sum. After 1893 this effort to reduce borrowing was not in evidence.

Another question of policy that has been discussed during recent years is whether Crown tenants who have obtained leases should be allowed to purchase the freehold, and permission has been given to certain classes of Crown tenants to purchase the freehold of their holdings. The only Crown lands which are held by lessees that are not to be parted with are those set apart for education endowments. No party has yet suggested that these education endowments should be sold.

Political parties.

Up to 1891 the tenure of office of ministries was not generally long, though one party was in office for eight years, but from 1891 until early in 1912 one party was continuously in power, though the premier and many of the ministers were changed. In that time two premiers died whilst in office. The two parties that are now in existence in Parliament are named the Reform Party and the Liberal Party. The Reform Party is in the majority. There is in addition to these parties the nucleus of a Labour Party. Labour is not, however, at present united. One branch of workers call themselves Federationists, and in their aims they are somewhat akin to the French syndicalists, or to the Labour Federation Party of the United States. The other branch is the United Labour Party. This latter party upholds the Conciliation and Arbitration Act, and opposes a recourse to strikes for the settlement of industrial disputes. It has at present the larger number of adherents. There is a militant Socialist party, but its numbers are few, and its members

are mainly enrolled amongst the Federationists. The general demand of both branches of the Labour Party is for land taxation, for a reduction of the hours of labour, for a better treatment of the workers, and for an increase of the State's functions in industrial enterprises. It is doubtful if the Labour Party in New Zealand will ever be as successful as the Labour Party has been in Australia. New Zealand is a country of small farmers and small traders, and they are mainly married men, and it may be that these men who have a stake in the country will form a conservative element opposed to extreme socialist legislation, as are the small farmers in France. At all elections local questions often divide politicians and overshadow questions of wider interest. The distance of the extreme north from the extreme south, even the difference in climate between a subtropical and a temperate climate, may prevent any homogeneity of political feeling or opinion.

Non-party questions.

In New Zealand many questions that divide parties in England have been investigated and decided free from party considerations, such as the education question and the problem of internal defence. In 1877 it became necessary to pass a general Education Act, as the different provincial systems of education had come to an end with the abolition of the provinces in 1876. A free secular and compulsory system was agreed to with some approach to unanimity, and no party lines were recognized in its discussion. In defence also there has been a general feeling in favour of the training of the youth to defend their country, and the Labour Party has been in the main as favourable to providing for the defence of the country as those who are supposed to have capitalistic tendencies. In all social reforms—and there have been many measures of social reform passed since 1854—party has never come into question.[1]

Immigration and politics.

It is hoped by many that the ease with which higher education is obtainable by the youth of both sexes may

[1] Cf. J. E. Le Rossignol and W. D. Stewart, *State Socialism in New Zealand*, London, 1911.

PLATE XXIII. WAITAKERI FALL, AUCKLAND, NORTH ISLAND
(High Commissioner for New Zealand)

PLATE XXIV. SERUA, FIJI

(Mr. Basil Thomson)

help to steady political parties and political action. One disturbing element in the politics of the country is the fact that new settlers are coming every month to New Zealand. It is apparent that many bring with them the remembrance of the struggles and the hopes that have engaged their attention in the Motherland. They do not at first appreciate the conditions of the country into which they have come. Many of their proposals show that they have not studied the history nor comprehended the events that have led to the growth of the present political system. They are still worshipping the political *Lares* and *Penates* of Great Britain. The incoming stranger has had a considerable influence on the Labour Party. The extreme measures advocated by many of them, and their determination to stand alone, and not to coalesce with either of the other parties, led to the result that in 1912 there were fewer labour members in the House of Representatives than there were twenty years before.

Local elections.

It is rare that the election to local bodies is fought on political party grounds. Occasionally labour combines and elects labour representatives, but the municipal or other local elections are almost invariably fought and decided upon matters of local policy, and are unaffected by the political opinions of the candidates or the electors.

Women's franchise.

There are many active political associations, and women have political associations of their own. Women are not eligible as members of the General Assembly, but they take as active and intelligent an interest in politics as men. It cannot be honestly suggested that the granting of the franchise to women has had any evil effect; on the contrary, it may fairly be claimed that much of the social legislation owes its place upon the statute-book, if not directly to the female franchise, at least to a healthy public opinion engendered by the influence of high-minded women.

CHAPTER XIV

THE WESTERN PACIFIC

By Basil Thomson

Distribution of British islands.

The British islands in the Western Pacific are scattered over an area of 80 degrees of longitude and 35 degrees of latitude—from Ducie Island (124° W.) in the east to the Louisiade Archipelago (151° E.) in the west; from Makin Island (2° N.) in the north to Lord Howe Island (31° S.) in the south. It is a curious fact that scarcely any of the archipelagos comprised in this immense area belongs to the nation by whom it was discovered. The Marquesas, the Society Groups, and New Caledonia have passed to France; Samoa, the Marshalls, New Britain, and New Ireland to Germany; Fiji, Tonga, the Cook, the Gilbert, and Ellice groups, and the greater part of the Solomon Islands to England.

Besides the principal groups a considerable number of isolated islands, for various reasons, have become part of the British Empire.

Physical characteristics.

The physical features of these widely scattered possessions are infinitely varied. Many of the smaller islands are built of coral, either as atolls, like Ducie Island, elevated but a few feet above high-water mark and enclosing a lagoon, or, like the neighbouring island, Henderson, as elevated plateaus of dead coral, upheaved 80 feet above the sea. Sometimes volcanic rock is extruded through the coral so as to form a mountainous core, fringed by limestone cliffs, as in Vavau; sometimes the reef has been raised scarce 20 feet as in Tongatabu; sometimes again the whole island is formed of volcanic material, with or without a fringing reef of coral. In fact, the formation of all these archipelagos may be traced directly or indirectly to volcanic agency, perhaps at a not very remote geological period. In the island of Tanna in

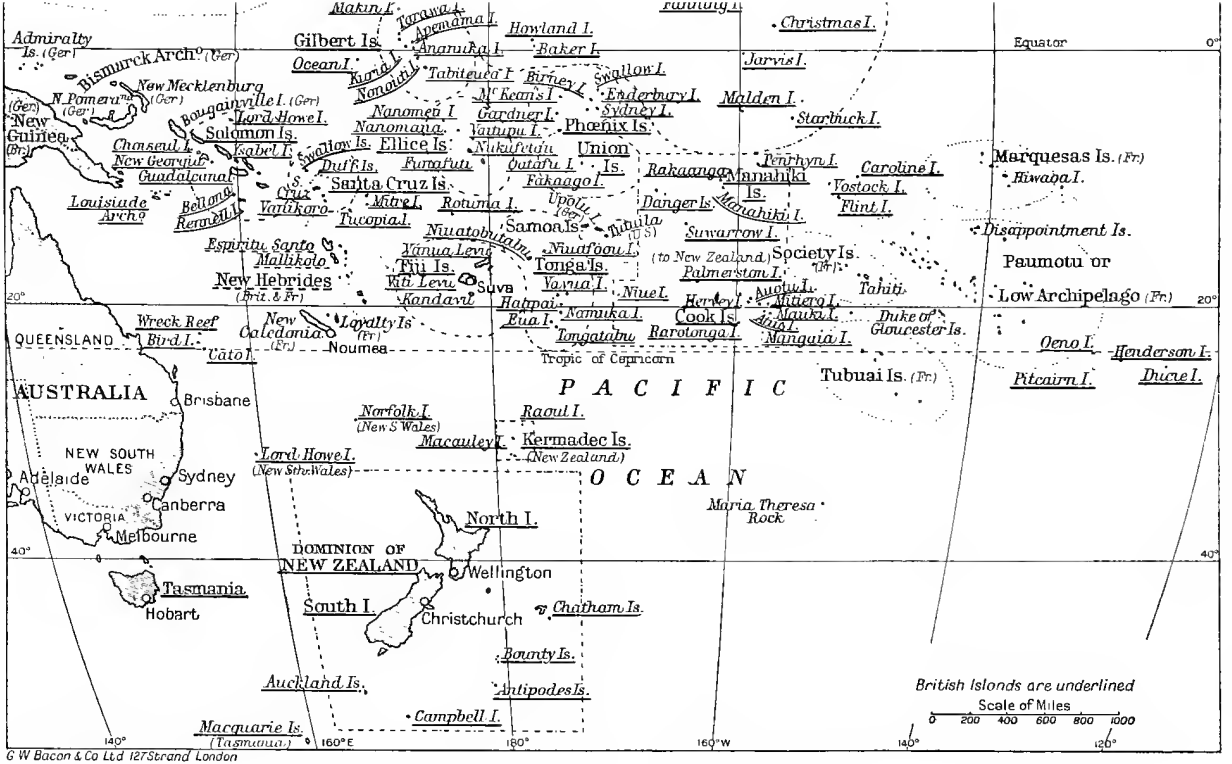

FIG. 65. British Possessions in the Western Pacific.

the New Hebrides, in the Tongan Group, and in Niuafoou there are volcanoes active either now or within recent years : hot springs are found in Vanualevu (Fiji) and in other islands. Changes of level have taken place in historical times. During the eruptions in Tonga in 1886, Falcon Reef, over which the sea normally broke at high water, discharged a mass of pumice which formed an island from 80 to 100 feet high ; it was finally washed away by the waves in 1898. In Vatulele, an upheaved reef island in Fiji, one may see cut deep into the cliff face some 20 feet above high-water mark a continuous gallery, eroded by the waves before the island was thrust up suddenly to its present level. In the caves with which these coral islands are honeycombed one may see the stalagmitic columns cut asunder as if a slice had been taken out of them with a sharp knife at their weakest point, either near the roof, or midway, or near the floor. The edges are free from any fresh deposit of stalactite, and show that the change in level must have been quite recent. Detached coral barriers like the Astrolabe and Indispensable Reefs, stretched like a net across the path of shipping, have destroyed many vessels ; for at night there is nothing to warn the approaching ship of her danger except the sound of the breakers, inaudible in heavy weather, and, when the wind is in the right direction, the smell of the reef itself. There is a compensation in coral seas, however, in the multitude of safe harbours to which the reefs form natural breakwaters. It is the peculiarity of coral that it cannot live in a sea diluted with fresh water ; consequently there is a break in the reef opposite the mouth of every stream, through which vessels can pass to a safe anchorage. In Vavau (Tonga), in Fiji, in the New Hebrides, and in the Solomon Islands are harbours safe in all winds, large enough to shelter a fleet, and capable of being fortified whenever the necessary money is expended upon them. At present they lie at the mercy of any hostile squadron which may choose to take them.

Scenery. The scenery of the islands, as might be expected from

the varying nature of the material, is of extraordinary beauty and variety. When the volcanic islands are of any size they are heavily timbered on the windward side almost to the top, and the condensation is sufficient to feed streams of limpid water even in the dry season. On the lee side, where the rainfall is much lighter, the slopes are covered with a coarse grass with belts of timber here and there. Bush fires, lighted annually by the natives, by carelessness, or with the object of finding wild yams, serve to keep the young timber from getting foothold. The course of the mountain streams, dashing in cascades from rock to rock, filling deep pools so clear that every rounded pebble on the bottom may be counted, arched over with branches and dappled with shafts of sunshine, is a fairyland. Great vines trail from the leafy roof, or twine about the smooth columns of the *dakua* trees; tree-ferns rear their coronets in every glade; feathery bamboos sway rustling in the breeze. At a break in the foliage there is a glimpse of the ocean and the undulating line of the barrier reef white with foam.

In the upheaved coral islands the scenery changes. Here there is no running water. The copious rainfall is swallowed by the porous rock, to collect in natural cisterns far underground, but the scenery is no less enchanting in another fashion. Here we find dense vegetation alternating with coco-nut groves and plantations, from which all undergrowth has been removed; broad grass roads or narrow paths, shaded by palms and bread-fruit trees; villages of grass or cottages with whitewashed walls and thatched roofs. It is the scenery of the coral atoll on a larger scale.

Nature is not always in sunny mood. The rainfall of more than 100 inches is made up by cataracts of rain, when the mountain masses of the larger islands are veiled in cloud and sodden with water. On such days the tinkling stream becomes a roaring torrent; waterworn boulders are torn from their beds and washed down the channel. The larger rivers flood all the low-lying lands near their mouth, and leave a deposit of silt upon the

mangrove roots in the river deltas, converting the swamp into dry and very fertile land. The heaviest floods occur after cyclones which are sometimes accompanied by tidal waves, and it is therefore unnecessary to argue, as the missionaries have done, that the stories of a deluge, which are found in the oral traditions of nearly every native tribe, refer to the flood of the Pentateuch.

The reef.

No picture of island scenery in the Pacific is complete without the reef. In every glimpse of the sea it lies in the middle distance as an irregular line of white foam following the trend of coast-line about a mile out to sea. Night and day the roar of the 'league long roller' is heard in a muttered undertone, and when on still nights the undertone rises to a booming roar the natives foretell bad weather. In some of the islands an unusual noise of breakers on the reef is regarded as a death-portent for one or other of the high chiefs. When a heavy sea is breaking, the line of the reef may be traced by the bank of spray that shrouds the breakers in a shimmering mist. When the wind is blowing from the shore the rollers take on a new beauty: their white crests stream backward like horses' manes as they fling themselves impotently against the sullen barrier of coral. At low tide the receding waters leave pools full of crabs and small fish, which become the prey of the native women and children, whose merry shouts may be heard as they carry their fish-spears and nets from pool to pool. Above high-water mark there is a belt of dazzling white sand, which, on close examination, proves to be composed of minute particles of shell, and beyond, without any intervening region of dune or grass land, the forest begins suddenly. Wherever the shore slopes down to the water's edge there is always a luxuriant growth of trees, whose roots must be drawing their sustenance from the salt water. The floating seeds of the sago palm, the *Barringtonia speciosa*, the *dilo* (*Calophyllum inophyllum*), and the *walai* vine (*Entada scandens*) litter every beach.

Climate: winds.

The climate of the Pacific Islands is dependent upon the south-east trade wind. This wind used to blow with fair

regularity over the whole area from March to October, attaining considerable force and raising a high sea. But the older inhabitants of the islands assert that during the last few decades it has decreased in both force and regularity ; and it is certain that even during the fine winter months there are many days of calm and rain and wind from the west and north-west. In the summer months, from October to March, among the easterly islands the wind is variable. Days pass with low-lying rain-clouds and moist heat when there is no wind at all, and the thermometer stands at over 90° F. Life is then a burden even to the natives. These calms are succeeded by strong westerly winds that may blow fiercely for three or four days, and sometimes, especially in December and March, by destructive cyclones. As one travels westward the war between the south-east trade and the north-west monsoon becomes increasingly manifest, until in the Solomon Islands the year is divided between them, with a few weeks of variable weather between each change. In the regions of the north-west monsoon hurricanes are almost unknown. In most of the larger groups inter-insular navigation profits from the land-breeze. Small craft, which find it very difficult to beat against the choppy sea raised by the south-east trade during the day-time, lie snugly at anchor until nightfall, when the wind drops to a calm, a gentle breeze sets in from the land, and they can creep along the coast until daybreak, although a few miles from the coast the trade wind is blowing as fiercely as ever. For some reason, which is not understood, even a low-lying group of islands like the Paumotu has a marked effect upon the regularity of the trade wind.

Cyclones.

The approach of a cyclone is announced by the behaviour of the barometer. The mercury falls very rapidly,[1] and in some recorded instances the glass is said to ' pump ', i.e. rise and fall alternately. The birds seem by their evident alarm to feel the approach of the storm. The cyclone begins with a freshening gale which increases to a

[1] In a hurricane in Fiji in March 1910 the mercury fell $\frac{9}{10}$ in four hours. *Colonial Reports*, No. 72, C. d. 5216.

velocity of 85 miles an hour when the cyclone is at its height. Torrents of rain fall. After blowing for about four hours the wind drops, and there ensues a calm so complete that a match may be lighted out of doors. This deceptive lull lasts about fifteen minutes, but though the air is motionless there is a continuous roar in the upper atmosphere. The calm is interrupted by a sharp puff of wind from the opposite quarter, and the experienced residents know that the centre of the cyclone has passed over them and that the worst has yet to come. In a few minutes the storm is upon them with redoubled fury—this time from the opposite side ; native huts that have been driven by an easterly gale into a slant towards the west, are now blown to a corresponding angle the other way. The path of the cyclone is not very wide. Accurate observations taken in Fiji show that the cyclonic portion is seldom more than 50 or 60 miles wide, though a strong gale may extend for twice that distance. While the velocity of the wind is from 80 to 90 miles an hour, the rate of progression of the gigantic eddy is only 10 miles an hour. Cyclones strip coco-nut trees, uproot bananas, and lay canefields flat, besides unroofing and demolishing houses and driving vessels ashore, but the loss of life is not great and the islands recover from them far sooner than is expected by those who survey the ruin of their property.

Rainfall. The rainfall varies a good deal. In the Cook Group the annual average for twelve years was 81·18 inches. At Niué in latitude 19° 1′ it is about the same. At Suva in Fiji the rainfall is from 107 to 112 inches, and in the mountains in the interior even more. In Fanning Island (latitude 3° 51′ N.) the average for ten years was 105 inches ; the larger part falling between March and July. Observations kept on the coast of the Solomon Islands for some years show a rainfall of more than 130 inches. The maximum temperature, however, in these wet islands seldom exceeds 86° F., and the minimum never falls below 75°. In the large islands there is a great difference between the rainfall on the windward and the leeward sides. The densely-timbered slopes of the east side

appear to comb out the rain clouds until they have parted with their moisture, and while it may be raining hard on the one watershed the other may be quite dry. In the large islands of Vitilevu (Fiji) and Guadalcanar (Solomons) the western portions show the difference of climate in their grass-covered plains.

An excessive annual rainfall in these islands does not denote an excessive number of wet days. In Fiji no less than 8·33 inches fell on a single day (in October 1910), and during the winter months, June to August, weeks may pass without a drop of rain falling. At such times the dew is very heavy.

Vegetation.

The soil and climate of the larger islands are suited to all kinds of tropical vegetation. Even the coral atolls are densely timbered to the water's edge. The seeds of most of the littoral trees float in salt water and have been observed drifting in the current more than 100 miles from the nearest island. The distribution of inland trees has probably been effected by fruit-eating pigeons, which often cross a strait to their roosting-grounds, where they perch on high trees and disgorge the seeds they have swallowed in other islands. The timber trees belong principally to the orders Coniferae, Casuarineae, Guttiferae, Myrtaceae, and Leguminosae. Chief among the conifers is a species of *kauri*, known in Fiji as the *dakua* (*Dammara vitiensis*), a magnificent tree which attains 100 feet in height and 6 or 7 feet in diameter. Like the New Zealand variety it exudes a gum, which is occasionally found buried in lumps of 50 lb. weight in places where the trees have rotted away, and is used by the natives for burning in torches and for glazing pots. The timber is excellent for spars and sawn planks. One of the conifers, the *kausolo*, is peculiar to Fiji. Another (*Dacrydium elatum*), found in the mixed forests of most of the larger islands, has very delicate leaves and branches, which tremble in the lightest breeze like an aspen. A large tree (*Calophyllum inophyllum*) called *dilo* by the Fijians and *tamanu* by the Polynesians, not unlike the walnut in appearance, grows on the seashore in most of the larger islands. Its

timber is hard, beautifully grained, and easily polished, and its fruit is rich in an oil which is said to be a specific for muscular sprains and swellings. Allied to it is a large forest tree (*C. burmanni*) called *damanu* by the Fijians, from which canoes and small vessels are built. Another useful timber is the *tavola* (*Terminalia Catappa*), from which native drums in many of the islands are cut. A very hard and heavy wood, much used for clubs and neck pillows, is found in the *Casuarina equisetifolia*, which flourishes in a poor soil, and in Tonga and Fiji is planted about tombs and cemeteries on account of its sombre aspect and the wailing noise made by the wind in its branches. Associated with this *Casuarina* in poor soil a *Pandamus* with aerial roots is generally to be found. The mangrove (*Rhizophora mucronata*), which abounds in the swamps at the river-mouths, has a blood-coloured sap, much used by the natives for dyeing their skins and for decorating their pottery. Its elastic aerial roots are used for bows, and its fruit, in time of scarcity, is baked and eaten. But most useful of all the timbers in the Pacific Islands is the tree called *vesi* by the Fijians (*Afzelia bijuga*). The wood is hard and dark coloured, not unlike the European oak in its qualities of toughness and durability. It sinks in water and is not easily set on fire. The tree is widely distributed, though in some of the islands, such as Tonga, the demand of the canoe-builders was so great that it is now extinct. Sandalwood, which attracted so many ships to Fiji and the New Hebrides at the beginning of the nineteenth century, is now scarce, and the efforts made to plant it systematically have not been very successful.

One of the most beautiful objects in the forests of the well-watered islands is the tree-fern (*Alsophila excelsa*), a palm with a slender trunk about 25 feet high and a magnificent crown of fronds. The wood of the trunk is often carved by the natives into fantastic shapes and seems almost indestructible by weather or by fire.

The coco-nut palm.

The coast-line of most of the islands is enriched by a broken belt of coco-nut trees, springing straight from the

dazzling line of white sand and extending for some distance inland in the neighbourhood of villages or European plantations. The palm thrives best when it is rooted in the sandy soil of the seashore on the windward side of the islands, though the popular belief that it will not grow out of sight of the sea is a fallacy. The trees come into bearing about their seventh year and live from sixty to seventy years. The natives make use of every part of the tree—the fruit for eating, drinking, and making oil for home use or copra for export; the fronds for basket-making; the trunk for rafters; the flower spathes for torches; the fibre for sinnet; the tough roots for stepping the yards of their canoes. Next in importance as a food staple is the bread-fruit, which is planted widely near the native villages. The surplus fruit is buried in pits and is afterwards eaten in a fermented state in spite of its horrible smell. In the Cook Group and in Tonga the bread-fruit has suffered very much from the depredations of horses, who are excessively fond of the bark and strip the tree of it up to a height of 5 feet from the ground. In its shape and the brilliance of its foliage it is one of the most beautiful trees in the world. The other indigenous fruits in the islands are insipid to the European palate, though they are highly esteemed by the natives. From the bark of the paper mulberry (*Broussonetia papyfera*), which is carefully cultivated, the natives obtain their clothing and curtains. Unfortunately cheap cottons are supplanting native bark cloth, and the beautiful art of painting tapa will soon be lost.

Food plants and other vegetable products.

The other staple foods of the natives are yams of several kinds, both wild and cultivated; taro (*Colocasia esculenta*), which is grown either in irrigated beds or on dry land; plantains (*Musa troglodytarum*); sweet potato (*Batata edulis*), introduced probably from New Zealand; the kassava, the sugar-cane, and the trunk of a gigantic swamp plant, called by the Fijians *via* (*Alocasia indica*). To these have been added bananas (*Musa chinensis*), peanuts, shallots, pumpkins, cucumbers, water-melons, and other vegetables. Oranges and lemons grow very well, though

the fruit rarely turns yellow even when over-ripe; pine-apples flourish amazingly. The papaw (*Carica Papaya*), introduced into Fiji probably early in the nineteenth century, has spread widely, though neither the Europeans nor the natives appear to care much for its fruit. The pepper plant (*Piper methysticum*) from which the national beverage (kava) of Tonga and Fiji is made is to be found in most of the islands, but it does not seem to be used as a drink in the Solomons or the other islands, where betel-nut is chewed; another pepper (*Piper Betel*) is there used together with lime. It is a curious fact that plants which are highly prized in one part of the Pacific are allowed to grow neglected in the forest in another. The sago palm (*Sagus vitiensis*), whose pith is the staple food on the south-east coast of New Guinea, grows in Fiji, where its uses are unknown; the tobacco now smoked universally by the natives of both sexes was growing wild in some of the islands. The forests are so rich in fibre plants that no native is ever in need of rope or string. Besides the indigenous plants, the hibiscus (*Paritium tiliaceum*), the coco-nut palm, the *yaka* (*Pachyrhizus angulatus*), and several vines, the imported ramie and cotton do very well.

Native herbal remedies.

Many Europeans put great faith in the natives' knowledge of herbal remedies and vegetable poisons. The secrets of these herbs are handed from mother to daughter, and as there has been no opportunity of subjecting them to any scientific test, it is possible that there are plants with valuable medicinal properties that have not yet found a place in the Pharmacopoeia. It is certain, for instance, that the natives are expert procurers of abortion, and several of the herbs used for this purpose are known. The Fijians believe that the smoke of the poisonous sinu (*Excaecaria Agallocha*) is a specific for leprosy. The patient is suspended by the ankles with his head about a foot above a fire on which pieces of the tree have been laid. Suffocated by the poisonous smoke, and enduring agony from the torture, he often faints, but when he comes to himself the leprosy is said to recede until he is quite cured. The fruit of the *Barringtonia speciosa*, pounded and thrown

into water, is used by fishermen to stupefy the fish in a pool. The fish soon recover, but the effects last long enough for the fisherman's purposes. The natives know of other vegetable poisons. The sap of more than one tree in the islands produces a painful eruption on the skin, and the tree-nettle (*Laportea*) called *salato* by the Fijians inflicts many hours of suffering upon those who are tempted to touch its beautiful leaves with their naked hands.

Land fauna.

There are very few indigenous mammals in the islands. A native rat, now nearly exterminated by the brown rat, and five species of bat are the only land mammals, if we except the cuscus opossum in the Solomon Islands and the domestic animals, cats and pigs, which have taken to the bush and are breeding wild there. A native breed of fowls appears to have been common in Santa Cruz and the Solomon Islands, possibly even in the other islands, for the wild fowls of the bush in Fiji are certainly more like the Java wild fowls than could be accounted for by mere reversion. However this may be, the imported fowl seems to have driven out the wild fowl even in Santa Cruz. Europeans have introduced dogs, horses, cattle, goats, sheep, and turkeys. Cattle thrive well, and in the islands where they have run wild they multiply very rapidly. In the less mountainous islands the natives as well as the Europeans are beginning to keep horses. Sheep thrive in the grass land on the lee side of the islands, but the wool is said to be short in staple. Goats are turned loose on the barren rocky islands, and in Fiji herds of Angora goats have been found profitable. It is strange that rabbits, thoughtlessly introduced by Europeans into Fiji, have shown no tendency to multiply to a dangerous extent, and since the introduction of the mongoose it is unlikely that they will long survive. At first the mongoose did what was expected of it in killing off the rats that were doing immense damage to the sugar-cane, but it carried devastation into the hen-roosts on which so many of the small settlers are dependent, and multiplied so amazingly that it was said in some districts to have exhausted all possible sustenance except the cane itself.

Numbers are found in the mangrove swamps of the river deltas, where they are believed to live upon the sea-slugs and small crabs. Birds are more numerous than mammals.

Anthropoid apes.

There are persistent rumours in the Solomon Islands and the New Hebrides of wild men or anthropoid apes. In Florida they are called Mumulou. The native description is that they talk like men ; the hair of their heads reaches to their legs ; they are covered with long hair ; they live in caves and live upon snakes and lizards ; they eat any coast man they can catch ; they use spears, and pelt men with stones. Some years ago, one of them was killed, so the natives know what they are like. In the New Hebrides similar creatures are seen basking on the rim of the crater of the Ambrym volcano. Here they are called Mae. They have long hair and long teeth ; they dwell in caves, carry off pigs, and if they meet a man alone they will kill and eat him ; in the night they are heard crying in the valleys, and it is then said that the Mae is washing her child. Whatever may be the origin of these stories, it is now certain that there are no anthropoid apes or ape-like men in the islands ; possibly the belief is founded on the tradition of anthropoids in the former home of the Melanesians, but it is more likely a fanciful exaggeration of the difference, much exaggerated by the coast people, between the inland folk and themselves.

Birds.

Among the larger birds are herons, bitterns, ducks, teal, pigeons, paroquets, and two species of green parrot. The swift (*Collocalia*) which produces the edible birds' nests is found in the Solomon Islands. There, too, is the mound-building 'bush hen' (megapode), which buries its eggs in a mound and leaves them to be hatched by natural heat. This bird is common in the Santa Cruz and New Hebrides Groups, and though unknown in Fiji or any of the Polynesian islands, it is found in Niuafoou (Keppel Island), which is included in the Tonga Group. Attempts that have been made to acclimatize the bird in Tongatabu, only 200 miles from Keppel Island, have failed. Among the small birds are shrikes, kingfishers,

and several warblers. Mynahs, imported into Fiji from India, are increasing very rapidly.

Marine fauna.

If the fauna is scanty on the land it is not so with the sea. Here Nature has lavished her ingenuity. About 150 species of fish are known. The sperm-whale (a mammal, it is true, but popularly classed as a fish) attracted many whaling ships to the islands a century ago, but is now becoming rare. Sharks and dog-fish abound, and the shallow waters and rivers are full of edible fish. Some of the native tribes live entirely by fishing, using the seine net, the spear, and the fence—an elaborate trap built of reed-fencing in which the fish are entangled during the ebb tide. The edible and the shell turtle are both common and are caught with nets. It is in the lower forms of marine life that there is the greatest variety—in the crabs and the myriad creatures that live in the pools on the reef. Strangest among these is the balolo (*Palolo viridis*), an annelid worm that rises in myriads to the surface of the sea twice a year with such regularity that it has given Fijian names to the months of October and November. As the balolo makes its appearance at the last quarter of the moon in October and November, it follows that to keep its dates with accuracy it must observe both solar and lunar time, and skip a lunation every twenty-eight years. It is treated by the natives as a delicacy and sent all over the islands in a half-cooked state. It tastes like caviare, and Europeans find it not at all unpalatable. The natives declare that if the balolo breaks up and disappears earlier than usual there will be a cyclone that season.

Crustaceous animals abound. Shrimps, prawns (both the fresh- and salt-water varieties), crayfish, and crabs are eaten. The land near the shore is honeycombed with the burrows of a land-crab, which in certain months wanders even into the houses, and with claws erect shows fight if the proprietor threatens to eject it. The large coco-nut eating crab (*Birgos latro*) is confined to certain islands where the natives regard it as a great delicacy.

Reptiles.

There are about ten species of snakes in the islands, all

harmless except the *Hoplocephalus par*, a sort of cobra peculiar to the Solomon Islands. A handsome little snake, with alternate bands of black and white, is often seen swimming in the calm waters between the reef and the shore in Fiji. One of the harmless snakes about five feet long is eaten as a delicacy by the inland tribes in Fiji. Frogs are said to be rare in oceanic islands, but there are no less than nine species in the Solomon Islands and two in Fiji. One of the Solomon Island species (*Ceratobatrachus guentheri*) belongs to a new family, and some of the others dispense with the tadpole stage and are fully developed in the egg. Frogs seem to be unknown in the smaller islands. Lizards are represented by a large chameleon and four other species.

The crocodile (*Crocodilus sporosus*) swarms in the rivers and swamps of the Solomon and Santa Cruz Islands, but is unknown in the islands further east. There are two recorded occasions, however, in which large crocodiles, drifting on the current, made their appearance, one in Fiji and the other in Rotuma. The largest is twelve or thirteen feet long. The dugong is confined to the Solomon Islands, where it is fairly common. Three species of turtle—two of them edible and the third a shell turtle—are common to all the islands ; in Fiji the edible turtle is a royal fish, and must not be taken by any but the chief's fishermen.

Insects, &c.

There is more variety in the field of entomology, though besides the scorpion and the centipede, few of the insects are poisonous. Apart from the usual tropical pests of cockroaches, mosquitoes, and flies, there are mason bees which build their pot-like structures in the eaves of houses and fill them with caterpillars artificially paralysed to put them at the mercy of the growing larvae. Leaf and stick insects and the ' praying ' mantis are fairly common, and glow-worms and fire-flies are found in the larger islands. The spiders are large, but, with one exception, harmless. There is much variety in the moths and butterflies. Unfortunately hornets have been accidentally introduced into Tonga, where they have already become a pest, and

there is danger that they may spread to the other islands. Until lately it was supposed that the absence of malaria from Fiji was due to the healthiness of the indigenous mosquito, but recent investigations seem to show that one species of this insect is responsible for disseminating the microbe of dysentery, which takes so heavy a toll of lives every year.

Economic Conditions

Agriculture.

The islands are passing rapidly from the phase of trading in natural products into that of agriculture. Before 1860 the natives only cultivated land sufficient for their own support, and the few European settlers lived as parasites upon the natives. Such European commodities as reached the islands were purchased from whaling vessels in exchange for fresh water and vegetables, or from East Indiamen and Americans in payment for logs of sandalwood and bêche-de-mer. As the European settlers in Fiji increased in numbers the natives began to plant coco-nuts and to manufacture oil for export, but it was not until the American Civil War of 1861–3, when the price of cotton rose enormously, that there was any organized investment of capital in the islands. For a few years large profits were made, but as soon as cotton fell to its normal price the crop grown in Fiji, loaded with the heavy cost of freight and transhipment, ceased to be profitable. At this period the natives of Tonga, under the guidance of the missionaries, were making and exporting coco-nut oil; in the other groups there was very little trade. The cotton bushes thrive very well, and the 'Sea Island' cotton is remarkable for its length of staple; unfortunately a shower of rain at the critical time of ripening will spoil its colour, and planters, knowing the difficulty in obtaining a plentiful supply of casual labour for picking the crop, have turned their attention to products that involve less risk. Experiments are, however, now being made in Niué with seed selected by the Manchester Cotton-Growing Association under the direction of the Resident Commissioner.

Labour: the recruiting system.

With the failure of cotton many of the settlers drifted away from Fiji: others fell back upon copra, the sun-dried kernel of the coco-nut, from which the oil is pressed. Considerable areas of land acquired by purchase from the native were planted with coco-nut palms and, since no dependence could be placed on a regular supply of Fijian labour, there grew up a system of recruiting native labour in the New Hebrides and Solomon Islands on indenture to work the plantations in Fiji. Even when regulated by the Government, after Fiji became a British colony in 1874, this traffic was full of grave abuses. If not actually kidnapped or sold to the recruiting agent by their chiefs, the labourers were generally ignorant of the conditions under which they were engaged. They suffered acutely from nostalgia; the mortality was very high; and when they were repatriated at the end of their term of service they were sometimes landed at some part of the coast where the natives were their hereditary enemies, because it was a more convenient anchorage for the schooner chartered to convey them. A good many have settled permanently in Fiji, either as domestic servants or casual labourers in the two principal towns. The recruiting of Melanesians has now been stopped, and the small copra planters, who found them the most suitable labour for coco-nut planting, are naturally feeling the pinch.

Copra.

Up to about 1900 the price of copra was so low that the plantations could scarcely be worked with profit, but for the last ten years copra has been sold locally at £19 a ton, and the area under coco-nut cultivation in Fiji alone exceeds 30,000 acres. A number of small islands in other parts of the Pacific have been leased for 99 years to Messrs. Lever Brothers to grow coco-nuts as material for soap. The rather desultory work of a copra plantation suits the temperament of the Melanesian labourer very well. The ground must be kept clear of weeds, especially when the trees are young, but the palms themselves call for little attention. The ripe nuts must be collected soon after they fall from the trees; otherwise they will germinate and the kernel will be useless for copra. If the fibre is to be used

the husk is stripped from the nut by striking the fruit upon a pointed stake planted slantwise in the ground, but if there is no sale for the fibre the nut and husk together are split with a hatchet longitudinally into two halves which are hung upon horizontal poles in the sun. In a few days the kernel shrivels up and separates itself from the shell, from which it is easily dislodged. The copra, as it is then called, must be put under cover, but it is fit for shipment without undergoing any further process.

Very soon after the annexation of Fiji it was realized that no progress could be made with agriculture unless a new source of coloured labour could be tapped. Arrangements were made with the Indian Government for the recruiting of East Indian coolies upon an agreement for ten years, of which five were to be worked on the plantations under contract, and five as free labourers. The employers were required to provide quarters and medical attendance, and these provisions were enforced by means of inspectors. At the end of the first five years the government offered small holdings to the coolies on very advantageous terms, but for the most part they have chosen their own career, either as petty shopkeepers or market gardeners. The free passage to India, guaranteed at the end of ten years, has not tempted many to leave the colony.

Sugar.

As soon as Indian coolies were available the planters began to cultivate sugar. Owing to the competition of bounty-fed beet sugar, the margin of profit for some years was so small that only those who were equipped with the latest and most expensive machinery could carry on the manufacture. One by one the smaller companies failed, and were engulfed by the Colonial Sugar Refining Company, an enterprise that may be said to have a monopoly of the sugar market of Australasia. Four large mills in different parts of the group have been erected, and to supply them practically all the land in their neighbourhood on which sugar-cane can be grown has been put under cultivation. Besides the areas owned or leased by the company, there are many smaller holdings on which

private owners are growing cane for sale to the mills. The total area under sugar is about 50,000 acres. The export of sugar during 1910 amounted to 61,761 tons, valued at £669,432. In addition the company exports molasses and spirit distilled from molasses, and the other waste products of the cane are returned to the land.

Other plantations.

Next in importance to the copra and sugar industries in Fiji is the banana, which is grown by small planters near the seaports and exported to Australia and New Zealand. The fruit is picked while green, and carried from the plantations to the steamer's side in lighters. To guard against over-ripening on the voyage, the hold of the steamer is specially constructed to keep the fruit cool. Oranges and pine-apples are also exported in smaller quantities. The pine-apples grow very easily and are of excellent quality, but the oranges, though of good flavour, are less profitable, being small, thick-skinned, and green in colour even when ripe.

Coffee and other products (Fiji).

Great things were expected from coffee-planting in Fiji. Planters who had gained their experience in Ceylon formed productive plantations, and even taught the natives how to grow coffee for export. Unfortunately the coffee-leaf disease was introduced in some plants from Ceylon, and the plantations were abandoned. A few tea plantations on the high land of Taveuni and Vanualevu have been more successful, in spite of the fact that local labour cannot always be relied upon for picking the 'flushes'.

Small plantations have been formed for growing cinchona and vanilla, but the prices of quinine and vanilla are now so low, and the skilled labour required for vanilla-growing so costly, that the extension of the experiment has been checked. Rubber, on the other hand, has attracted much attention recently, and large plantations are being formed. Sheep and cattle have been profitable in Fiji, though there are now no sheep reared for wool, and the herds of cattle are kept only to supply the local needs. The export of hides appears annually in the trade returns of the colony.

Most of the other British islands have to depend upon their own natives for labour, and as every native is himself a landowner dependent upon his personal skill in gardening for the support of himself and his family, there is little inducement to Europeans to invest capital in agriculture. In Tonga Europeans may hold land only upon lease, and consequently there is practically no agriculture except the copra and bananas grown by the natives themselves. In the Gilbert and Ellice groups the islands are scarcely large enough to support their population: in the Solomon Islands, though there has as yet been little attempt to develop the resources of the country, the export of copra in 1910 was 4,030 tons, and the first shipments of bananas to Sydney realized high prices. About 100 acres have been planted with Para rubber, and an experimental cotton crop brought as much as 1*s.* 2*d.* per lb. The ivory-nut, obtained from a variety of the sago palm (*Sagus amicarum*), is peculiar to the Solomon Islands. It grows plentifully in ground too swampy for other cultivation, bears fruit but once and then dies, leaving a crop of seedlings to take its place. The nuts are used for the manufacture of buttons and fetch very good prices. Agriculture and products of other islands.

In the Cook Islands, under the administration of New Zealand, bananas, oranges, and pine-apples are exported, besides copra and several minor products, such as vanilla, candle-nuts, coffee, honey, and bees-wax; in Niué copra and fungus, destined for the China market, are exported.

The harvest of the sea is an important though a declining factor in the export trade of the islands. The lagoon islands still produce pearl-shell worth as much as £90 per ton, though the beds are being rapidly exhausted. The sea-reefs yield a sea-slug (*Holothuria*) known as bêche-de-mer, which is parboiled and sun-dried for export to China. So highly is it esteemed among Chinese gourmets that cargoes have been sold in Manila for fifteen dollars a picul, which is more than fifteen times the cost of production. The European palate does not appear to acquire a taste for it, since there is only one recorded instance, in 1862, Marine products.

when it found a place in the *menu* of a banquet in London. High prices are realized for the shell of the *taku* or non-edible turtle, and even the shark has been turned to account: the dried fins are considered a delicacy in China and sell for 10*d.* a pound in Hong Kong; the skin, the teeth, and the oil are also marketable.

It is possible that other natural products may prove valuable. In 1910 a trochus shell which abounds on the reefs was discovered to have a high commercial value in France and Japan for the manufacture of buttons, and, as the cost of collection is very small, large profits were made. There are signs now that the market may easily be glutted.

Phosphates.

The value of rock phosphates is also a recent discovery. A bed of this valuable chemical manure, from one to four feet thick, extends over the greater part of a number of remote islands such as Ocean, Jarvis, and Enderbury Islands, which were otherwise commercially valueless. The geological history of these beds is not yet undisputed, but they are supposed to have been formed by the filtration of a solution of rain-water and guano deposited by sea-birds into the loose grained coral of which the islands are composed. Rock phosphate varies considerably in quality and price according to its value as a manure, but wherever native labour is forthcoming, it is very easy to quarry and collect, especially where there is a natural anchorage. Portable tram-lines are laid down from the beds to the shipping place, whence the phosphate is transported to the ship's side in lighters. The discovery has led to the inclusion of a number of islets in the British Empire which would not otherwise have been worth claiming. Ocean, Starbuck, Wreck Reef, Cato, Suwarrow, Bird, Jarvis, Enderbury, and McKean's Islands have all been leased by the British Government to the Pacific Islands Company for terms sufficient to allow their phosphate deposits to be removed. When they are completely denuded they will, doubtless, sink back into their old remote isolation. The great obstacle to the working of these islands is the scarcity of native labour. Most of the

neighbouring islands, where the natives are of a roving disposition, have been laid under contribution, and in each island there is a motley settlement of many races and tongues, but as the labourers seldom bring their women with them, no fusion of races is likely to result. Mangaia, Niué, Manahiki, and the Gilbert Islands have been favourite recruiting grounds, but the difficulty in inducing natives to leave their islands for such uncongenial work is increasing.

Mining.

There is practically no mining in the British islands. From time to time indications of gold and of copper have been found in Fiji, but not as yet in sufficient quantities to pay. But since mining has been profitable in the French colony of New Caledonia, it is probable that when the Solomon Islands come to be fully explored ores will be found.

Manufactures.

Beyond the extensive manufacture of sugar in Fiji, and of its by-products, molasses and raw spirit, there are no manufactures of any importance. The available labour is fully occupied in remunerative agriculture, and as long as sugar and copra remain at their present price it is unlikely that capital will be invested in factories. It is, however, remarkable that while copra, the raw material for soap-making, is exported to Europe, soap to the annual value of £1,600 is brought all the way from Europe, when a small factory on the spot would have the advantages of cheap material, cheap labour, a local market, and no charges for freight. The minor manufactures, such as boat-building, desiccated coco-nut, and brick-making, are confined to Fiji. With very few exceptions, all the buildings in the colony are of wood. Though native timber is plentiful and there is building-stone of good quality within reach of Suva, all the materials are imported. The reason is that the local market in the islands is too small to justify capitalists in training workmen and in laying down the plant necessary for equipping a factory.

Currency.

The legal tender currency throughout the British islands is British sterling. There are no banks in the

islands except in Fiji, where there are two, besides a government savings bank. Despite an export duty on silver, heavy importations of coin have to be made, owing, in Fiji, to the practice among the Indian coolies of melting down coin for jewellery.

Transport. Except in Fiji, where light railways are extensively used for carrying cane to the sugar mills, and in Tongatabu, where the roads are wide enough to carry horses and carts, all the transport of the islands is by water. In the barrier reefs that surround most of the larger islands Nature has provided safe water-ways for light craft. The inter-insular goods are carried in cutters of from three to fifteen tons. Many of these are owned and manned by natives and half-castes, whose charges for short voyages are as high as £1 per ton. In the interior of the larger islands goods are carried either in shallow lighters on the rivers or in packages of from 50 to 100 lb., slung on bamboos on the shoulders of native porters.

Fiji is connected with Australia by a branch of the Trans-Pacific cable. There is also a cable between Suva and Levuka, which takes the place of the old service by carrier pigeon. A telephone line, traversing the heart of Vitilevu for 125 miles, connects Suva with Ba and Lautoka, and there are wireless telegraph stations in Suva and Taveuni.

Commerce. Accurate returns of imports and exports are available only for the groups of islands which are administered by a centralized government. They show during recent years a rapid increase. The trade of Fiji increased 30 per cent.; that of Tonga increased 90 per cent., while the trade of the Solomon Islands and the Cook Islands more than doubled in 1906–10.

About 80 per cent. of the trade is with Australia and New Zealand; the trade with foreign countries amounts to less than 7 per cent. Regular monthly steamers run from Sydney and Auckland to the principal groups, and it is therefore natural that the greater part of the trade should be carried in British ships.

PLATE XXV (*a*). FISHERMEN ON REEF, FIJI

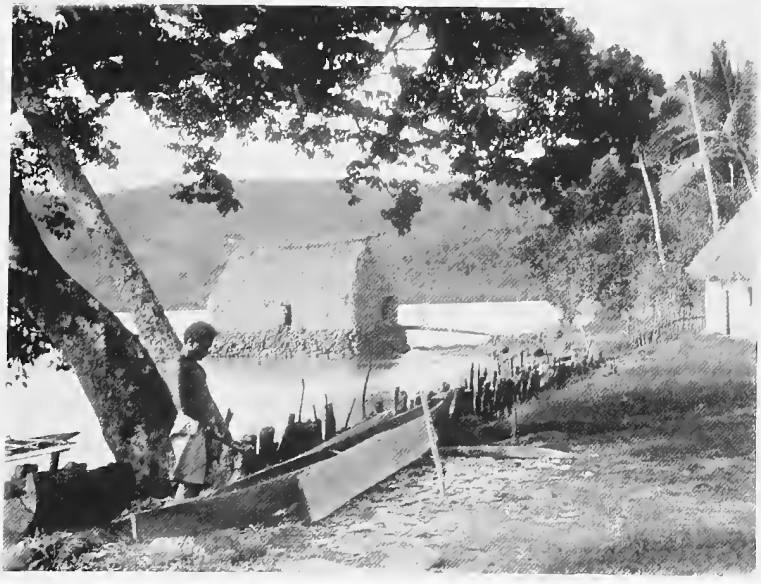

PLATE XXV (*b*). KADARU, FIJI: A CANOE BUILDER
(Mr. Basil Thomson)

PLATE XXVI. GILOGILO, FIJI: NATIVES FISHING

(Mr. Basil Thomson)

Social and Political Conditions.

The native population[1] of the British islands belongs to three races. The people of Tonga, the Cook and Ellice groups, and the other islands lying to the east of Fiji are Malayo-Polynesians, speaking a common root-language with dialectic variations; the people of the Solomon Islands, Santa Cruz, and the other islands lying west of Fiji are Melanesians—Fiji is the meeting-ground of the two races; the Gilbert Islanders belong to a mixed race of uncertain origin, called, for lack of a better term, Micronesians. Population: Races.

The average Polynesian is tall and handsome, light brown in colour and wavy haired. After middle age he is prone to obesity. His hair, naturally black, is dyed red with lime and cut short in order that it may stand erect like a barrister's wig. In Niué and some of the other detached islands more than one type, due to crossing with some alien stock, may be detected. Having long been subject to a monarchical form of government he has acquired a polished ease of manner which is wanting in the ruder Melanesian. In this respect the Fijian resembles him, though he differs from him in language and in physical characteristics. Most of the Polynesians have adopted European material for clothing, though the ancient kilt of bark cloth may still be seen in Tonga, especially during native ceremonial gatherings. Polynesians.

The Melanesian varies a good deal in colour. In Vanikoro he is nearly black; in the Solomon Islands there is every gradation of colour from black to red-brown, even in the same island. His hair is frizzy like that of the Fijian, but he is shorter and stouter in build, and more energetic and industrious. Though there are chiefs in all the Melanesian islands they wield less absolute authority than the chiefs in Polynesia and Fiji, and the Melanesian instincts are republican rather than aristocratic. Though the Solomon Islanders have been in closer association with Europeans than the other islanders, through the large Melanesians.

[1] See Fig. 59, p. 281.

number who have worked on plantations in Fiji and Queensland, they are still in a very primitive state of culture. The European clothes which they wore on the plantations and on European vessels are cast aside in their own island: they seem even to prefer their primitive digging-stick to the European spade which they were taught to use in Queensland. There are exceptions to the rule that the islands west of Fiji are inhabited exclusively by Melanesians. Polynesian castaways driven westward by the trade winds have established little colonies in Ongtong Java, Sikiana, and Bellona in the Solomon group, the Reef Islands near Santa Cruz, and Tucopia, and these colonies have not all lost their Polynesian characteristics by intermarriage with the Melanesians.

Fijians. The Fijian is a man of fine physique, muscular and athletic, with a dark-brown skin and frizzy hair, which he dyes with lime and dresses out until it forms an enormous golden aureole about his head. He is singularly conservative in small matters. His loin-cloth, which for convenience is now made of calico, has never made way for trousers; he still lives in the thatched hut which contented his fathers, and fashions a tree-trunk into a canoe. His language is Melanesian with many Polynesian words.

Gilbert Islanders. The Gilbert Islander has some Malayan characteristics, but there has been so much Polynesian intermarriage that one may trace in the same village two or more racial types. The normal Gilbert Islander is rather short and stoutly built, rather long in the body in proportion to the legs, with eyes set a little oblique, a brown skin, and straight black hair, which is worn long. He is the most expert and daring fisherman in the Pacific, besides being more energetic and passionate than either of the other races. Until the beginning of this century the Gilbert Islanders suffered from chronic over-population of their barren islands, but during more recent years there has been a heavy fall in the birth-rate.

Marriage. The marriage laws have had a profound effect upon the native population. In the Polynesian islands there is no

system of exogamy, though there appear to be survivals of group marriage in the terms of relationship. In Fiji, where races are mixed, there is much variety : in the island of Vanualevu descent is still traced through the mother, but throughout the larger part of Vitilevu there prevails the curious system of obligatory marriage which has been noticed in some parts of India. Shortly stated, the system carries an obligation on the children respectively of a brother and sister to marry, and a strict prohibition against the marriage of first cousins who are the children respectively of two brothers or two sisters. It does not, of course, follow that all the cousins of opposite sexes who ought to marry actually do so, but even if they do not, their children by other partners are regarded as brothers and sisters. It is a curious fact that, in a census designed to investigate the vital statistics of such marriages in 1893, it was found that about one-third of the total marriages were those of the right kind of first cousins, and that these marriages not only produced the greatest number of children, but also the greatest number of children still alive; whereas in the case of the marriages of first cousins of the prohibited kind scarcely any of the children survived.

In Santa Cruz and the greater part of the Solomons the population was divided into two exogamous classes, and descent was counted through the mother. This is probably the first social conception which grows in the mind of every young Melanesian of either sex, and it is the foundation on which the fabric of society is built. There are no tribes in these islands in the ordinary sense ; no territory, however small, belongs to one of these classes ; no family can fail to consist of members of more than one of the classes ; both classes, where there are two, and all, where there are more than two, are intermixed in habitation and in property. Suppose that the two classes are called *O* and *X* : an *O* man must marry an *X* woman, and all the children of both sexes are *X*. The brother of the *X* woman marries an *O* woman, and all the children are *O*. Speaking generally, it may be said that, to a Melanesian man, all women of his own generation are either sisters or

wives; to the Melanesian woman, all men are either brothers or husbands.

A good illustration of this is to be found in the story of Taso, from Aurora, in the New Hebrides, in which a man discovers and brings to his wife twin boys, the children of his dead sister. The wife asks: 'Are these my children or my husband's?' and the man answers: 'They are your husband's; they are my sister's children.' In that island there are two divisions, and the man's sister's children were of his division; had they belonged to the wife's division she would, on account of their age, have called them her children rather than her brother's.

There is a remarkable exception to this general rule in Ulawa, Ugi, and parts of San Cristoval, Malaita, and Guadalcanar. In this district there are no marriage classes, and descent follows the father. The languages also belong to a group by themselves, and a difference in the appearance of the people and their decorative art, Melanesians though they are, is noticeable.

Slowly but surely the law of marriage classes is breaking down under the teaching of the missionaries and the influence of the travelled native, and this change cannot fail to have a great influence on the social condition of the people.

Adoption. In Tonga, and in the Gilbert Islands, there is a remarkable institution of adoption. Apparently there were no fixed rules, but any person might adopt a child, from a whim, or from personal pique against his natural heirs. The adopted child immediately acquired a position superior to that of the real children. In Tonga, the motive was usually to protect a friendless child, or to provide against neglect in old age where the man had no child of his own; but in the Gilbert Islands, where the system is known as *tibun*, adoption often took place against the wishes of the man's relations, and there was much heart-burning and bitterness of feeling when the adopted child inherited land.

Vasu. In Fiji, one effect of the marriage laws was the institution called *vasu*. A young chief, and, in a lesser degree,

a young commoner, had an extraordinary claim upon his maternal uncle, a claim so great that, when he visited the territory of his uncle, he was expected to seize and carry off all the property that took his fancy. The people never thought of murmuring against these exactions; but it was the practice when a high chief woman married into another tribe to send with her certain persons whose business it was to make away with any children who might be born, for fear that they might prey upon her fellow tribesmen when they grew up. The institution of *vasu* was not, of course, confined to Fiji; it was found even in the Bantu tribes of Mozambique.

Land tenure.

The system of land tenure among the natives is of great importance, in view of increasing prosperity in agriculture. In the larger islands the land was of three categories; in Fiji it consisted of (*a*) the house site, (*b*) the plantation, (*c*) the bush. The general disposal of the land was vested in the chief as representing the community.

The house site was hereditary from father to son, but any member of the tribe might acquire the vacant site with the consent of the village head-man.

The manner of acquiring a plantation was as follows: the would-be owner, being a member of the tribe, went to the chief and said, 'I propose to plant on such and such land.' The chief would ask the people round him whether the land was vacant, and, on being assured that there was no other claimant, he would grant the request. Thereafter, the piece of land planted on was vested in that man and his descendants, unless they voluntarily surrendered it, or abandoned it so long that their term of ownership was forgotten.

The bush land might be granted by the chief to fugitives from other tribes, who paid rent for it in the form of service both in peace and war. Most of the large confederations were formed in this way. Speaking generally, the boundaries of a tribe were elastic; they advanced and retreated according to the power to occupy and defend the territory claimed. Such a system could, of course, be possible only where the land far exceeded in extent the

needs of the people who claimed it ; it suited the wasteful system of agriculture, where plantations were abandoned as soon as the land needed manure, and new ones were formed on virgin soil. Whenever a man or a tribe wished to make good a claim to land by occupation, it was usual to go off secretly and form plantations on its extreme boundary : this practice became very common during the sitting of the Lands Commission in Fiji, when the natives were trying to repudiate the sales made to Europeans. It is the general principle throughout the Melanesian islands that the ownership of fruit-trees and other crops is quite independent of the ownership of the soil. It was quite a common practice for a man to ask leave to plant coco-nuts in the land belonging to another, and, though he was entitled to all the fruit from such trees, he never thought of laying claim to the land itself. The land tenure in the more crowded islands, such as the Gilbert and Ellice groups, some of the atolls, and the Rewa delta in Fiji, was quite different ; here the land was barely sufficient for the support of all the people, and it could only be made productive by the individual labour spent upon it ; consequently the ownership was individual and hereditary, rather than communal.

Land purchase.

Europeans are astonished by the natives' intimate knowledge of their boundaries. In the Solomon Islands, in the Rewa delta, and in the Gilbert Islands, the boundaries were reckoned from tree to tree, and the land at every few yards' distance had a separate name. One native might hold individually plots a few feet square in twenty or thirty different places, and knew to six inches where his boundaries went, though they were not marked either in a plan or on the ground, and there was no written record of them. It will be seen from all this that the purchase of land is a very difficult matter ; the chief individually had no power to sell ; indeed, the out-and-out alienation of tribal lands was a conception that a native could not grasp ; they had these alienations for a life-time, or even two ; they had appropriations to particular members of the tribe ; but to sell to a stranger, and give

him the right of treating them as trespassers when the land lay within their boundaries, was incomprehensible. In Fiji, the Government has wisely determined not to allow any more native lands to be sold to Europeans, and has only acquired as Crown land such tracts as have been left without an owner by the disappearance of an entire tribe. It has met the need of the planters by negotiating for long leases of the unoccupied lands, and even here there has been much difficulty in distributing the rents. In some districts the chief, by old custom, has the right to a portion of the produce ; in others, the proprietary unit included widely-scattered septs ; in others, again, the only living representatives of the old proprietors were two or three children. But whatever were the actual rights, the number of claimants that came forward for a share of the land was countless, and even though three-fourths of them were turned away, they eventually secured a share by pestering their more fortunate relations.

In the Solomon Islands the problem was even more complicated by the large number of persons who had a legitimate interest in the land. Probably this arose from the custom of drawing upon all the relations and friends to help in clearing the land and forming a plantation. Such help was reciprocal, and it gave every helper an interest, not only in the land which he claimed as his plantation, but in all the plantations which he himself had helped to make. A good deal of land has been sold to Europeans, but no purchase is complete until all these claims have been satisfied, and the compensation settled by common consent.

Native arts.

Some problems of ethnology may remain for ever unsolved. Alone among Pacific islanders the people of Ongtong Java, Sikiana, and the islands near Santa Cruz use a hand-loom. Some of these natives are descended from Polynesian castaways, and yet none of the Polynesian races understands weaving. If they invented the art in their new home it is curious that their Melanesian neighbours should not have imitated them. Again, though potter's clay exists in many of the

islands, the art of making pots is unknown to any of the Polynesians. In Fiji it is practised by the women in certain districts, where some intricate and beautiful shapes of hand-made pottery have been evolved without even the wheel or the kiln. The art is known in only one place in the New Hebrides, and in the Bougainville Straits in the Solomon Islands, and nowhere else. Though the method is perfectly well known to the women of the tribes bordering upon the potters, who are aware that they might turn it to profitable account, no instance is known of any attempt on the part of natives to introduce the art into a tribe with whom it is not hereditary.

European settlement and administration.

During the first half of the nineteenth century the European settlers were for the most part runaway sailors, who were content to be absorbed into the native social system without attempting to alter it. The early missionaries, who won their converts through the active support of the chiefs, had a strong motive for maintaining intact all native institutions that were not incompatible with Christianity; and since the Colonial Government found it easier and less costly to govern the natives through their hereditary chiefs, there was a tendency on the part of government officials from the outset to put a ring fence round the natives and to keep the destructive agency of commercial competition at arm's length as long as possible.

Effects of European intercourse.

Before the institution of settled government the native polity had begun to decay. In the islands ruled by an autocracy or an oligarchy of chiefs, the system of government, closely interwoven with religion, lost much of its prestige when the people adopted Christianity. Club law, when it existed, was quickly displaced by a simple code adapted from an English model by the missionaries, and the stocks, the lock-up, and the prison gang working on the roads became the only penalty for the transgressor. The power of the chiefs waned, and in Tonga, where aristocracy was most developed, the chiefs were fain to preserve the last semblance of outward respect by making it a penal offence to ride past a chief without dismounting.

In democratic communities like the Gilbert Islands the Kaubure, or native counsellors, formerly composed of old men, is now an assemblage of young men qualified, by their foreign travel as sailors, to speak with authority on the customs of white men. The transition state between two ethical codes must always entail some moral deterioration. The present-day native is milder and less cruel than his forefathers, but he is also less truthful, less industrious, and less continent. In the larger groups the possession of European vessels has created a class of loafer who cruises about from island to island, abusing the hospitality of unwilling hosts.

Diseases and reduction of population.

With all this, new diseases, such as measles, phthisis, and dysentery, luxuriating in a virgin soil, have wrought wide destruction, and the population of all the islands has been declining. The native population of Fiji, having fallen from 150,000 to 87,000, appears for a time to be stationary, but in all the other islands it is still falling. As might be expected, in islands destitute of milk-yielding animals, the mortality is chiefly among infants, for the old custom of suckling for from two to three years has fallen into disuse. The vitality of the people, when once they are safely through the dangerous period of infancy, seems to be equal to that of Europeans ; and individuals live to a great age. King George I of Tonga was known to have been 96 when he died, in 1892. In the decrease of a race from new diseases there seems to be a stopping-place. It may come when the population has been reduced to one-fifth, as with the Maoris, or to a mere handful, as with the blacks of New South Wales, but there comes a time when decay is arrested, and then perhaps fusion with another race sets in.

Effects trading and labour.

Commercial prosperity has of course not left the natives untouched. The greater part of the land in Fiji and all the land in Tonga is the property of the natives, who, even with their wasteful system of agriculture, consisting as it does in moving their plantations to fresh ground after almost every crop, require only a small portion of their holdings for their own support. The remainder is

leased to Europeans, if they require it, and the rent, as well as wages for work, is paid to the native landlord or labourer in hard cash. Out of this, instead of the old courtesy and hospitality, has grown a spirit of hard commercialism. Even the Fijians, whose conservatism has made them the last to adopt European dress, and who gave hospitality to every passing traveller, now expect payment from their guests. It cannot be said that the money so easily acquired has been of any benefit to the natives. As a rule their idleness increases in proportion with their means.

Native migration and changes in habits.

In the Polynesian islands the increasing demand for labour is affecting the native population adversely. The men of Niué, Manahiki, Uea, the Gilbert Islands, and Mangaia, have always had a passion for roving, and with the opening of the phosphate beds at Ocean, Fanning, and other islands, where good wages are paid, they fall an easy prey to the recruiting agent. Occasionally their women accompany them ; more often they are left at home, in an island almost destitute of young men. A few races, like the Fijians, are slow to adopt European habits, but for the most part the travelled labourer casts his picturesque native dress aside, cuts his hair, and adopts a villanous suit of slop clothing and a hat, though he is still wise enough to go barefoot. With this goes a growing taste for tinned salmon and biscuits, for tea and sugar, and even for cheap scent. No more will the young man learn from his father the art of growing yams or taro ; the life at home is too tame for him. When the thatched roof begins to leak, only the very old men know how to thatch. The house built of timber or lime concrete out of the wages earned abroad is probably more sanitary than the grass huts of a few years ago ; but as a rule the money is not spent so usefully. It is frittered away in toys such as boats, sewing machines, gramophones, and musical boxes, or else in a lavish profusion of food at the public feasts. A very few Fijians have become employers of labour as owners of banana plantations, and have banking accounts, but these are exceptions, and it has never occurred to a native, however commercial in spirit, to

compete with the local trader by opening a shop. The social condition of the people, however, is changing very rapidly. Islanders who have never seen a domestic animal except the fowl and pig may turn in the course of a few months into horsemen, and even into pastoralists. The islands are in a state of transition, and it is impossible to predict what degree of culture there will be even in the near future.

Religion

With the exception of some of the tribes in the Solomon Islands and the small adjacent islands who retain a simple form of ancestor-worship, the native races of all these scattered possessions are nominally Christians. In the eastern groups, the London Mission; in Tonga and Fiji, the Wesleyans; in the New Hebrides, the Presbyterians; in Norfolk Island and the Solomon Islands, the Church Missionary Society, have divided the Protestant field between them, and scattered through all the islands are Roman Catholic priests and sisterhoods, generally French or Belgian, each with their little church and congregation, less successful than their self-denying labours deserve, perhaps because they belong to nationalities who find it less easy than Englishmen to win the confidence of natives; perhaps because of the determined hostility shown towards them by the Protestant missionaries.

When one considers the character of the Polynesian, it is not surprising that the first heat of conversion has begun to cool. The experience of Hawaii, New Zealand, Tonga, and Fiji seems to show that the active life of missions in the South Seas is from fifty to seventy years. After that time there will remain the social habit of church-going, and of contributing to the annual collections, because open-handedness is a quality without which no man can command any social consideration. But the missions will have lost much of their influence upon the daily conduct of the people, and there is besides a tendency towards the invention of a compound between Christianity, magic, and ancestor-worship which appeals strongly to the religious instinct of the natives. Of such were the *hauhaus* among the Maoris, the *tuka* among the Fijians.

The majority of the Europeans scattered through the Pacific probably belong by upbringing to the Episcopal Church, but except in the considerable white community in Fiji, where there is now a resident bishop, they have little opportunity for practising their religion, and they live much as Englishmen are obliged to live in outposts of the Empire, without a church unless they choose to attend the native missionary church.

Indian labourers.

The Indians who have poured into Fiji as labourers for the sugar plantations, and now number not less than 40,000, have introduced a new factor. The greater part of these are low-caste Hindus, a minority are Mohammedans. But though there are both Hindu and Mohammedan priests among them, the great majority may be said to have no religion at all. Their priests have made no attempt hitherto to proselytize among the Fijians, and so great is the natural antipathy between the two races that it is unlikely that they will ever do so. The Wesleyans, and to a smaller extent the Anglicans, have attempted missionary work among them, but without much success.

Missionary work.

The missionary work among the Gilbert and Ellice Islanders has been carried on exclusively by native Samoan teachers of the London Missionary Society, who have done remarkable work, even though they have not escaped the reproach of having used their position to interfere in native politics. This is a reproach from which their European instructors cannot entirely be absolved, and it is indeed difficult to see how a teacher, upon whose word even the chief of the new converts hangs, can refuse to give advice upon temporal matters, especially in law-making, when it is sought. On the whole, with a few notable exceptions, they have not misused their opportunities.

As we journey westward into the domain of the Church Missionary Society, we find the missionaries driving with a lighter rein. The head-quarters of this mission are in Norfolk Island, and it has been the practice for the European missionary to leave the unhealthy islands during

the hot season to the care of native teachers trained in the mission school in Norfolk Island. It is not easy to see how this could have been avoided, but the result is not always satisfactory. Among the democratic tribes of Melanesia, where there is often no chief of paramount influence, there could never have been the wholesale conversions accomplished among aristocratic peoples of Tonga and Fiji, where the people followed the chief to church like a flock of sheep, and where none dared betray his pagan leanings when the lukewarm fit was on him. Nevertheless, if the Melanesian Mission has been slow in bringing all the natives in its sphere of influence to conversion, it is now able to claim that they are all, excepting perhaps a few inland villages in Ysabel Island, nominally Christians.

Education.

The education of the natives throughout these scattered groups of islands has cost nothing to the state. Settled government found the missions already in possession of the field, with a large staff of native teachers trained in the mission school, and qualified to act as school-masters as well as clergy in the villages to which they were posted. In the Gilbert and Ellice groups the teachers were sent from Samoa ; in the Paumotus from Tahiti ; in the Cook Islands, in Tonga, and in Fiji, the teachers were all indigenous. It is greatly to their credit that all the younger natives of both sexes were soon able to read and write their own language and to do simple arithmetic after a fashion. There the education stopped. There was no attempt at technical education nor at teaching English, and with the material at hand it is not easy to see how this could have been done. In Fiji and the Cook Islands and in Tonga, the administration has made a serious attempt to remedy these defects. There are school boards in the towns of Suva and Levuka (Fiji), and the schools are open to the children of all races. There are also Government technical schools for the natives, and attached to the Colonial Hospital there is a medical school for Fijian medical practitioners. In Tonga there has long been a Government College, where natives were too often taught

only showy accomplishments such as higher mathematics, shorthand, &c., but in 1910 the system was remodelled and prominence was given to technical education. In the Cook Islands, the natives having shown a strong wish for better education than the mission was able to give them, the Government has taken over the schools, and a course of technical education is given.

Non-native population.

The beachcomber in the tropical islands is now happily extinct, and his place has been taken by the trader and the planter, who have passed through many lean years before they attained their present prosperity.

The Europeans in Fiji number about 3,500, but of these some 500 are temporarily employed at the sugar mills as artisans and are not permanent settlers. About 1,500 form the population of the two towns, Suva and Levuka, the only municipalities in the British islands. The remainder are missionaries, civil servants, planters, overseers, and traders.

The white population of the Cook Islands is only 160 and of the Solomon Islands 307. In the protectorate of Tonga the whites number less than 100.

In the Gilbert Islands, the Chinese trader is rapidly ousting the European. The Chinese can make a living where the white man cannot, and the consequence of the present competition is that the white traders are barely securing a livelihood. They buy copra from the natives for a penny a pound, and sell it to the steamers for a penny-halfpenny, and upon this narrow margin on forty or fifty tons of copra annually they have to live. The white trader has disappeared from the Ellice Islands altogether, and there the steamers buy copra direct from the natives. The position of the white trader is very different in Tonga, where the competition is less and the resources of the island greater. Some of the traders in Tonga and Vavau are reputed to be worth £10,000. The trader in Fiji has suffered from the competition of the Indian coolie, and from the large merchants of Suva and Levuka, though, even in that group, some of them do exceedingly well. In the Solomon Islands they are still

pioneers, but with enterprise and frugality, while the prosperity of the group is growing, they are bound to succeed.

Climate and health.

The climate of all the islands except the Solomon Islands and Santa Cruz, where there is much malaria, is not unhealthy. White women suffer from the tropical heat more than men, but both sexes are healthy and live to an advanced age.

Racial and class relations.

Although there is no marked race antipathy between the whites and the natives in Fiji, there is little intercourse between them; few of the natives speak English, and if we except the missionaries and civil servants, few Europeans speak Fijian. Each of the three races who are to mould the destiny of the colony—English, Indians, and Fijians—live their lives severely aloof. In the islands where the whites are few and widely scattered, as in Tonga and the Solomon Islands, Europeans fraternize to some extent with the natives on more equal terms. Men of strong character acquire great influence over the chiefs; the others are inclined to treat them with deference and to take the native Government quite seriously.

In Fiji, and in a lesser degree in Tonga and the Cook Islands, the half-castes form a class apart and do a large part of the coasting trade as masters and seamen. They marry among themselves and have large families, but though they are of fine physique they appear to suffer more than the natives from scrofula. In Fiji they number nearly 2,000.

Government.

In these widely scattered possessions every type of political institution is to be found. Fiji is a Crown colony with an official majority on the Legislative Council; Tonga, with a population of only 20,000, is a protectorate governed by a King, a Privy Council, and two Houses of Parliament, the only *nexus* with the British Government being the Agent and Consul; the Cook Group and a number of adjacent islands are annexed to New Zealand and are administered through the chiefs by a Resident; the Solomon Islands are governed by a Resident

Commissioner under the control of the High Commissioner; a number of the smaller islands, such as Flint and Malden Islands, are leased to companies; Pitcairn Island, inhabited by the descendants of the mutineers of the *Bounty*, is administered by an elected president. The form of government in each case has been determined by circumstances.

Fiji.

Fiji was ceded to the Crown by the native chiefs in 1874 under the implied condition that the islands would be administered by the Crown; otherwise they might ere now have been handed over either to the Australian Commonwealth or to New Zealand. As in other Crown colonies the Government is administered by the Governor and an executive council, and the legislative authority is the Legislative Council, consisting of official and unofficial members, the official members being in a majority. Local Ordinances passed by the Legislative Council require the sanction of the Crown before they can come into force. The English law applies where it is not inconsistent with a local Ordinance. The natives are subject to a special body of Regulations enacted by the Native Regulation Board, which regulates matters that lie outside the scope of the criminal law of the colony.

Native government.

For the purposes of native government the colony is divided into provinces corresponding generally with the large tribal confederations that existed before the group became a British colony. Each province is under a chief, termed *roko tui*, if possible the hereditary chief of the province, who is responsible to the Governor, and who receives a salary of £150 to £300 a year. Each province is divided into districts coinciding roughly with the old tribal divisions, each under a chief, called the *buli*, who receives a salary of £3 to £12 a year. The *buli* presides over the District Council at which the village head-men (unpaid officers) are present to discuss such matters as the making and repair of roads, the apportioning of the duty of providing food for strangers, &c. The elaborate system of native councils appeals to the Fijian's love of form and ceremony. Provinces, districts, and villages each have

their councils, and there is besides a Great Council of Chiefs, which meets periodically under the presidency of the Native Commissioner to advise the Governor, as supreme chief, on matters affecting the Fijian people. The other paid native civil servants are magistrates, with criminal jurisdiction over Fijians up to imprisonment for three months, and provincial scribes, who receive about £12 a year and act as treasurers and clerks for the province. On the whole the system has worked well, but it is questionable whether the natives are not beginning to outgrow it. As long as the *roko tui* and the *buli* commanded allegiance as the hereditary chiefs the people gave them willing obedience, but when the hereditary chiefs had to be deposed by the Government on account of misconduct, and a mere native official was installed in his place, the whole of the machinery was out of gear. The salaries are so small that though the native officials are not as a body corrupt, the temptation to borrow from the funds passing through their hands has been too strong for not a few of them.

The natives pay a special tax in kind which is assessed annually according to the resources of the province. The tax produce is sold to a contractor, and any surplus over and above the assessment which may result from the sale is returned to the natives in cash.

Law.

The law is administered by a Supreme Court, and petty sessional courts presided over by Stipendiary Magistrates; the native regulations by a provincial court consisting of a European and a native magistrate, and district courts in which a native magistrate sits alone. The stipendiary magistrates are also commissioners of the supreme court for the trial of actions up to £50, and much of their time is taken up by the trial of actions brought by one Indian coolie against another, for as a class the coolie is inordinately fond of litigation.

High Commissionership for the Western Pacific.

The Governor of Fiji is also Consul-General and High Commissioner for the Western Pacific, an office constituted by an Order in Council. All the islands not annexed by other Powers, or by New South Wales or New Zealand, are

under his jurisdiction. He has power to make regulations which are binding on British subjects throughout his jurisdiction for the control of such matters as the sale of liquor, arms, and ammunition to the natives. Unfortunately he has no power over foreigners, and this presses with peculiar hardship on British subjects in islands such as the New Hebrides, where there is a *condominium* with the French Government, and where British traders have the mortification of knowing that the foreign traders who are in competition with them are selling contraband to the natives almost openly. The High Commissioner has also the power to grant leases of the British islands that are in his jurisdiction, and it is under leases so granted that a number of the smaller islands which have lately become valuable for their deposits of rock phosphates are held by commercial companies. Over British subjects in these islands he has peculiar powers. He may prohibit any British subject who is shown to be a disturbing influence in an island from remaining there for a fixed time under pain of imprisonment. The court for the trial of civil and criminal cases arising in the jurisdiction of the High Commission is the supreme court of Fiji, but as this court does not go on circuit its powers are delegated to Deputy Commissioners who are Consuls or British Residents in each group of islands, or captains of ships of war. The Deputy Commissioners' courts have civil and criminal jurisdiction, but their powers in criminal cases are limited to those that may be tried summarily ; persons charged with indictable offences must be committed for trial by the supreme court of Fiji.

Gilbert Islands Protectorate.

The seat of government in the Gilbert Islands Protectorate is Ocean Island. In islands where there is a powerful hereditary chief he sits as president of the *Bowi*, or island council. There is a native magistrate, chosen by the British Resident to administer the island laws, and a scribe to keep the records, accounts, and registers. The other paid officials are police, jail warders, and a hospital orderly to dispense medicines. The native council readily takes the advice of the European officer,

and the system is therefore well adapted to the needs of the people. The Ellice Islanders, who as pure Polynesians differ widely from the more energetic and rougher people of the Gilberts, practically govern themselves. They are seldom visited by government officials and there are no European traders. Crime is almost unknown in these islands.

Islands belonging to New Zealand.

The islands belonging to New Zealand are administered by Resident Commissioners. In the Cook Group the Resident Commissioner is assisted by resident agents on each of the larger islands. These agents are assisted by advisory island councils. The Resident Commissioners are responsible to the cabinet in Wellington. There is a High Court in Rarotonga with civil and criminal jurisdiction and summary courts in the larger islands. Rarotonga is also the head-quarters of the Land Titles Court.

Islands under New South Wales Government: Norfolk Island.

Two European settlements are under the control of New South Wales—Norfolk Island and Lord Howe Island. Norfolk Island lies outside the tropics in latitude 27° S., an island of low hills and rolling grass land, dotted with clumps of the beautiful Norfolk Island pine. The total area exceeds 7,000 acres. The climate is healthy and equable. Formerly a station for the worst class of convicts, the island has always been a part of New South Wales. The system of electing the chief magistrate from among the residents having proved to be unsatisfactory, an appointment is now made by the government of the parent colony, the residents being represented by one of the members of the Lower House. The Melanesian Mission of the Church of England has its head-quarters on the island, and there are still a few descendants of the mutineers of the *Bounty* who were brought to the island from Pitcairn. Education is compulsory and free. The island is connected with the outer world by cable via Fiji and with Sydney by a monthly steamer.

Lord Howe Island.

Lord Howe Island contains 3,220 acres, of which the greater part is steep and mountainous. Situate just within the tropics, the climate is mild and temperate, the

thermometer varying from 60 to 80 degrees. There is a rainfall of from 60 to 100 inches, and the inhabitants rely upon tanks for their water-supply. The island is composed of a mountain of grey basalt, and the piece of flat land on which the inhabitants live is formed of the detritus from the mountain. The first inhabitants were a Maori family brought to the island by a whaler. They were bought out, and all the land now belongs to the Government of New South Wales, which allows the settlers, some 90 in number, to squat on the land on sufferance. The only export is the seed of a palm, the *Ficus colomnaris*, which flourishes on the steep sides of the hill. The palm takes from fifteen to twenty years before it is in full bearing, and the seed has to be carried on the shoulders of the collector. The position of the islands has been much improved lately by the establishment of a monthly steamer. A magistrate visits the island four times a year to deal with any judicial cases; executive affairs being dealt with by the Chief Secretary in Sydney.

The population, who are all descended from Australian settlers, numbers 100; they vote for the King division in Sydney. The older men are illiterate, but education is now compulsory, and the school is regularly attended.

Pitcairn Island.

Like Norfolk and Lord Howe Islands, Pitcairn Island had no natives of its own. The story of its colonization by the mutineers of the *Bounty* ship of war in 1789 is well known. The mutineers had well chosen their place of retreat, for it was not until 1809—twenty years after the mutiny—that their existence was discovered by Captain Folger of the American ship *Topaz*; only one of the mutineers, John Adams, then survived, but the half-caste children of the others by Tahitian mothers were growing up, and had all been taught by him to speak English and to read the Bible. The population increased so rapidly that in 1856 the British Government removed all the inhabitants, to the number of 194, to Norfolk Island. Three years later they began to return to Pitcairn Island, and the little colony is again flourishing. The island is of volcanic formation and stands high: there is no

PLATE XXVII (*a*). FANNING ISLAND: RECLAMATION DAM NEAR ENGLISH HARBOUR

PLATE XXVII (*b*). FANNING ISLAND: THE WEATHER SHORE
(Sir Everard F. im Thurn)

PLATE XXVIII (*a*). ANTARCTICA: NEW GLACIER ENTERING SEA-ICE (DEVIL'S RIDGE); MOUNT SUESS NUNATAK IN REAR

PLATE XXVIII (*b*). ANTARCTICA: ICE FLOOD FLOOR AND SUMMER TARN. YOUNG CWMS ON SLOPES OF MOUNT ENGLAND (see p. 518 seqq.)

(Mr. Griffith Taylor, by permission of Commander Evans)

anchorage nor is the island surrounded by the usual barrier reef. It is about four miles long and two miles wide, heavily timbered and very fertile. Though it was uninhabited when the mutineers arrived there is evidence that it was formerly inhabited; a platform, similar to those in Easter Island, with three stone statues still standing on it, having been found on a ledge of one of the sea cliffs. Bones were found buried under the platform in the usual way. The patriarchal government of John Adams has given place to that of an elected president. The island became a British protectorate in 1842. The president, a descendant of one of the mutineers, hoisted the British flag over the adjacent islands of Oeno, Henderson, and Ducie in 1911.

British Islands in the Western Pacific, with dates of acquisition, and status.

Fiji Group (1874). Crown Colony.
Rotuma (1876). Crown Colony.
Cook Group (1891). Annexed to New Zealand.

Rarotonga	Atiu
Mangaia	Mauki
Aitutaki	Mitiero

Hervey Group (1891). Annexed to New Zealand
Manuai. Auotu. Takutea.

Manahiki (Humphrey)
Rakaanga (Rierson)
Niué (Savage)
Danger Group
Pukapuka
Motukoe
Motukauta
Nassau
Suwarrow
Palmerston
} (1891). Annexed to New Zealand.

Lord Howe Island
Norfolk Island
} Annexed to New South Wales.

Pitcairn (1842). Protectorate.

Baker
Howland
} Purchased by a British subject from American Guano Co.

Oeno
Henderson
Ducie
} Annexed by Mr. McCoy, President of Pitcairn Island.

Malden (1901). Leased to British Company.

Caroline, Flint, Phoenix Group, Sydney, Hull, Gardner, Swallow, Birney, Vostock (1901). Leased to Messrs. Lever Brothers for 99 years.

Enderbury, McKean's (1901). Leased to Pacific Islands Company for 21 years.

Ocean, Starbuck (1902). Leased for 98 years to above company.

Wreck Reef, Cato, Bird, Jarvis (1902). Leased to above company for 21 years.

Washington. Owned by a British subject.

Union Group (1889). Protectorate.

Fakaago. Nukunono. Oatafu.

Ellice Group (1892). Protectorate.

Nni	Nuitau
Funafuti	Nanomanga
Nukufetau	Nanomea
Nuknlailai	Vaitupu

Tonga (1900). Protectorate.

Tongatabu	Niuafoou
Haapai	Namuka
Vavau	Tofua
Niuatobutabu	Eua

Gilbert (1892). Protectorate

Apemama	Tabiteuea
Kuria	Maiana
Ananuka	Tarawa
Nonouti	Makin

Santa Cruz Group (1898). Protectorate.

Vanikoro	Tncopia
Santa Cruz	Cherry
Utupua	Mitre
Duff Group	

Solomon Group (1893). Protectorate.

San Cristoval (1893)	Sikiana (1893)
Guadalcanar (1893)	Rennell (1898)
Malaita (1893)	Bellona (1898)
Ysabel (1900)	Ulawa (1893)
New Georgia (1893)	Three Sisters (1893)
Florida (1893)	Fauro (1900)
Santa Cataliua (1893)	Gower (1893)
Santa Anua (1893)	Choiseul (1900)
Buena Vista (1893)	Ugi (1893)
Treasury (1893)	Savo (1893)
Eddystone (1893)	Ongtong Java (also called Lord Howe) (1898)
Buka (1893)	

Swallow Group (1898). Protectorate.
Nupani. Pileni. Nukapu.
Kermadec Group (1886). Annexed to New Zealand.
Penrhyn Island (1901). Annexed to New Zealand.
Fanning (1888). Property of British subject.
Macquarie. Annexed to Tasmania.
Christmas (1888). Leased to British company.
Bounty (1901). Annexed to New Zealand.

[See J. W. Burton, *The Fiji of To-day*, London, 1910; Florence Coombe, *Islands of Enchantment*, London, 1911; H. S. Cooper, *The Islands of the Pacific*, London, 1888; Lilian S. Gibbs, 'A Contribution to the Montane Flora of Fiji, with Ecological Notes,' in *J. Linnean Soc.*, 1909, pp. 130–212; H. B. Guppy, *The Solomon Islands and their Natives*, London, 1887, and *Observations of a Naturalist in the Pacific*, London, 1906; B. Thomson, *Savage Island*, London, 1902, and *The Fijians*, London, 1908; C. M. Woodford, *A Naturalist among the Head-hunters: Solomon Islands*, London, 1890. Works of Robert Louis Stevenson may be consulted with profit, and there is a considerable literature of descriptive and narrative travel-books.] Literature.

CHAPTER XV

THE DEFENCE OF BRITISH AUSTRALASIAN TERRITORIES

The strategical conditions as regards the defence of Australia and New Zealand, if not identical, are so similar that they are best considered together. There are various cases that might arise that would necessitate active measures being taken by both Dominions for their own defence or the defence of Imperial interests.

1. War with a European naval Power or group of naval Powers.

2. War with a naval Power in the Pacific (Japan or the United States).

3. Intervention by a Pacific naval Power when the Empire is at war with a European Power or group of Powers.

The first contingency is best understood by taking a concrete case. On the principle that the greater contains the less, let us suppose, therefore, that war has broken out between the Powers of the Triple Entente and those of the Triple Alliance. We can discard Sir Wilfred Laurier's theory of the possible neutrality of the Dominions.

The test of this theory is the case of a vessel belonging to one of the Dominions that meets a hostile commerce destroyer on the high seas. Is she or is she not a legitimate prize ? There can be but one answer. We must assume, therefore, that in such a case it will be necessary to afford protection to the oversea trade of both Australia and New Zealand. We can also assume that the decisive theatre of naval operations will be either the North Sea, the Atlantic, or the Mediterranean, and not the Pacific. As far as local defence, therefore, is concerned, these Dominions would only have to fear the depredations of such commerce destroyers as might elude our fleets disposed for commerce protection. Should the Dominions neglect entirely the protection of their commercial harbours the enemy might be tempted to combine a raid on these with his efforts at commerce destruction.

The local risks being so slight it is perhaps not unreasonable to go a step further, and to assume that the interests of the Dominions in the case under consideration would be best served by co-operation at the decisive point both on sea and land, rather than by concentrating their efforts on local defence.

War with either of the Pacific naval Powers, Japan or the United States, is unlikely at the present time for reasons which it is not necessary to detail here. Should it take place, however, British naval action would necessarily be governed to some extent by the situation in Europe. The heart of the Empire must be adequately protected in all circumstances, and under present conditions it is possible that Australia and New Zealand would have to face temporary sea supremacy in the Pacific on the side of the enemy. Such sea supremacy, however, could not endure for any length of time. Mr. Winston Churchill contemplates the formation of a formidable ' whole world fleet ', which will eventually be in a position to reinforce our naval power in the Pacific at short notice. In addition, we could undoubtedly send naval reinforcements from the North Sea or the Mediterranean to the Pacific unless our relations with certain

European naval Powers were unsatisfactory. Moreover, war with a Pacific naval Power could hardly take place without a complete change in our relations with the Power or Powers concerned, which would undoubtedly be followed by a redistribution of our naval forces in peace time, and the distance that separates Australia and New Zealand from the naval bases of the naval Powers in the Pacific limits to some extent the possibilities of effective action on their part.

The conditions in which successful oversea attack can be carried out are referred to at some length in the volume in this series which deals with general imperial topics, where it is pointed out that when decisive results are aimed at it is necessary to establish sea communications on a firm basis. It is difficult to conceive that this could be done in the case under consideration, and, although greater efforts would be required from the Dominions than in the case already considered, it is unlikely that their resources would be put to a very severe test before naval assistance from European waters eased the situation considerably.

The third case, that is to say intervention by a Pacific naval Power when we are at war with a European Power or group of Powers, is the most formidable contingency that Australia and New Zealand have to face. The conditions would be similar to those just discussed, but would differ considerably in degree. The naval power of our possible enemies in Europe is such that no estimate can reasonably be formed of the time that must elapse in such a case before we should be able to establish sea supremacy in the Pacific. Sea communications, as already stated, are necessary for a decisive attack, but it will suffice to maintain them till the military object in view has been achieved. In this respect the military power of Japan, which would enable her to equip and launch an expedition more rapidly than the United States, makes her a more formidable potential antagonist.

Whether the risks involved in the above cases are sufficient to justify naval and military preparations on

a scale adequate to meet all or any of them is a political question for the Governments of the Dominions concerned to solve, in co-operation with the Home Government. It is only possible to judge of the views held on these questions by the Governments of Australia and New Zealand from the nature of the preparations that they are making. This brings us to a consideration of their present naval and military policy.

Naval policy.

British naval power in the Pacific has been so far reduced since the conclusion of the Anglo-Japanese Alliance that in June 1913, according to the Navy List, it was represented by :

Eastern fleet.

China Squadron :

6 Cruisers (the largest the *Minotaur*, being 14,600 tons).
6 Gunboats.
10 River Gunboats.
8 Destroyers.

Australia Squadron :

3 Cruisers (the largest the *Cambrian*, being 4,360 tons).
1 Sloop.

East Indies Squadron :

1 Battleship (11,600 tons).
4 Light Cruisers.

This fleet, unless reinforced, is obviously no match for the naval power of either Japan or the United States.

While, for the reasons stated in Vol. VI, progress with the formation of the China and East Indies fleet units agreed to at the Imperial Conference of 1909 has been delayed, Australia has persevered with her side of the arrangement.

In 1910 Admiral Sir Reginald Henderson accepted the invitation of the Commonwealth Government to visit Australia in order to advise on matters connected with naval defence. The battle-cruiser for the Australian fleet unit agreed to in 1909 was laid down, contracts for two protected cruisers were placed, and the construction

of two destroyers was completed by the Fairfield Company. The battle-cruiser to be built at the cost of the New Zealand Government was laid down at Govan.

In 1911 Admiral Sir R. Henderson presented his report to the Commonwealth Government. He recommended the creation within twenty-two years of an Australian fleet of 8 armoured and 10 protected cruisers, 18 destroyers and 12 submarines, including the vessels then under construction. The battle-cruiser *Australia* was launched at Clydebank. One destroyer was shipped in sections from England to Sydney, where it was put together and launched, and the Commonwealth Government accepted the tender of the New South Wales Government for the construction of a cruiser and three destroyers required to complete the Australian fleet unit.

In 1912 two protected cruisers for the Australian fleet unit were launched, and an agreement was entered into between the Admiralty and the Commonwealth Government dealing with the arrangements for the transition period prior to the completion of the Australian fleet unit. H.M.S. *Encounter* was lent as a training ship for Australian naval recruits, and H.M.S. *Pioneer* was presented to the Commonwealth for use as a gunnery training ship. As the result of communications between the Home Government and the Government of New Zealand, the latter agreed to the battle-cruiser *New Zealand* being stationed wherever H.M. Government considered her services of most value.

In June 1913 the situation was as follows : The battle-cruiser *Australia* had completed her trials and was intended to leave for Australia during the course of the summer. The *New Zealand* sailed on February 7 on a round-the-world cruise, during the course of which she was to visit New Zealand. The *Melbourne*, light cruiser, 5,600 tons, left for Australia on January 27. The *Sydney*, same class, completed her trials on the Clyde in April. The *Brisbane*, same class, was building at Sydney, where also three destroyers, the *Torrens*, *Swan*, and *Derwent*, were in progress of construction. Three destroyers, the

Parramatta, *Warrego*, and *Yarra*, were in commission, and some submarines were under construction.

As regards personnel, plans were adopted for a naval college at Gervaise Bay, and recruiting proceeded, so that before the end of the year 1913 the Commonwealth was in possession of the vessels proposed in the first part of Admiral Sir R. Henderson's scheme.

It is clear from the above that Australia takes a serious view of her responsibilities as regards naval defence, and that she is determined in the course of time to construct a fleet that will enable her to offer opposition to naval attacks on her territory should any of those contingencies arise that have been discussed above, till such time as she may be relieved by naval reinforcements from home waters. The Government of New Zealand, on the other hand, has hitherto favoured the policy of naval concentration as represented by contributions, and it remains to be seen whether it will adhere to this policy or come into line with Australia.

The Australian military forces.

In compliance with an invitation from the Commonwealth Government, Field-Marshal Viscount Kitchener visited Australia in 1909 with a view to tendering advice as to the development of the military forces of the Commonwealth. He embodied his recommendations in a report rendered in February 1910. An amendment to the Defence Act of 1903 had been passed in 1909 providing for the introduction of a system of universal service, and this amending Act formed the basis of Lord Kitchener's recommendations, which were as follows :

(i) The development of land forces to the extent of 80,000 fighting troops, of which about half would be required to secure the large cities and defended ports, while the other half would be free to operate as a mobile striking force.

(ii) The organization of these forces as :

21 Infantry Brigades of 4 Battalions each—84 Battalions.

28 Regiments of Light Horse.

49 Field Batteries (4 guns).

7 Heavy and Howitzer Batteries (4 guns).
14 Field Companies of Engineers.
7 Communication Companies.
Departmental troops to be provided in proportion.

(iii) The training required by law, over and above home training, to be :

Junior Cadets, 12 to 14 years—120 hours.
Senior Cadets, 14 to 18 years—16 days.
Recruit training, 18 to 19 years—16 days, 8 of which to be in camp.
Trained soldiers, 19 to 20 years—16 days, 8 of which to be in camp.
20 to 21 years
21 to 22 years
22 to 23 years } 6 days in camp.
23 to 24 years
24 to 25 years
25 to 26 years—Muster parade.

(iv) The yearly quotas to be trained to be about 16,000 in the first year (18–19), which would be reduced by wastage to about 12,000 in the sixth year (24–25).

(v) A system of registration to be introduced, and exemptions to be provided for on the principle that the welfare of the family should not be prejudiced, and that the State should get the best men available.

(vi) The division of the country into areas, each area being designed to provide a definite proportion of a fighting unit, and to be in the charge of a thoroughly trained permanent instructional officer, assisted by one or two non-commissioned officers. Ten areas to form a ' group ' under a superior instructional officer, who would become a staff officer in time of war. The formation of 215 areas was recommended.

(vii) The duties of area officers to be :

The organization and inspection of cadets.
Registration.
The enrolment, equipment, and training of the soldier from 18 to 25 years of age.

(viii) The formation of a Staff Corps to provide officers for :

Central administration at Head-quarters.
Officers for the Permanent forces.
Area and group officers.
Staff of a Military College.

(ix) The establishment of a Military College of about 100 students to provide the 350 officers required for the Staff Corps. The college to be organized on similar lines to the Military College of the United States at West Point, the course being of three years' duration.

(x) The provision of Citizen officers from amongst the Senior Cadets, and their instruction by the officers of the Staff Corps.

(xi) The control of the military administration by a Military Board and the appointment of an Inspector-General with an adequate staff to carry out the duties of the department of the Inspector-General.

Lord Kitchener estimated the annual cost of his proposed scheme in the seventh year at £1,884,000.

The clauses of the amended Defence Act of 1909 were made operative by proclamation on January 1, 1911, and the Commonwealth Government is now engaged in giving effect to Lord Kitchener's proposals.

In 1913 the Commonwealth Forces consisted of :

Permanent Forces.

Staff.
3 Batteries, Field Artillery.
13 Companies, Garrison Artillery.
2 Submarine Mining Companies } Engineers.
5 Electric Light Sections }
Army Service Corps.
Army Medical Corps.
Ordnance Department.
Pay Department.

In all about 190 officers and 1,800 other ranks.

Militia.

Staff.
Area Officers.
23 Regiments of Light Horse.
20 Batteries, Field Artillery.
13 Companies, Garrison Artillery.
9 Field Companies
6 Signal Troops
7 Signal Companies
1 Telegraph Company
2 Submarine Mining Companies
5 Electric Light Companies
} Engineers
45 Battalions of Infantry.
Departmental troops in proportion.

In all about 2,200 officers and 32,000 other ranks.

Rifle Clubs.

There are rather over 1,000 Rifle Clubs, with a membership of about 50,000.

The Permanent Forces train throughout the year in a similar manner to regular troops.

A Military College has been established at Duntroon, Federal Territory, and was opened on June 27, 1911. The establishment of students is 150, 32 Australian and 10 New Zealand students entering each year. The normal course is four years, the students entering from 16 to 19 years of age. The staff of the college comprises 8 military instructors, 7 civil instructors, and 3 administrative officers.

Area officers have been appointed and the system proposed by Lord Kitchener as regards their duties is in operation.

Cadet training is proceeding under the provisions of the Defence Act, which made this compulsory for all youths from 14 to 18 years of age.

As the senior cadets attain the age of 18 they are drafted into the existing voluntarily enlisted militia, which is being maintained during the transition period.

The militia will, in the first instance, be so expanded as to form the nucleus of the increased establishment recommended by Lord Kitchener. As its ranks become filled by senior cadets it will, as at present constituted, gradually disappear and be replaced by the Citizen Force.

At present 6 light horse brigades, 5 field artillery brigades, and 12 infantry brigades have been organized, and form the Field Force. The remaining troops are allotted to garrison duties.

A Military Board has been formed, its composition being similar to that of the Army Council. An officer of the Regular Army fills the post of Inspector-General, and a Commonwealth section of the Imperial General Staff has been formed at Head-quarters, Melbourne.

The members of rifle clubs, which consist of men between the ages of 16 and 60, form the principal reserve.

At present the Militia is maintained for home defence only, but the Defence Act permits individuals to volunteer for service overseas. As is the case with the other Dominions, Australia maintains no military forces available at short notice for the defence of the Empire.

The military forces of New Zealand.

The military forces of New Zealand[1] are organized on very similar lines to those of Australia. They consist of:

Permanent Forces.

Staff Corps.
Field Artillery.
Garrison Artillery.

In all about 90 officers and 450 other ranks.

Territorial Force.

Staff.
12 Regiments of Mounted Rifles.
8 Batteries, Field Artillery.
1 Mountain Battery.
9 Companies, Garrison Artillery.

[1] The internal defence of New Zealand, especially as regards the bearing of the problem on local political considerations, is also considered in Chapter XIII, where further particulars concerning the laws of military service will be found (p. 438).

Engineers.
16 Infantry Battalions.
Departmental troops in proportion.
Amounting to about 1,100 officers and 22,500 other ranks.

Senior Cadets.

368 Companies with a total of about 26,000 cadets.

Rifle Clubs.

189 Rifle Clubs with a membership of about 4,000.

These forces are constituted under the Defence Acts of 1908 and 1909. By the latter Act provision was made for the conversion of the volunteers into a Territorial Force, and for the introduction of a system of compulsory service. Every youth who attained the age of 14 on or after March 1, 1911, and had not on that date attained the age of 21, was obliged to register. Between the ages of 12 and 14 boys are trained as junior cadets ; between the ages of 14 and 18 they are trained as senior cadets ; between the ages of 18 and 25 men are trained in the Territorial Force, and from 25 to 30 they form part of the reserve.

The Territorial Force is liable for service in New Zealand only. The training in this force consists of 30 drills, 12 half-day or 6 whole-day parades, and a musketry course. A system of registration and instruction by area officers prevails similar to that in force in Australia.

The New Zealand Government co-operates with Australia in the maintenance of the Military College at Duntroon, and the students educated there join the New Zealand Staff Corps.

The forces are commanded and administered by a General Officer appointed from the Regular Army, and a local section of the Imperial General Staff has been established.

CHAPTER XVI

ANTARCTICA

The British Sector

By Griffith Taylor

The Antarctic continent.

So little is generally known of Antarctica that most people hear with surprise that there is another continent beside, the five usually enumerated. Few but geographers are aware that this continent is by far the most elevated of the six. With the exception of the Tibetan and Bolivian plateaus, there is no other large portion of the earth's crust which is so far above sea-level, and this feature, even more than its high latitude, has prevented its exploration.

Data for discussion.

We must briefly consider first of all how the data at our disposal have been collected. Until 1902 the existence of this great plateau was not suspected, and we are only just beginning to realize what far-reaching effects this cold block of the earth's crust has upon the well-being of the more settled regions of the world.

The limits of the ice-pack were determined by Cook in 1772. D'Urville, Wilkes, and Ross, 1840–2, carried out explorations on behalf of France, the United States of America, and Britain, and first approximately mapped out the coast-line south of Australia, including the area more particularly discussed in this chapter; while various whalers landed on outlying islands during the nineteenth century. In 1898 the first determined effort to spend a whole year in the Antarctic was successfully made by the Belgian Gerlache. In 1900 Borchgrevink landed on the great Ross Barrier after wintering at Cape Adare, thus forecasting the two furthest stations of Captain Scott's last expedition.

To Captain Scott must be given the credit of penetrating the interior of the continent and of initiating the plateau journeys which resulted in the attainment of the

South Pole. Since 1902 it has been realized that there are two types of exploration in the south: (1) sledge-journeys along the coasts where valuable collections of rocks and of organic life may be made; (2) sledge-journeys up the 'outlet glaciers' to the great Ice Cap, or plateau, where no rock shows above the covering of snow, and where no animal or vegetable life has ever been observed.

Only two comparatively small areas of the continent can be described as at all adequately mapped. These are General physical character.

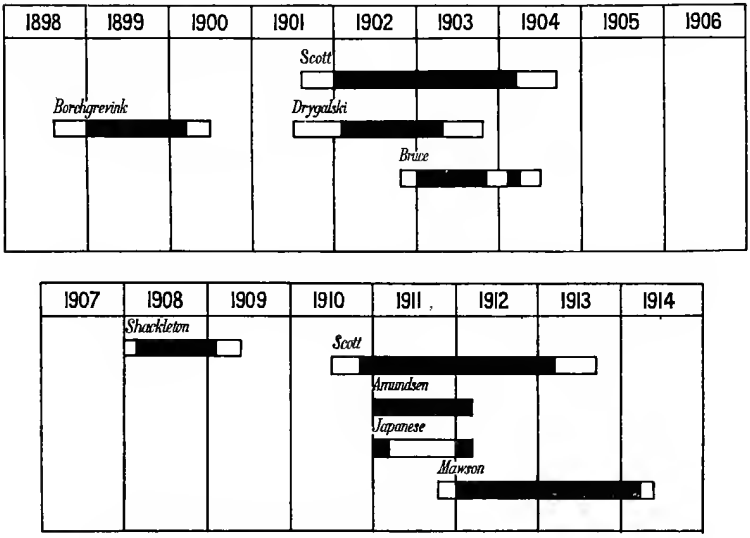

FIG. 66. Periods of some Antarctic Expeditions.

Graham's Land (West Antarctica) south of South America, and the Ross Sea area south of New Zealand. From coastal surveys—which are only fairly complete south of the Indian Ocean, and practically non-existent south of the Pacific and Atlantic oceans—we can now gain a fairly clear idea of the shape of the Antarctic continent. It is seen to be curiously like that of South America, with a cordillera at Graham's Land which, as it were, hooks into the southern curve of the Andes, and a curved Australian sector which in a similar fashion duplicates the Venezuelan coast. This last even more strikingly

parallels the Great Australian Bight, and these two tectonic features are probably related. The area of the continent can be estimated at about $3\frac{1}{2}$ million square miles (3,670,000), and it may thus be broadly compared in area to that of Australia. How different their configuration is shown in the annexed sketch diagram. The crustal pucker constituting the Andean range, which is undoubtedly continued through South Georgia and the South Orkneys, and is also carried south by the Graham Land cordillera, should be especially noticed. The great earth-dome of Antarctica has some of the characteristics of a primitive crustal bulge, and the Jeffreys Deep south

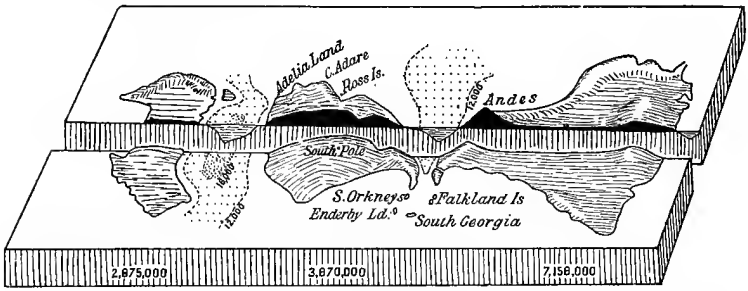

FIG. 67. Comparative areas, Shape, and Relative Elevations of Australia, Antarctica, and South America.

of Australia lends support to this view. Australia itself barely emerges above sea-level, though we know that the south-western portion of Australia has not, in all probability, been submerged since Cambrian times. The discussion on the physiography of the Antarctic plateau, however, is better reserved to a later stage.

It is not safe to state that any portion of the earth's crust will never be of economic importance. We have evidence of this in the coal and marble mines of Spitsbergen. Whaling has become a profitable enterprise in western Antarctica, in the hands of the Norwegians, and many hundred people here spend a considerable portion of the year within the Antarctic region.[1]

[1] See chapter on the Falkland Islands and dependencies in the American volume (IV) of this series.

This raises the question as to how much of Antarctica should be included in a survey of the British Empire. The obvious conclusion is to deal primarily with those portions whose geography has been investigated by British expeditions, and only to deal with the regions explored by French, Germans, Norwegians, and others, as seems necessary for the broadest discussion. For this reason the present chapter deals principally with the quadrant extending from King Edward VII Land to Termination Land, in fact to the areas covered by recent British and Australasian expeditions. The data obtained by Amundsen's expedition (1910–11) are of course of very great importance, especially in determining the shape of the great Ross Ice Barrier.

Sphere of principal British interest.

The British sector extends from long. 150° W. to 90° E., and reaches southward to the Pole. It comprises approximately 1,500,000 square miles. The most remarkable feature of the sector is the great inlet extending into the continent from 70° S. to 85° S. lat. This is known as the Ross Sea in its northern moiety, and as the Ross Ice Barrier south of 78½° S. lat. The western boundary of this depression is marked by a range of high mountains, which have been fairly accurately mapped for a distance of almost a thousand miles. Volcanic islands and volcanic peaks characterize this belt, which to some extent is a continuation of the volcanic strip extending down the western Pacific. Great ' outlet ' glaciers cut through the range and form natural gateways leading to the ice plateau. Even here, however, relics of the once continuous ice sheet are preserved as glacier tongues and piedmonts, and in the far south there is the immense area of the Ross Ice Barrier of this nature.

The British sector of Antarctica.

Strangely enough, the northern portion of the sector is shrouded to a still greater degree by the marginal portions of the Ice Cap. For hundreds of miles the coast, if it can be called so, consists of a wall of ice from 50 to 200 feet high, of which many miles are undoubtedly floating. This type of country is characteristic of that portion of Antarctica explored by the Australasian expedition. As

will be seen later, the far southern region in MacMurdo Sound, near lat. 78° S., is certainly the most snow-free portion of this sector of Antarctica.

The following would appear to be a logical sequence in describing the physiography of the British sector : (1) the belt of pack ice ; (2) the islands ; (3) the capes ; (4) the piedmont glaciers ; (5) the valley and outlet glaciers ; (6) the dry valleys, moraines, lakes, &c. ; (7) the ice-flood floor ; (8) the great Ross Ice Barrier ; (9) the volcanic region ; (10) the inland Ice Cap ; (11) general meteorology in Antarctica ; (12) relation to extra-Antarctic areas.

The pack ice.

There is the possibility of some confusion in the term 'pack ice', for it occurs both as heavy ice drifting in great masses over the ocean, and as dense collections of the same material packed against the coasts by onshore winds. It is derived from the sea-ice of the preceding winter, which begins to form in the south of the Ross Sea late in February or early in March just at the period when the heavy autumn gales are tearing away the last relics of the previous winter's ice. The diagram herewith shows the great belt of pack ice encountered by the *Terra Nova* in her voyage of December 1910. At first a few large bergs are seen, then isolated ragged floes, which soon congregate closer until in this instance they formed a barrier 300 miles wide, containing individual floes many acres in extent. The belt extended from about lat. 64° S. to lat. 71° S. on this occasion, and then to the southward was the open water of the Ross Sea right to Ross Island. Later in the year, in March, this belt has usually disintegrated and been driven to the north-west by the prevailing winds. Large fleets of icebergs remain, characteristically tabular for the most part—as they have broken from the piedmont glaciers, from the ice tongues, or from the great Ross Ice Barrier. These vary in size up to 20 miles long (*Terra Nova*, Feb. 1913), but are usually less than 400 yards long. The variation in the amount of pack is a very important point in Antarctic exploration. In February 1903 Granite Harbour was free from ice, and the coast near Mount Melbourne further

north could readily be reached. In February 1912 a belt of jumbled pack ice 20 to 40 miles wide collected against this coast and effectively prevented the relief of Scott's northern and western parties, though further south in Macmurdo Sound it broke away much as usual in the same year. The coastal survey of Captain Davis [1] has given us much information on the distribution of the pack. It was his belief that open water would be found in the lee of the Termination Ice Barrier which enabled the Austra-

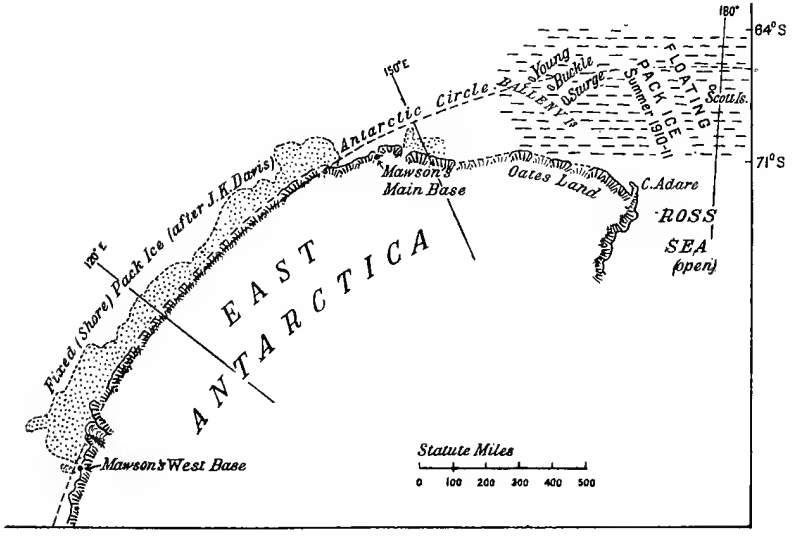

FIG. 68.

lian western party to plant a base on the coast there. This was quite impossible to the eastward because of the heavy pack carried by wind and currents against Clarie and Sabrina Land. The pack ice has a fairly constant thickness of some five feet, but when breaking up, its lower surface is often found to be greatly weathered and eaten away by the warmer sea-water. The rapid change from a field of apparently solid sea-ice into loose floes drifting in large rectangular blocks to the north and west is one of the most characteristic and dangerous incidents in

[1] In connection with the Australasian expedition under Dr. Mawson, who returned home in February, 1914.

Antarctic exploration. Finally, it is to be noted that even in the middle of winter the Ross Sea, as far south as 77° S. lat., often has belts of water free from ice, even though the air temperature be −50° F. In calm weather these freeze over instantly, and the constant shearing of the sea-ice and the 'squeeze' and pressure on the resulting blocks give rise to the jumble of rectangular blocks which forms the dreaded 'screw-pack'.

The islands of British Antarctica, and land connexions with other continents.

Some mention must be made of Macquarie Island, which provided the site for a wireless telegraphic station of high importance, in connexion with Dr. Mawson's expedition. It lies about 600 miles south of New Zealand, and a like distance separates it from Antarctica at Adélie Land (Mawson's main base). It is the only relic of the land bridge which undoubtedly once connected New Zealand and Australia with Antarctica. An interesting submerged peak was discovered by Captain Davis, 300 miles south of Tasmania, where soundings rose rapidly from a depth of 12,000 feet to 3,000 feet; but thence southward the depth seems to be fairly continuously 12,000 feet.

Biological evidence.

The chief evidence of this lost southern land, however, is biological.[1] The kinship among the fauna of the southern continents shows that South Africa was separated first. New Zealand, though possessing many of the features of the common southern flora and fauna, never received a marsupial population, and its final separation is therefore allocated to early Tertiary times. Australia was then separated, and more recently Tasmania and South America. In support of this we find that the living Tasmanian 'tiger' or *Thylacinus* is essentially identical with the *Prothylacinus*, an extinct marsupial from Patagonia. Moreover, in the whole of Asia, now much more readily accessible from Australia, no living or fossil marsupial has ever been found.

The Balleny Group and other islands.

Almost due south of Macquarie Island and about 200 miles from the mainland is the Balleny Group.

[1] This question is discussed in a paper by Dr. Mawson in the *Geographical Journal* for June 1911, p. 613, and reference should also be made to Chapter IV of this volume.

These islands consist apparently of volcanic rocks, and one of them, Buckle Island, which is 15 miles long, has an active volcano at the northern extremity. They are all almost wholly covered with ice, which descends as glaciers over steep cliffs, and in some cases forms a sea-borne glacier or ' piedmont afloat '. Another small group lies to the east : the largest member is Scott Island.

Various other islands, such as Coulman Island (73½° S.), fringe the coast of South Victoria Land, and are nearly all of volcanic origin. Franklin Island (76° S.) and Beaufort Island, though further from the mainland, are apparently of the same nature, as are the small Dailey and Dellbridge groups in Macmurdo Sound. Ross Island will be considered in connexion with Mount Erebus.

A word may be said as to the ice islands. In November 1911 the writer was convinced that he had discovered a new island, but when closely approached it was found to be an iceberg coloured a dark brown from included silt and débris. Such an incident suggests the origin of the doubtful Royal Company and Nimrod groups, &c.

The capes.

The importance of lists of capes in the old-fashioned geographies is at the present time discounted, but it is safe to say that the capes in Antarctica are the most important portions of the continent. For if we consider the shores of Macmurdo Sound, which extend over a distance of 150 miles, it is found that on the coast of Ross Island there are only half a dozen spots where a landing on *terra firma* can be effected. Some of these are historic, such as Cape Royds (1907), Cape Evans (1910), and Cape Armitage (1902). On the western coast of the Sound is Cape Roberts, where Scott's western party was isolated in 1912, Cape Dunlop, Cape Bernacchi, and one or two small areas in the south-west. Almost everywhere else the ice mantle covers the shore, and this is apparently the case to an even greater extent as we proceed northward to regions of greater precipitation.

Often the capes are bounded by steep cliffs. If the cliffs are composed of basic rocks they crumble rather readily, as at Cape Evans and Cape Royds. Beaches

occur rarely, the open water only acting on the coast for about a month each year. Yet such are found, notably at Cape Adare, where the beach is nearly two miles long, in the south-west of Granite Harbour, and near Cape Royds. More characteristic is the ice-foot, which skirts the rocky coast almost universally. This is about 50 feet wide and is a fringe of ice, due partly to frozen surf, partly to snow, and partly to freezing of shore waters. But the tidal movement of the sea-ice gives rise to a tide crack which separates the ice-foot (fixed to the rock) from the sea-ice. This latter is carried away on the summer break-up. The ice-foot forms an invaluable sledging-route during the summer and autumn months, when the sea-ice is always treacherous and often absent.

Quite commonly the lower capes are prolonged into a low island, as at Cape Gregory and Cape Dunlop. The apparently haphazard shape of these islets—sometimes sharp-ridged as in Big and Little Razorback, and elsewhere low and almost flat—makes the question of coast-line movement in this region one of great difficulty. Some raised beaches have been discovered, as in Dry Valley at a height of 40 feet, and at Cape Royds. It must be confessed that there is no evidence of a 'tide-level shelf', such as would be expected to occur with such rapid uplift, on the coasts of the islets thus raised from the shelter of the frozen ocean to face the rapid attacks of frost and blizzards.

The piedmont glaciers.

The piedmont glaciers appear to be more characteristic of the Ross Sea area than of the northern coasts. In the latter case the Ice Cap seems to come down to the sea in a uniform sheet, practically no rock appearing above the surface. But the great mountain range forming the shore of South Victoria Land effectually prevents this condition from arising. However, between the range and the sea there is generally a regeneration, as it were, of the continuous ice-sheet, and to this the name of piedmont glacier is given. The largest area of this nature is situated just south of lat. 75°. It includes the Drygalski Ice Tongue and the large extent of fixed ice at the foot

of the Reeves Outlet Glacier. There is little doubt that it represents a relic of a more general glaciation, held in by the land-locked conditions of the region, and to some extent nourished by local snowfall and the glaciers entering it from the west. The Wilson Piedmont (lat. 77°) was traversed and surveyed in 1912. Its area is about 10 miles by 30 miles, the shorter axis being in the direction of motion, which is to the east. Two large outlet glaciers enter it, and opposite these it is badly crevassed; but elsewhere its surface is continuous and is moulded over hidden inequalities in most beautiful dimples and domes. Behind the capes its edge is seen to be about 200 feet thick, and this no doubt is true where it dips into the sea, for about 30 feet remain above water in these portions.

The ice tongues.

The extraordinary ice tongues merit a short description. In some cases they are merely the last portions of the piedmont to disappear. They are nearly always floating freely at the end, for no tide crack separates them from the sea-ice. Seen in profile they are beautifully waved, and the depressions often reach sea-level at the sides and give rise to a serrated border to the tongue. The example in Granite Harbour has been carefully surveyed and its motion was found in the summer of 1912 to be a yard a day. The parallelism of the sides and its mode of occurrence lead the writer to believe that in this case the tongue is not a relic of a piedmont, but is the genuine outflow of a land glacier confined between steep walls, as is the case with the Mackay Glacier hereabout. The ice is forcibly pressed out just as in the familiar ' expansion of ice ' experiment where the plug of ice extrudes as a tongue also. The better known glacier tongue near Cape Evans did not seem to have changed in length between 1902 and 1911, and this is probably of relic origin. In a storm in 1911, however, three miles of it were torn off and stranded fifty miles to the north-west, where this portion was re-surveyed by Scott's western party.

The valley and outlet glaciers.

With conditions as they are in Antarctica, it is obvious that the valley and outlet glaciers can only occur where the great Ice Cap passes through a mountain range so

high that it rises above the normal level of the inland ice. This condition obtains along the western coasts of the Ross Sea, where the highest land in the British sector is, curiously enough, immediately adjacent to the water, or to its southern prolongation, the low-level Great Ross Barrier. In the nearest continent of Australia we see the same conditions. The highest mountains here also are almost on the west coast of the Pacific Ocean. It is sufficient here to note that the same factors—crustal subsidence along an old divide—seem to have given rise to similar results.

This grand range, extending from Cape Adare (lat. 71°) practically to the Pole, has several peaks rising to 13,000 feet, notably Mount Lister (78° S.) and Mount Markham (83° S.), and is almost continuously over 5,000 feet for the whole distance. The lowest portion is near Granite Harbour, where the continuous ice of the plateau is reached at a level of about 4,000 feet. Professor David considers this range is a 'horst' or fault residual. 'Every twenty or thirty miles this fairly continuous range is broken by a huge "outlet" glacier.[1] Many of these are now well known, such as the Beardmore, which is over 100 miles long and often 30 miles wide, the Ferrar, Mackay, David, &c. They form the sole routes from the coast to the interior, and were it not for the *ice falls* where the glacier covers some irregularity in its rock floor, or the more dangerous crevassed areas, where it sweeps round a corner, or receives the thrust of a large tributary, they would not be difficult to traverse with sledges. The average grade is not steep, varying from 70 to 100 feet per mile, as in the Beardmore and Ferrar-Taylor routes.'

Velocity of glaciers.

The velocity of these outlet glaciers is a question of interest. There would appear to be an area of low precipitation near New Harbour (lat. 78° S.), to the north and south of which the snowfall increases. Thus the Beardmore Glacier (83° S.) is moving considerably, for

[1] The reader is referred to the chapter by the writer in *Scott's Last Expedition*, vol. ii, p. 419, whence this paragraph is derived

it was found to have raised great ridges in the Barrier surface (into which it enters) for fully 20 miles (*vide* David). The Koettlitz Glacier (78°) is quite stagnant over a great part of its bed, though some movement may occur along the south shore. The Ferrar has a slight movement as measured by the 1910 expedition. The Taylor Glacier is stagnant; the Mackay (77°) raises slight pressure ridges in the sea-ice of its snout, and has an accurately measured velocity (in summer) of three feet a day. The Drygalski Tongue, fed by glaciers to the west, raises pressure ridges 80 feet high in a single season's sea-ice (*vide* David).

Mackay, Ferrar, and Taylor glaciers.

The outlet glaciers most thoroughly investigated lie between 77° and 78° 30′. Each of the four glaciers occupies a somewhat different place in the glacial cycle. The Mackay Glacier is 30 miles long and about 10 miles wide where it streams round the numerous *nunatakker* of its upper valley. The main walls rise to 5,000 feet, and are notched by couloirs and cwms, and pierced by large tributaries (Cleveland, &c.) and by one transection glacier (Miller). They show splendid *facets*, especially on the north side, but only the upper 'triangles' are visible. There is a very well marked ice-flood floor, which near the sea is elevated 1,000 feet and rises to 2,000 feet in 10 miles, and 3,000 feet in 15 miles. These 'floors' are practically flat and are covered with granite débris, though polished platforms and perched blocks are common. The glacier has also overridden obstructions 1,000 feet above the floor, for rounded ridges (*nunakoller*) contrast with the cwm topography above 3,000 feet.

About forty miles south is the Ferrar Glacier. Here the valley is well defined, being about forty miles long and only four miles wide. The walls are beautifully carved by the glacier 'plough', and almost all the tributary glaciers 'hang' on the sides and do not reach the main valley. It shows a later stage of recession.

United with the latter glacier is the Taylor Glacier. There is an interesting ice-divide near Knob Head which obviously covers a ridge once separating the two 'apposed'

glaciers. But the alimentation of the Taylor Glacier is very slight. Its snout stops short 20 miles from the sea, leaving an empty valley, which, but for its lack of vegetation, exactly resembles one of the typical Swiss valleys (e. g. the Val Ticino, south of the St. Gotthard tunnel). Just below the snout is a rock bar 600 feet high, pierced by a narrow gully on the north. This juts into Lake Bonney, a drainage lake three miles long and held back by great moraine accumulations. About nine miles below the glaciers a great bar (Nussbaum-Riegel) rises 3,000 feet across the trough. A narrow defile on the north—almost blocked by an obtrusive tributary glacier—cuts through this barrier and leads to the wide débris-filled expanse known as Dry Valley. Ten miles further east the waters of New Harbour are reached. This alternation of riegel, gorge and basin, for 20 miles without a single snow-drift, must be accounted one of the most interesting regions of Antarctica.

Koettlitz Glacier and Mount Lister.

Still further south is the Koettlitz Glacier, beneath the mighty scarp of Mount Lister. The main glacier cascades over ice-falls and reaches sea-level some twenty miles from the sea. The features of this ice-delta are due primarily to thaw-waters which have cut them into a thousand forms of ice-sculpture ranging from great tables 100 feet high, through bergs, 'bastions', 'pinnacles', &c., to 'bottle-glass' ice, whose names are self-explanatory.

Finger valleys.

The 15 miles of hinterland between the main glacier and this 11,000-foot scarp are occupied by a series of 'finger' valleys, which probably offer an unrivalled example of cwm erosion.[1] High up on the scarp are magnificent cwms, from 1 to 5 miles across. On the lower levels are straight-sided valleys (separated by narrow ridges 3,000–4,000 feet high), which radiate from the cwms of the scarp much as the fingers of a hand radiate from the knuckles. Indeed a negative cast of the knuckles and outspread fingers would represent extremely closely the physiography of the Koettlitz hinterland.

[1] Cwm, corrie, cirque, kar, &c. are the typical 'arm-chair' valleys developed in high-level glacial erosion.

The heads of these ' finger valleys ' are occupied by small glaciers about five miles long. The latter do not now reach within five miles of the main Kocttlitz Glacier. Evidently here is an example of recession in a manner intermediate between that offered by the Ferrar and Taylor Outlet Glaciers.

The Ross Ice Barrier.

Our knowledge of the Ross Ice Barrier has been largely increased by Amundsen's journey. We now know that it occupies a huge bay in the coast-line of Antarctica, and is triangular in shape with sides about 400 miles long. On the west and south it is bounded by high mountains, while to the north-east, Prestrud (1911) explored Scott's Nunatakker and found them also to be part of a large area of elevated land. Ice ridges to the east seen on the Norwegian polar journey about 80° S. seem to indicate an eastern land boundary. The surface is but little above sea-level, and probably the greater part of it is floating. In a lecture[1] at winter quarters, Captain Scott graphically compared it to ' a sheet of cardboard $\frac{1}{8}$ inch thick, and the length of this hut ' (50 feet).

The Ross Barrier is probably slowly receding, in common with Antarctic glaciation, for its northern face is markedly concave, whereas an advancing mass might reasonably be expected to show a convex front, since its velocity at the centre would normally be greater than at the sides.

The face varies in height from 150 feet down to places where one can land from a whaler. Its average thickness is probably about 400 feet. Like many so-called icebergs, it seems to consist largely of compacted snow, which floats much higher out of the water than pure ice. Measurements made in 1903 and 1909 show that it is moving north about 700 yards per annum. Shackleton's party further obtained a value of 13 inches of hard snow as the annual fall in this region. In the lecture cited above, Captain Scott put forward an ingenious theory, developed by Dr. Simpson and himself, that the weight of this snowfall would be sufficient to account for the movement of the Barrier. The comparatively small amount of ice added

[1] See *Scott's Last Expedition* for a report of this lecture.

by the mainland glaciers certainly does not seem adequate to account for the great number of bergs annually calved from the Great Barrier. Since the face is practically unchanged in position since Ross first plotted in it in 1840, it is obvious that the increment must equal the bulk lost in the form of bergs.

The Barrier is a relic of the Ice-Flood period, of which we see evidence everywhere in the form of flood-floors and *nunakoller*. It owes its stability purely to its high latitude, for it is only for a few months in the year that the waves can actively erode it. Although open water is visible at times in mid-winter off the Barrier, yet this is prevented by the pack-ice from inflicting much damage on the Barrier edge. Amundsen's winter quarters on the Barrier do not appear, however, to have moved north. Here then the Barrier is held stationary, perhaps by a submarine bank, and the crevasses he met further south may mark the boundary between the stationary and moving barrier. At the extreme north-west corner of the barrier, where it presses against Cape Crozier (Ross Island), is a highly disturbed area. In ice-locked bays beneath the cliffs of the cape is one of the two known breeding-places of the Emperor penguins. Near Termination Land Wild discovered a second.

Volcanoes. The extensive faulting along the western shore of the Ross Sea is accompanied by striking evidence of volcanic action. David and Priestley consider that the volcanoes lie on transverse faults crossing the dominant down-throw faults of the region. Thus Mount Erebus and Mount Terror occupy one such fault-line in 78° S. Mount Melbourne and Mount Mackintosh lie on another near 74° S. Buckle Island and the other Balleny Islands form a third line of volcanic activity. South of 78° is the cone of Mount Discovery, but no very definite evidence is known of recent activity nearer the Pole.

Of these volcanic peaks Buckle Island and Erebus are still active, though in a solfataric stage. Perched on the glaciated walls of the Taylor Valley a small perfectly formed crater was discovered in 1911, which shows that

PLATE XXIX. NORTHERN BOUNDARY OF WILSON PIEDMONT GLACIER, SHOWING CLIFFS EXPOSED BY RECESSION

(Mr. Griffith Taylor, by permission of Commander Evans)

PLATE XXX. MOUNT EREBUS AND ITS GLACIERS AND CAPE EVANS MORAINES EXPOSED BY RETREAT OF GLACIERS. GROUNDED BERGS IN FOREGROUND

(Mr. Griffith Taylor, by permission of Commander Evans)

on the mainland volcanic activity has been subsequent to the maximum period of glaciation. Other craggy surface lava flows, several hundred feet thick, in this valley and in the Koettlitz Valley, point to the same conclusion. In a less perfect condition are small puy-like craters near Hut Point. Probably they are of the same age, but being composed of a less resistant lava the craters have yielded further to frost disintegration.

Mount Erebus.

The chief interest, however, centres on Mount Erebus. We owe our knowledge to the narrative of Professor David, who ascended it in March 1908.[1] The height is over 13,000 feet, the summit being 15 miles due west of Cape Royds. The mountain is formed of four superimposed craters. The lower, oldest crater-ring forms a gigantic black cliff several thousand feet high. Its diameter is about 8 miles. The second crater is at the level of 11,500 feet, and has a diameter of about 3 miles. It is nearly filled with ice and snow, and is occupied by many fumaroles. This second gigantic crater is one-third filled by a cone about $1\frac{1}{2}$ mile in diameter, which in turn carries the present active crater. The latter is 900 feet deep and $\frac{1}{4}$ mile wide. The greater part of this volcanic mountain is built up of the remarkable lava known as Kenyte. It is a special form of trachyte, also found at Mount Kenya and in Norway, and is characterized by large lozenge-shaped crystals of anorthoclase felspar, which are embedded in a fine-grained ground-mass. The other centres of activity around MacMurdo Sound seem to have poured out a more normal basic lava.

The inland Ice Cap.

In 1903 Scott penetrated 150 miles into the Antarctic continent, along lat. 77°. He discovered that it had a uniform level of about 7,000 feet, and consisted of a sheet of snow, unrelieved by any change of contour except near the coast, where its entry into the outlet glacier was marked by icefalls and crevasses. It is difficult to estimate the depth of this Ice Cap. Where it joins the outlet glaciers it seems to be not much over 1,000 feet thick, if we may judge from the profiles of *nunatakker* in this region. At

[1] Priestley and David, Geological Congress, Stockholm, 1910.

the time of the ice-flood it may have been 1,000 feet thicker (as shown by the upper limit of glacial erosion), and as at this period there was little to prevent a bodily flow outwards from the plateau, we may assume its thickness at 2,000. Moreover, behind the Mackay Glacier, the tips of *nunatakker* projecting above the surface have been seen (from Erebus), well within the Ice Cap proper.

The plateau at the Pole has an altitude of about 10,000 feet, and somewhat north (near Shackleton's furthest point south) it rises still higher. Then it drops to about 8,000 feet and maintains that level north to the Magnetic Pole at 73° S. From this point it drops fairly rapidly to the head-quarters of the Australasian party (Dr. Mawson) at sea-level in 66° S.

Antarctic meteorology

It is almost impossible to generalize in meteorology from disconnected data, but, as will be seen from Fig. 66 (p. 519), there are the records of eight expeditions which have wintered in the Ross Quadrant, and of these, three have each spent over two years in the Antarctic. The question of temperature is naturally the most interesting in this region. In midsummer (December 21) the Antarctic receives more of the sun's heat ('greater insolation') than any other part of the earth's surface. This is owing to two facts: firstly, that this part of the earth approaches nearer the sun than does any other portion; and, secondly, that the sun is acting during the whole 24 hours, so that no cooling occurs. But owing to the immense body of ice universally covering the continent most of this heat is expended in melting a layer of ice, and none is radiated back to warm the air, as in more favoured climes. The actual black-bulb readings are very high, and the differences between the temperatures and those of the air are extraordinary. For instance, on Midsummer Day 1902 at Ross Island the air temperature was +24° F. and that of the black-bulb (recording the sun's heat) +154°.

Temperature.

When the average monthly temperatures for these expeditions are plotted, the most striking feature observed is the manner in which all the curves unite in midsummer, even

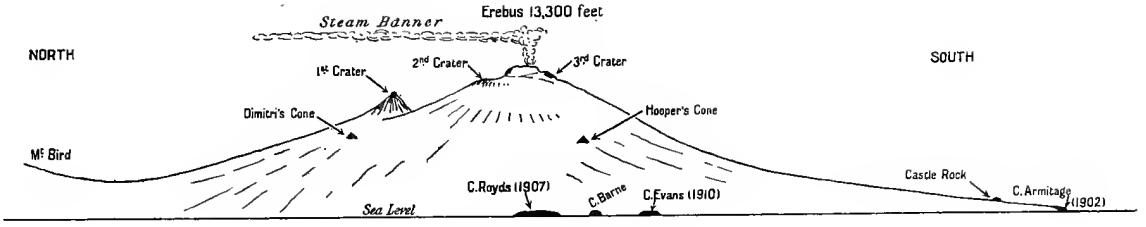

FIG. 69. Mount Erebus.

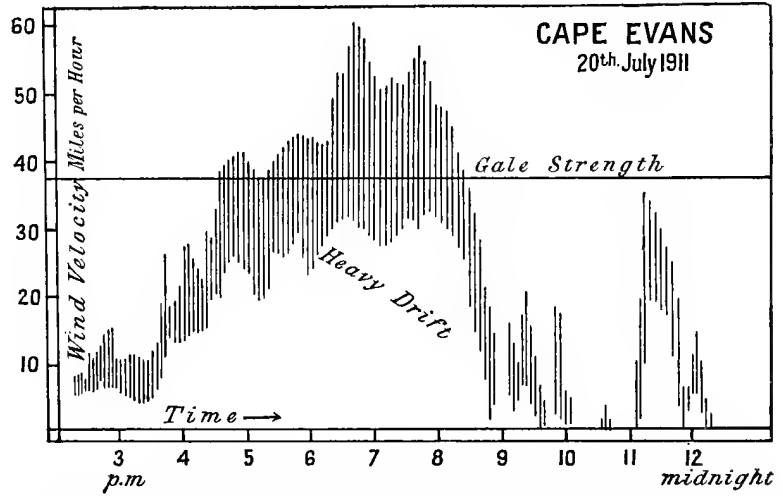

FIG. 70. A Short Blizzard (Cape Evans, July 20, 1911), illustrating Rapid Rise and Fall of Wind Strength.

though they differ by 50° in midwinter. This is due to the large revenue of sun's heat merely raising the temperature to 32° F. as mentioned above. The Barrier station (Amundsen) during 1911 gave much colder readings than previous expeditions, being roughly about 20° colder than the head-quarters in MacMurdo Sound. Amundsen's minimum was −73° in August, whereas Scott in the same year experienced only −50° at Cape Evans. On Wilson's sledge journey in midwinter 1911 to Cape Crozier the temperature reached −77° near the south-east of Ross Island.

The barometer at the most southern station (Amundsen's, at 78° 40′ S. lat.) showed an average of 29·07 in 1911 (ten months), varying between July 28·86 and January 29·65. Further notes on this element will be found in the following paragraph.

Snowfall and blizzards.

The amount of snowfall has never been accurately gauged. At Minna Bluff the deposition appeared to be equivalent to 7½ inches of rain per year. But in the blizzards the snow is carried about as drift, and in the majority of cases not much precipitation occurs. The most extraordinary feature of the meteorology is the difference between the weather at Amundsen's quarters and at Cape Evans, 300 miles to the west-north-west. The former records only eleven stormy days, whereas the British might have summarized their weather as eleven stormy months. In both cases the heavy winds were derived from the east or south-east. This difference is due to the proximity of the British to the Great Plateau. The temperature gradient between this elevated mass of ice and the warm waters of MacMurdo Sound is undoubtedly steep.

Description of a blizzard.

The history of a blizzard is described in the following account of a storm which the writer experienced at Granite Harbour (77° S.). It seems to have covered several hundred miles, for on the same date Captain Scott met his heaviest snow-storm at the foot of the Beardmore Glacier (83° S.). On December 4, 1911, the sky was covered with mackerel clouds, and the sun was bright. The barometer was 29·81 at 8 a.m. and rose to 29·97 by the evening. During the day there were variable

winds with some strong cold gusts from the south, and some snow at 7 p.m. The temperature rose from +11° F. to +15° F. On the 5th the barometer was dropping rapidly from 29·55 at 10.30 a.m. to 29·20 at 9 p.m. There was a slight west wind and the temperature was rising steadily from +18° to +23° in the evening. Towards 10 o'clock a very dark storm-cloud appeared along the eastern horizon (the south was hidden by mountains). It began to snow at midnight and a furious blizzard started at 3 a.m. There was very heavy drift, and wind from the south-east rose to force 7 of the Beaufort scale; the barometer fell still further to 29·18. The sling thermometer could not be used, but drift melted on the hand readily. The wind dropped rather suddenly at 1.30 p.m., but snow continued to fall in large 'fluff balls'. Nothing was visible at 30 yards' distance, and the sledges and gear were covered deep in soft snow. At 5 p.m. on the 6th, the barometer was rising slightly (29·30) and the temperature was very high, being +27°. Snow continued all night and stopped at 2 p.m. on the 7th, when the snow cloud blew off *en masse* to the west, leaving blue sky behind. The barometer had risen (at 8 p.m.) to 29·72; while the thermometer had dropped 10° F. in the preceding twelve hours.

Antarctic and Australasian climatic relations.

It is now possible to give a brief *résumé* of the relations of Antarctic to Australasian meteorology from data collected. There is apparently a permanent anticyclone over the great Ice Plateau round which the blizzards blow to the north-west in the quadrant under consideration. These constitute the dominant winds in the Victoria Land coast. In the latitude of Cape Adare is a belt of lower pressure—perhaps the minimum lies near the Antarctic circle. The pressure increases both north and south of this latitude. Easterly winds and gales are characteristic of the regions south of the circle, and westerlies of the ocean-belt north of the circle.

Isobars.

The isobars apparently exhibit a tendency to lie parallel to the great Antarctic mountains bounding the Ice Plateau. On many occasions almost identical readings

were taken at Cape Evans and Cape Adare, though the latter is 450 miles north, e. g.:

December 26, 1911.	*Temp.*	*Pressure, inches.*
Cape Adare . . .	26·5°	29·8
Cape Evans . . .	26·5°	29·8

Pressures decrease to the east of these mountains—the large area of warmish water in the Ross Sea undoubtedly tending to this result, e. g.:

February 4, 1911.	*Pressure.*
Cape Evans	29·24
Balloon Bight (300 miles east) . . .	28·93

Sometimes, however, when a 'low' lies over New Zealand, a 'high' covers Cape Adare:

December 23, 1911.	*Pressure.*
Cape Evans	29·955
Cape Adare	30·004
Terra Nova 500 miles NE. of Cape Adare .	30·01

This leads to the inference of breaks in the great low-pressure belt of the Southern Ocean.

Pressure curves.

During the voyage of the *Terra Nova* to and from Antarctica, it was possible to trace the relation of Australasian and Antarctic pressure curves. From December 1, 1910, until December 23, 1910, the ship was proceeding south from the Auckland Isles to lat. 60° 31′. In general it may be stated that there was a distinct resemblance in the barometric variation of the station at the Bluff, N.Z. ($46\frac{1}{2}$°), and the ship until latitude 67° was reached. On the return voyage correlation was again possible only between these latitudes. The second voyage gave similar results. These graphs showed a great similarity in the barographs at Cape Adare and Cape Evans, but there was greater amplitude at Cape Adare than Cape Evans. The Cape Adare (71°) and Cape Evans ($77\frac{3}{4}$°) barographs are almost totally opposed to those obtained at the Bluff. The *Terra Nova* graph of course starts in unison with the Bluff, and ends in unison with Antarctica. It apparently passes through the region of maximum amplitude about 60° S. Summarizing, we may state that Australasian weather does not reach to Cape Adare (71°), but may extend south beyond the Antarctic circle (66°).

GAZETTEER OF AUSTRALASIAN TOWNS

(*Note.*—The towns included in this list have been selected mainly on a basis of population, but partly with reference to the importance of certain towns in relation to the localities in which they are situated. The figures for population are in accordance with the latest available census returns. N.S.W. = New South Wales; Vic. = Victoria; S.A. = South Australia; Q. = Queensland; W.A. = Western Australia; Tas. = Tasmania.)

AUSTRALIA

Adelaide, 34° 57′ S., 138° 38′ E., the capital of South Australia, on the Torrens River, 7 m. from its mouth in St. Vincent Gulf, 483 m. ENE. of Melbourne, situated at the foot of the Mount Lofty Range, is one of the most attractive cities in Australia. Its seaport, Port Adelaide, is the third in the Commonwealth. Flour mills, breweries, and manufactures of woollens, iron goods, earthenwares, and soap. Seat of a university, and of a Roman Catholic archbishop and an Anglican bishop. Pop. 189,982.

Albany, 35° 2′ S., 117° 54′ E., W.A., seaport on the south coast, on Princess Royal Harbour, a branch of King George Sound, 340 m. SE. of Perth, has the finest harbour in Western Australia, and is a naval coaling station. It is a health resort on account of its equable climate, its mean annual temperature being 58·6° F. Pop. 3,747.

Albury, 36° 6′ S., 147° 0′ E., N.S.W., on the north bank of the Murray River, at the head of navigation, near the frontier of Victoria, 190 m. NE. of Melbourne, is the centre of a rich pastoral and agricultural district, raising wheat, tobacco, and fruit. Numerous vineyards in the neighbourhood. Pop. 8,816.

Ararat, 37° 30′ S., 142° 57′ E., Vic., railway junction, situated towards the western extremity of the Great Dividing Range, 131 m. WNW. of Melbourne, is the trading centre of a great pastoral, agricultural, and wine-producing district, and also for the quartz and alluvial gold mines of the Hopkins Valley and of Mount William. Granite, bluestone, limestone, and good timber abound in the neighbourhood. Pop. 5,489.

Armidale, 30° 32′ S., 151° 38′ E, N.S.W., on Dumaresq Creek, 359 m. N. of Sydney, is the centre of a rich pastoral and agricultural district, and near the alluvial goldfields of Hillgrove, and antimony mines. It lies 3,313 feet above sea-level, amid picturesque mountain scenery, and has a fine cool climate. Seat of Anglican and Roman Catholic bishops. Pop. 6,704.

Bairnsdale, 37° 49′ S., 147° 35′ E., Vic., on Mitchell River, near the head of a lagoon called Lake King, which is open to the sea, 171 m. E. of Melbourne, is the centre of a pastoral district, in which there are also several goldfields, with both alluvial and reef mining. Pop. 4,669.

Ballarat, 37° 33′ S., 143° 52′ E., the second city of Vic., the chief gold-mining centre in the state, and historically the most famous mining town in Australia, is situated on the Yarrowee Creek, 74 m. WNW. of Melbourne. It is an important railway junction, and has iron foundries, flour and woollen

mills, breweries, and distilleries. It has a school of mines affiliated to Melbourne University, and is the seat of Anglican and Roman Catholic bishops. Pop. 52,551.

Bathurst, 33° 24′ S., 149° 37′ E., N.S.W., situated in a fertile plain on the west side of the Blue Mountains, on the south bank of the Macquarie River, 145 m. WNW. of Sydney, is the centre of the chief wheat-growing district in New South Wales. In its neighbourhood gold mines are worked at Wattle Flat, Sofala, Hill End, Turon, silver mines at Sunny Corner, and copper mines at Burraga and Cow Flat, while statuary marble is also quarried. It has railway workshops, flour mills, tanneries, breweries, and coach factories. Seat of Anglican and Roman Catholic bishops. Pop. 11,972.

Beaconsfield, 41° 9′ S., 146° 6′ E., Tas., situated at the foot of Cabbage Tree Hill, on the River Tamar, near its mouth, 145 miles N. of Hobart, is the centre of the most extensive goldfield in the island. Pop. 3,411.

Beechworth, 36° 22′ S., 146° 41′ E., Vic., on Spring Creek among the May Day Hills, 1,805 feet above sea-level, 172 m. NE. of Melbourne, is the principal centre of the Ovens goldfields. The district is essentially devoted to mining, but much fruit and grain are also grown. It is a favourite tourist resort, the scenery around the town being singularly beautiful. Pop. 4,842.

Bendigo (formerly **Sandhurst**), 36° 46′ S., 144° 17′ E., Vic., mining town on Bendigo Creek, 101 m. NNW. of Melbourne, is the centre of a large goldfield, which contains the deepest developed mines in the world. Besides mining, it has iron foundries, breweries, tanneries, coach-building, and manufactures of pottery, bricks, and tiles. Seat of Anglican and Roman Catholic bishops. Pop. 43,623.

Brisbane, 27° 28′ S., 153° 6′ E., capital of Queensland, seaport, situated on both banks of the River Brisbane, 25 m. from its mouth in Moreton Bay, 725 m. N. of Sydney, is built on a series of hills rising from the river banks, but some parts of the city occupy low-lying flats which are exposed to inundations. It is the chief commercial city of the state, and exports gold, sheep, tallow, wool, frozen meat, and hides; industries include tanneries, boot factories, tobacco and soap works, and breweries. Seat of a university, and of a Roman Catholic archbishop and Anglican bishop. Pop. 139,480.

Broken Hill, 31° 58′ S., 141° 26′ E., N.S.W., silver-mining town, situated at the foot of the Barrier Range, 333 m. NE. of Adelaide. Gold is associated with silver in the ores, and large quantities of lead, copper, zinc, and tin are also found. One of the mines, the Proprietary, is the richest mine of its kind in the world. The town is also the centre of an extensive pastoral district; seat of a Roman Catholic bishop. Pop. 31,386.

Bulli, 34° 9′ S., 150° 29′ E., N.S.W., picturesquely situated between the Illawarra Mountains and the coast, 42 m. S. of Sydney, is the centre of several large collieries. The beautiful Bulli Pass, 1,000 feet above sea-level, over the Illawarra Mountains, is one of the most attractive resorts for visitors in the Commonwealth. Pop. 20,873.

Bunbury, 33° 18′ S., 115° 38′ E., W.A., seaport, on Koombanah Bay, 115 m. S. of Perth, has exports of coal from the neighbouring collieries on the Collie River, and of tin, timber, and agricultural produce. Seat of an Anglican bishop. Pop. 4,372.

Bundaberg, 24° 53′ S., 152° 21′ E., Q., port on the River Burnett, 8 m. from its mouth in Wide Bay, 217 m. N. by W. of Brisbane, has numerous

sugar factories in the vicinity, and exports sugar, golden syrup, and timber; coal-fields in the neighbourhood. Pop. 10,132.

Cairns, 16° 55′ S., 145° 47′ E., Q., seaport on the western shore of Trinity Bay, about 950 m. NNW. of Brisbane, has a commodious and well-sheltered harbour. It is the outlet for an extensive mineral district producing gold, silver, tin, and copper, and also for the largest sugar-growing district in northern Queensland. The Barron Falls, among the finest in Australia, are near Kuranda, 19 m. from Cairns. Pop. 6,524.

Castlemaine, 37° 4′ S., 144° 14′ E., Vic., gold-mining town situated in a basin at the southern foot of the Mount Alexander Range, at the junction of Barker's and Forest Creeks, 78 m. NNW. of Melbourne. Grey granite is quarried in the hills of the neighbourhood, and the district produces wine and fruit, especially apples. Pop. 7,865.

Charters Towers, 20° 3′ S., 146° 18′ E., Q., mining town, situated on the northern spurs of the Towers Mountain, 82 m. SW. of the port of Townsville, and 820 m. NW. of Brisbane, is the centre of an important goldfield. Pop. 17,298.

Cobar, 31° 32′ S., 145° 50′ E., N.S.W., 459 m. WNW. of Sydney, is the centre of the most important copper district in the state, which besides copper mines has also gold mines. The district produces also large quantities of wool. Pop. 6,186.

Cooktown, 15° 27′ S., 145° 17′ E., Q., seaport, situated at the mouth of the Endeavour River, about 1,050 m. direct NNW. of Brisbane, is the chief port of Queensland for the New Guinea trade. It is the outlet of the Palmer goldfields, and tin is also found in the district. It is the centre of a *bêche-de-mer* and pearl fishery, and the district produces coffee and rice. Seat of a Roman Catholic bishop. Pop. 1,963.

Coolgardie, 30° 57′ S., 121° 10′ E., W.A., mining town, 351 m. E. of Perth, where the first important gold discovery in Western Australia was made in 1891. Lignite, copper, graphite, and silver are also found. Pop. 2,226.

Dubbo, 32° 18′ S., 148° 35′ E., N.S.W., on the Macquarie River, 278 m. NW. of Sydney, is the trading centre of a rich pastoral and agricultural district; coal and copper are found. Pop. 5,389.

Echuca, 36° 8′ S., 144° 46′ E., Vic., river port, situated at the confluence of the Murray and Campaspe Rivers, 156 m. N. of Melbourne, is the centre of a rich agricultural district with extensive vineyards, and the entrepôt of the overland intercolonial trade. It has saw-mills, breweries, coach factories, and large wool stores. Pop. 5,554.

Fremantle, 32° 3′ S., 115° 45′ E., the principal seaport of Western Australia, at the mouth of the Swan River, 12 m. W. of Perth. It has smelting works, iron foundries, flour and saw mills, breweries, and tanneries. Pop. 19,346.

Gawler, 34° 39′ S., 138° 45′ E., S.A., situated at the junction of the north and south Para River, 25 m. NE. of Adelaide, is the centre of an agricultural and mineral district, where gold, silver, lead, and copper ores are found. It has engineering works, iron foundries, flour mills, breweries, and saw-mills. Pop. 5,767.

Geelong, 38° 10′ S., 144° 21′ E., Vic., seaport, situated on Corio Bay, the western arm of Port Phillip Bay, 45 m. SW. of Melbourne, is a seat of the wool trade. It has woollen mills, meat-preserving factories, tanneries, flour mills, and rope works; cement works and paper mills at Fyansford, 3 m. distant; lime quarries and coal-mines. Pop. 33,518.

Geraldton, 28° 46′ S., 114° 36′ E., W.A., seaport on Champion Bay, 306 m N. of Perth, is the chief outlet for the Murchison and Yalgoo goldfields, and has also exports of copper, lead, and wool. Seat of a Roman Catholic bishop. Pop. 3,594.

Goulburn, 34° 45′ S., 149° 45′ E., N.S.W., near the Wollondilly River, 134 m. S.W. of Syndey, is an important railway junction, and the chief dépôt of the inland trade of the southern part of the state. Has flour mills, breweries, tanneries, and boot and shoe factories. Seat of Anglican and Roman Catholic bishops. Pop. 13,429.

Grafton, 29° 40′ S., 152° 55′ E., N.S.W., port on both banks of the Clarence River, at the head of navigation, about 45 m. from the sea, 528 m. by land, 342 m. by sea NE. of Sydney, is the trading centre of a fertile agricultural and dairying district, producing sugar, maize, and oranges. Sugar refineries, saw-mills, creameries, bacon-curing factories, and tanneries. Seat of a Roman Catholic bishop. Pop. 9,527.

Gympie, 26° 12′ S., 152° 38′ E., Q., mining town, situated on the side of a range of hills on the upper part of the River Mary, 107 m. N. of Brisbane, is the centre of a district with numerous gold mines, and where copper, silver, nickel, bismuth, and antimony are also found; coal-fields. Pop. 12,419.

Hamilton, 37° 30′ S., 142° 5′ E., Vic., on Grange Burn Creek, 198 m. W. of Melbourne, is the centre of a pastoral district, and has important educational establishments. Pop. 6,015.

Hobart, 42° 53′ S., 147° 21′ E., capital of Tas., seaport on the southern coast of the island, on the estuary of the Derwent, 12 m. from its mouth, 443 m. SE. of Melbourne, has a fine natural harbour. Hobart stands on a series of low hills at the foot of Mount Wellington (4,166 feet), and is celebrated for its invigorating climate. It is the centre of a fruit-growing district, and has flour and saw mills, tanneries, breweries, iron foundries, and manufactures of pottery, woollen goods, jam, and fruit preserves. Seat of a university, and of a Roman Catholic archbishop and an Anglican bishop. Pop. 41,757.

Inverell, 29° 48′ S., 151° 10′ E., N.S.W., on the Macintyre River, 341 m. N. of Sydney, is the centre of a district where silver, tin, and diamonds are mined. The best Australian diamonds have come from this district. It is also in a rich agricultural region, with extensive vineyards. Pop. 5,788.

Ipswich, 27° 37′ S., 152° 48′ E., Q., at the head of navigation of the River Bremer, 23 m. W. of Brisbane, is the centre of a coal-mining and agricultural district, and has saw-mills, iron foundries, railway workshops, and woollen factory. Pop. 18,574.

Kadina, 34° 5′ S., 137° 40′ E., S.A., in the northern part of York Peninsula, 117 m. NW. of Adelaide, and 6 m. E. of Wallaroo Bay, centre of an agricultural and copper-mining district. The principal mines are at Wallaroo and Kurilla. Pop. 13,348.

Kalgoorlie, 30° 45′ S., 121° 30′ E., W.A., gold-mining town, 375 m. E. of Perth. As at the neighbouring town of Coolgardie, 24 m. to the W., the water-supply comes from a source near Perth, distant 360 m. Pop. 31,324.

Katoomba, 33° 27′ S., 150° 24′ E., N.S.W., on the eastern slope of the Blue Mountains, at an altitude of 3,350 feet, 66 m. W. of Sydney, is a favourite resort, being in the centre of magnificent mountain scenery and near beautiful waterfalls. Pop. 9,242.

Kyneton, 37° 12′ S., 144° 27′ E., Vic., on the Campaspe River, 56 m. NNW. of Melbourne, is the centre of an agricultural and pastoral district,

which contains also some rich gold-quartz reefs. It lies 1,687 feet above sea-level, amid beautiful scenery; a favourite resort. Pop. 4,695.

Launceston, 41° 30′ S., 147° 14′ E., Tas., port of entry, at the junction of the Esk with the Tamar River, 40 m. from its mouth into Bass Strait at Port Dalrymple, 133 m. N. by W. of Hobart, is situated in a valley of great beauty enclosed by lofty hills. It is the second city in the state: centre of a fruit-growing district, and has tin-smelting works. Pop. 25,227.

Lismore, 28° 50′ S., 153° 21′ E., N.S.W., at the head of navigation on the Richmond River, about 520 m. direct N. of Sydney, is the centre of a pastoral and agricultural district, growing maize, sugar, and potatoes, and has sugar refineries and saw-mills. Seat of a Roman Catholic bishop. Pop. 8,912.

Lithgow, 33° 35′ S., 150° 31′ E., N.S.W., in a valley in the Blue Mountains, 96 m. WNW. of Sydney, is the centre of a district rich in coal, iron ore, and deposits of kerosene shale. Pop. 8,851.

Liverpool, 33° 54′ S., 150° 58′ E., N.S.W., port at the head of navigation on George's River, 22 m. SSW. of Sydney, is the centre of a dairying district, and has paper mills, wool-washing establishments, and tanneries. Pop. 7,529.

Mackay, 21° 9′ S., 149° 13′ E., Q., seaport at the mouth of Pioneer River, 625 m. NNW. of Brisbane, is the outlet for the largest sugar-producing district in Queensland, and also for the copper mines at Mt. Orange and Mt. Gotthart, and the goldfields of Mt. Britten and Eungella. Pop. 5,905.

Maitland West, 32° 45′ S., 151° 35′ E., N.S.W., coal-mining town on the Hunter River, 120 m. N. of Sydney, is an important railway junction. It is also the trading centre of a fertile agricultural district, producing cereals, lucerne, tobacco, and wine. Seat of a Roman Catholic bishop. Pop. 33,787.

Maryborough, 25° 33′ S., 152° 43′ E., Q., on north bank of the Mary River, 25 m. from its mouth, 180 m. NNW. of Brisbane, is the centre of a fertile agricultural district, producing sugar, maize, potatoes, bananas, oranges, and lucerne. Pop. 11,626.

Maryborough, 37° 3′ S., 143° 44′ E., Vic., 112 m. NW. of Melbourne, is the centre of a gold-mining district. It is an important railway junction, and has extensive railway workshops, as well as iron foundries, coach factories, and breweries. Pop. 7,967.

Melbourne, 37° 49′ S., 144° 58′ E., capital of Vic., seaport on Hobson's Bay, the northern extremity of the great Port Phillip Bay, on both banks of the Yarra River, about 500 m. SW. of Sydney. It is the second port of Australia. It has a university and an astronomical observatory, and is the seat of Anglican and Roman Catholic archbishops. Pop. 588,971.

Mount Gambier, 37° 50′ S., 140° 50′ E., S.A., the chief town in the south-eastern corner of South Australia, 305 m. SE. of Adelaide, on the northern base of Mount Gambier, an extinct volcano, is the centre of a grain-growing district. Pop. 6,670.

Mount Morgan, 23° 50′ S., 150° 10′ E., Q., gold-mining town, near the head of the Dee River, 28 m. SSW. of Rockhampton; has also copper mines. Pop. 12,023.

Newcastle, 32° 55′ S., 151° 49′ E., N.S.W., seaport at the mouth of Hunter River, 62 m. by sea and 102 m. by rail NE. of Sydney, is the chief coal port in Australia, numerous mines being in the neighbourhood. It has smelting works, iron foundries, engineering works, shipbuilding, and other industries. Seat of an Anglican bishop. Pop. 62,406.

Orange, 33° 16′ S., 149° 11′ E., N.S.W., on Blackman's Swamp Creek, 192 m. WNW. of Sydney, is a favourite health resort, owing to its bracing climate, being situated 2,843 feet above sea-level. It is the centre of a fruit- and wheat-growing district, in which gold, silver, and copper are also found. Pop. 8,800.

Palmerston, 12° 27′ S., 130° 50′ E., chief town of the Northern Territory of Australia, seaport on the eastern shore of Port Darwin Bay, has a magnificent harbour, and is about 2,000 m. direct NNW. of Adelaide. Designed as the terminus of the trans-continental railway running southwards to Port Augusta. Pop. 3,310 whites (whole territory).

Parramatta, 33° 46′ S., 151° 1′ E., N.S.W., on the Parramatta River, near its entrance into Port Jackson, 14 m. NW. of Sydney, is the centre of a district growing fruit, especially oranges and vegetables. It has manufactures of tweeds, soap, candles, and tiles, and breweries. Pop. 34,558.

Perth, 31° 57′ S., 115° 52′ E., capital of Western Australia, picturesquely situated on the Swan River, 12 m. from Fremantle, its seaport. Seat of Anglican and Roman Catholic bishops. Pop. 104,635.

Port Augusta, 32° 29′ S., 137° 45′ E., S.A., seaport, situated at the head of Spencer Gulf, 259 m. NNW. of Adelaide, has a fine natural harbour and is the starting-point of the northern trans-continental railway. The district is rich in gold, silver, copper, iron, and coal, and ostrich farming is carried on. Seat of a Roman Catholic bishop. Pop. 2,340.

Port Pirie, 33° 10′ S., 138° 1′ E., S.A., seaport, situated on German Bay, an inlet of Spencer Gulf, 154 m. NNW. of Adelaide, contains the smelting works of the Broken Hill Proprietary Mine, and is the port of shipment of its products, as well as of large quantities of wheat. Pop. 11,307.

Queenstown, 42° 10′ S., 145° 35′ E., Tas., on the Queen River, near the West Coast Range Mountains, 353 m. NW. of Hobart, and 23 m. E. of Strahan, its seaport, is the centre of the Mount Lyell mining district, and has smelting works, brick works, and saw-mills. Pop. 5,292.

Rockhampton, 23° 24′ S., 150° 31′ E., Q., the chief commercial centre of central Queensland, on the Fitzroy River, 35 m. from its mouth, 420 m. NW. of Brisbane. It is surrounded by rich agricultural land, and has meat-preserving works and tanneries; gold, silver, and copper mines are in the neighbourhood. Seat of Anglican and Roman Catholic bishops. Pop. 20,915.

Shepparton, 36° 22′ S., 145° 24′ E., Vic., on the Goulburn River, 113 m. NNE. of Melbourne: centre of an extensive irrigated district. Pop. 5,174.

Singleton, 32° 24′ S., 151° 7′ E., N.S.W., on the Hunter River, 147 m. NNW. of Sydney, principal coal-mining centre. Pop. 5,162.

Stawell, 37° 3′ S., 142° 47′ E., Vic., mining town, 179 m. by rail WNW. of Melbourne, is the centre for quartz reef gold mines, which are worked at very deep levels. The surrounding district produces a good wine, and numerous freestone quarries are in the neighbourhood. Pop. 4,910.

Sydney, 33° 51′ S., 151° 12′ E., capital of N.S.W., and the chief port of Australia, on the eastern coast of the continent, occupies a noteworthy position as regards natural advantages and beauty of site, on a peninsula on the southern shore of Port Jackson, which forms one of the deepest, safest, and most beautiful harbours in the world. Although Sydney is chiefly a commercial city it is also the seat of numerous industries. It has a university, an astronomical observatory, and a library rich in manuscripts on the early history of Australia, and is the seat of Anglican and Roman Catholic archbishops. Pop. 632,624.

Tamworth, 31° 4′ S., 150° 57′ E., N.S.W., situated on the Peel and Cockburn Rivers, 282 m. N. of Sydney, is an important railway junction, and the trading centre of pastoral, agricultural, and mining districts, where gold and diamonds are found. Pop. 8,224.

Toowoomba, 27° 34′ S., 151° 58′ E., the chief inland town of Q., on the summit of the Great Dividing Range, at an altitude of 1,920 feet, at the head of Gowrie Creek, a tributary of the Condamine, 101 m. W. of Brisbane, is the trading centre of the rich pastoral and agricultural district of Darling Downs, which also produces large quantities of wine. Pop. 19,776.

Townsville, 19° 10′ S., 146° 57′ E., seaport, the principal town in northern Q., on Cleveland Bay, a subdivision of Halifax Bay, 870 m. NNW. of Brisbane, is the centre of a sugar-producing district. It is the starting-point of the Northern Railway, which goes inland to Hughenden and Winton, and the outlet for several goldfields. Seat of Anglican bishop. Pop. 13,835.

Wagga Wagga, 35° 7′ S., 147° 27′ E., N.S.W., on the south bank of Murrumbidgee River, 309 m. WSW. of Sydney, is the centre of a pastoral, agricultural, and gold-mining district. Pop. 7,222.

Wangaratta, 36° 21′ S., 146° 19′ E., Vic., at the junction of the Ovens and King Rivers, 145 m. NE. of Melbourne, is the centre of an agricultural district, and has industries associated with its products. Seat of an Anglican bishop. Pop. 4,345.

Warrnambool, 38° 24′ S., 142° 28′ E., Vic., seaport on Warrnambool Bay, 166 m. SW. of Melbourne, is the outlet of a rich agricultural and pastoral district. Sandstone quarries in the neighbourhood. Pop. 9,287.

Warwick, 28° 12′ S., 152° 4′ E., Q., on the River Condamine, 168 m. SW. of Brisbane, is the centre of a rich agricultural district in the Darling Downs, producing wheat, maize, lucerne, and fruit, and famous for its cattle and vineyards; coal, marble, building stone, and brick clay are found in the neighbourhood. Pop. 5,987.

Wellington, 32° 35′ S., 149° 0′ E., N.S.W., picturesquely situated at the foot of a mountain range on the left bank of the Macquarie River, at its junction with the Bell River, 248 m. NW. of Sydney, is the centre of a fast-developing agricultural and pastoral district. The famous Wellington Caves are situated in the neighbourhood. Pop. 5,372.

Zeehan, 41° 50′ S., 145° 30′ E., Tas., on the Little Henty River, 225 m. direct NW. of Hobart, 29 m. N. of Strahan, its seaport, is the principal centre of the silver-lead mining district in Tasmania, and has smelting works. It is an important railway junction, and contains a school of mines. Pop. 4,149.

NEW ZEALAND

Auckland, 36° 51′ S., 174° 50′ E., seaport on the east coast of North Island, the largest city of New Zealand, situated on one of the finest harbours in the Dominion, the Waitemata Harbour, a branch of the Hauraki Gulf. It lies on a peninsula only 6 m. wide, and possesses also a harbour on the west coast of the island, in the Manukau Harbour. It is 1,315 m. distant from Sydney. Has a University College, and a museum possessing a good collection of Maori remains; seat of Anglican and Roman Catholic bishops. Pop. 40,536; Greater Auckland, 102,676.

Christchurch, 43° 32′ S., 172° 38′ E., capital of Canterbury district in South Island, on the River Avon, 7 m. W. of Lyttelton, its seaport, is the

trading centre of a large agricultural and pastoral region. It is an important railway centre with workshops. Seat of a University College and of Anglican and Roman Catholic bishops. Pop. 53,116; Greater Christchurch, 80,193.

Dunedin, 45° 52′ S., 170° 31′ E., capital of Otago district in South Island, 231 m. S. of Christchurch, is picturesquely situated on the hills at the head of the Otago Harbour, 8 m. SW. of its seaport, Port Chalmers. Otago Harbour has been deepened by dredging operations, and large steamers are now berthed alongside the wharves of Dunedin. It has a University College, and is the seat of an Anglican bishop, who is the Primate of New Zealand, and of a Roman Catholic bishop. Pop. 41,529; Greater Dunedin, 67,237.

Gisborne, 38° 45′ S., 177° 59′ E., seaport on the east coast of North Island, on Poverty Bay, 86 m. NE. of Napier, is the trading centre of an agricultural district, and exports frozen meat, wool, and timber; petroleum has been discovered in the neighbourhood. Pop. 8,196.

Greymouth, 42° 25′ S., 171° 9′ E., the principal seaport on the west coast of South Island, is situated at the mouth of the Grey River, 150 m. SW. of Nelson. It is the shipping port of the coal-fields of Brunner Runanga and the Grey Valley, and of the goldfields of Kumara, Ross, Reefton, and Hokitika, and generally of the alluvial gold deposits of the province of Westland; also exports coal and timber. Pop. 5,469.

Hastings, 39° 40′ S., 176° 45′ E., in Hawke's Bay district, North Island, 95 m. NE. of Wellington, is the centre of an agricultural, fruit-growing, and dairying region. Pop. 6,286.

Invercargill, 46° 35′ S., 168° 50′ E., chief town of Southland district, South Island, on an estuary called the New River Harbour, 17 m. N. of its seaport, the Bluff, and 139 m. SW. of Dunedin. Situated at the southern extremity of the island, it is the terminus of five railways. Pop. 12,782.

Napier, 39° 29′ S., 176° 55′ E., chief city of Hawke's Bay district, and the principal seaport on the east coast of North Island, is situated on the peninsula known as Scinde Island, on the estuary of the Esk and Tutaekuri Rivers, 200 m. NE. of Wellington. Has exports of wool, tinned and frozen meat, hides, tallow, and timber. Seat of an Anglican bishop. Pop. 10,537.

Nelson, 41° 16′ S., 173° 18′ E., capital of Nelson district, seaport, beautifully situated at the head of Blind Bay, on the northern shore of South Island, 90 m. W. of Wellington, is the centre of a fruit-growing district, and, owing to its fine climate and surroundings, is a favourite health resort. Seat of an Anglican bishop. Pop. 8,051.

New Plymouth, 39° 3′ S., 174° 4′ E., seaport on the west coast of North Island, the principal town of Taranaki district, 251 m. NNW. of Wellington, near the foot of Mount Egmont, is the chief outlet of a rich dairying and agricultural region. Pop. 5,238.

Oamaru, 45° 6′ S., 171° 1′ E., seaport on the east coast of South Island 78 m. N. of Dunedin, is the trading centre of a farming district famous for its grain and live stock, and exports frozen meat, wool, and grain; limestone quarries in the neighbourhood. Pop. 5,152.

Palmerston North, 40° 21′ S., 175° 38′ E., North Island, on the Manawatu River, 88 m. NE. of Wellington, is an important railway junction, and the centre of a rich farming district. Pop. 10,991.

Petone, 41° 20′ S., 174° 45′ E., seaport on the south-western coast of North Island, situated along the northern shore of Port Nicholson, 7 m. N. of

Wellington, has the government railway workshops, meat-preserving and freezing works, and saw-mills. Pop. 6,640.

Timaru, 44° 23′ S., 171° 17′ E., seaport on the east coast of South Island, pleasantly situated on Caroline Bay, 100 m. SW. of Christchurch, is the port for an agricultural and pastoral region, and has meat-freezing works, saw mills, large flour mills, wool-scouring works, and iron foundries. Pop. 11,280.

Waihi, 37° 30′ S., 175° 30′ E., in Auckland district, North Island, 140 m. SE. of Auckland, is a gold-mining town. Pop. 6,436.

Wanganui, 39° 56′ S., 175° 5′ E., port on the west coast of North Island, on the Wanganui River, 4 m. from its month, 50 m. N. of Wellington, is the trading centre of an agricultural and pastoral district, and has meat-freezing works, saw-mills, railway workshops, flour mills, &c. Pop. 10,929.

Wellington, 41° 16′ S., 174° 47′ E., capital of New Zealand, and the most important port of call in the Dominion, is situated on the south-western shore of North Island, on Port Nicholson, an inlet of Cook's Strait, and possesses a large land-locked harbour. Seat of a University College and of an Anglican bishop and Roman Catholic archbishop. Pop. 64,372 ; Greater Wellington, 70,729.

Note to Statistics on following pages.

Trade with Principal Countries.

Theoretically the imports of one country from another should coincide with the exports of the country from which they purport to be consigned to the importing country; in reality freight, insurance and other charges, together with a lack of uniformity in the date on which the customs year begins, the diversion of goods exported when *en route*, variations in methods of valuation, and the consideration of ships' stores, bunker coal, &c., render comparison impracticable.

H. Y. = Highest Year, i.e. the year in which returns were highest during the period for which averages, &c., are quoted.

STATISTICS

By Harold Macfarlane

AUSTRALIA

RELATIVE AREAS OF STATES AND COMMONWEALTH

(Ratio which the area of each State and Territory bears to that of other States, the Commonwealth, and the United Kingdom.)

	Area sq. m.	*N.S.W.*	*Vict.*	*Qnsld.*	*S.Aus.*	*W.Aus.*	*Tas.*	*N.Terr.*	*C'wealth.*	*U.K.*
New South Wales*	310,372	1·0	3·532	0·463	0·817	0·318	11·84	0·593	0·104	2·55
Victoria . .	87,884	0·283	1·0	0·131	0·231	0·09	3·352	0·168	0·03	0·72
Queensland . .	670,500	2·16	7·629	1·0	1·764	0·687	25·577	1·28	0·225	5·52
South Australia .	380,070	1·225	4·325	0·567	1·0	0·389	14·498	0·726	0·128	3·13
Western Australia .	975,920	3·144	11·105	1·455	2·568	1·0	37·228	1·864	0·328	8·04
Tasmania . .	26,215	0·085	0·298	0·039	0·069	0·027	1·0	0·05	0·009	0·215
Northern Territory	523,620	1·687	5·958	0·781	1·378	0·537	19·974	1·0	0·176	4·31
Commonwealth .	2,974,581	9·584	33·847	4·436	7·827	3·048	113·469	5·681	1·0	24·5

* Includes Federal Capital Territory, 912 square miles.

TOTAL AREA UNDER CROPS IN THOUSANDS OF ACRES

	N.S.W.	*Vict.*	*Qnsld.*	*S.Aus.*	*W.Aus.*	*Tas.*	*C'wealth.*
1860–1 . .	260·8	387·3	3·3	359·3	24·7	152·8	1,188·2
1870–1 . .	426·9	692·8	52·2	801·5	54·5	157·4	2,185·3
1880–1 . .	629·1	1,548·8	113·9	2,087·2	57·7	140·8	4,577·5
1890–1 . .	852·7	2031·9	225·0	2093·5	69·7	157·4	5,430·2
1900–1 . .	2,445·5	3,114·0	457·4	2,369·7	201·3	224·3	8,812·2
1910–11 . .	3,386·0	3,952·0	667·0	2,747·0	855·0	287·0	11,894·0
Proportion under crops to total area, 1910–11, 1 acre in	59	14	643	89	730	58	160

THE PROGRESS OF AGRICULTURE (COMMONWEALTH)

Wheat.	1861.	1871.	1881.	1891.	1901.	1911.	*Inc. or Dec. %* since— 1901.	since— 1861.
Area (1,000 acres)	704·5	1,279·8	3,002·0	3,335·5	5,116·0	7,428·0	45·0	955·0
Yield (1,000 bush.)	10,236·5	11,917·8	21,444·0	25,675·0	38,561·0	71,636·0	85·0	600·0
Average yield per acre (bush.)	14·53	9·31	7·14	7·7	7·54	9·64	—	—
Oats.								
Area (1,000 acres)	129·7	225·5	194·8	246·0	461·4	617·0	33·0	375·0
Yield (1,000 bush.)	3,091·0	4,251·6	4,796·0	5,726·0	9,790·0	9,561·8	−2·4	209·0
Average yield per acre (bush.)	23·82	18·85	24·62	23·27	21·22	15·45	—	—
Barley.								
Area (1,000 acres)	27·0	48·0	76·0	68·0	74·5	116·5	56·0	331·0
Yield (1,000 bush.)	508·0	726·0	1,353·0	1,178·0	1,520·0	2,057·0	35·0	304·0
Average yield per acre (bush.)	18·75	15·08	17·84	17·31	20·40	17·6	—	—
Maize.								
Area (1,000 acres)	61·0	142·0	165·0	284·5	294·8	340·1	15·0	457·0
Yield (1,000 bush.)	1,800·0	4,576·6	5,726·2	9,261·9	7,034·7	9,040·0	28·5	402·0
Average yield per acre (bush.)	29·18	32·21	34·54	32·56	23·86	26·58	—	—
Sugar-cane.								
Area (1,000 acres)	—	11·6	19·7	45·4	87·0	101·0	16·0	777·0
Yield (1,000 tons)	—	176·6	349·6	737·6	1,368·0	1,682·0	22·0	852·0
Average yield per acre (tons)	—	15·25	17·74	16·23	15·73	16·6	—	—
Vineyards.								
Area (1,000 acres)	7·0	16·25	14·57	49·0	63·7	60·6	−5	765·7
Wine (1,000 gals.)	495·0	2,104·0	1,488·0	3,535·0	5,816·0	4,975·0	−14·5	905·0

MEAN PRODUCTION, 1906–11

	N.S.W.	*Qnsld.*	*S.Aus.*	*Tas.*	*Vict.*	*W.Aus.*	*C'wealth.*
Wheat (1,000 qrs.)	2,572·6	140·0	2,637·0	97·7	3,041·4	491·0	8,979·8
Barley (1,000 qrs.)	18·7	15·95	78·0	18·6	152·7	8·4	294·4
Oats (1,000 qrs.)	176·1	4·4	134·9	246·6	1,069·6	98·6	1,730·2
Maize (1,000 qrs.)	755·0	413·0	1·09	—	100·0	0·177	1,269·5
Wines (1,000 gals.)	862·0	80·0	2,746·0	—	1,440·0	155·0	5,283·0
Tobacco (1,000 lb.)	619·0	580·0	—	—	220·0	—	1,419·0
Sugar, 1908–12 (1,000 tons)	146·0	1,493·0	—	—	—	—	1,639·0

LIVE STOCK AND PRODUCE

	1861.	1871.	1881.	1891.	1901.	1911.
	1,000.	1,000.	1,000.	1,000.	1,000.	1,000.
Sheep .	20,980·0	40,073·0	65,092·7	106,421·0	72,040·0	93,003·5
Cattle .	3,846·5	4,277·0	8,011·0	11,112·0	8,491·5	11,829·0
Horses .	431·7	701·5	1,088·0	1,584·7	1,620·5	2,279·0
Pigs . .	319·0	586·0	703·0	845·9	931·3	1,110·7
Butter production (1,000 lb.) .	—	—	—	47,433·0	101,671·0	211,577
Cheese (1,000 lb.) .	—	—	—	19,147·0	11,575·0	15,887
Bacon & ham (1,000 lb.)	—	—	—	—	34,020·0	53,265
Total est. value of pastoral and dairy produce (£1,000)	20,736·0	29,538·0	39,256·0		36,890·0	69,832

WOOL

The Commonwealth

	1871.	1881.	1891.	1901.	1911.
Production: greasy (mill. lb.)	179	333	631·5	543	768

Average Annual Exports of Wool, 1907–11

	'Greasy.' 1,000 lb.	*'Scoured and washed.'* 1,000 lb.	*Total value.* £1,000.
United Kingdom . . .	223,200	38,000	11,625
France	134,600	13,900	5,986
Germany	96,400	11,700	4,732
Belgium	52,700	8,200	2,605
United States	18,400	31	893
Other countries . . .	10,600	1,622	586
Total	535,900	73,453	26,427

ANNUAL EXPORTS OF FROZEN MEAT

	Million lb.	*Value,* £1,000.
(*a*) *Beef*:		
1901 . . .	90·7	1,175
1911 . . .	108·8	1,102
Av. 1907–11 . . .	76·4	808
(*b*) *Mutton*:		
1901 . . .	66·0	726
1911 . . .	129·6	1,634
Av. 1907–11 . . .	127·5	1,524·5

LAND SETTLEMENT

New South Wales. Area, 198,638,080 acres.

	Alienated.		*In process of alienation.*		*Held under lease or licence.*		*Unoccupied.*	
	Area. 1,000 *acres.*	%	*Area.* 1,000 *acres.*	%	*Area.* 1,000 *acres.*	%	*Area.* 1,000 *acres.*	%
1901	26,444	13·32	21,596	10·87	127,055	63·96	23,543	11·85
1911	38,742	19·5	16,210	8·16	123,224	62·04	20,463	10·3
			Victoria. Area, 56,245,760 acres.					
1901	20,067	35·67	3,730	6·63	17,110	30·42	15,338	27·28
1911	23,728	42·18	6,365	11·31	14,719	26·34	11,434	20·17
			Queensland. Area, 429,120,000 acres.					
1901	13,533	3·15	2,792	0·65	280,024	65·26	132,771	30·94
1911	15,709	3·66	9,025	2·1	308,206	71·82	96,180	22·42
			South Australia. Area, 243,244,800 acres.					
1901	7,535	3·1	554	0·23	85,591	35·18	149,565	61·49
1911	9,893	4·07	1,761	0·72	111,090	45·67	120,500	49·54
			Northern Territory. Area, 335,116,800 acres.					
1901	473	0·14	—	—	112,654	33·62	221,989	66·24
1911	474	0·14	—	—	93,745	27·97	240,898	71·89
			Western Australia. Area, 624,588,800 acres.					
1901	3,469	0·56	6,116	0·98	97,451	15·6	517,553	82·86
1911	7,203	1·15	11,843	1·9	169,938	27·21	435,605	69·74
			Tasmania. Area, 16,777,600 acres.					
1901	4,622	27·54	272	1·62	1,521	9·06	10,362	61·78
1911	4,965	29·6	1,275	7·6	1,519	9·05	9,018	53·75
			The Commonwealth. Area, 1,903,731,840 acres.					
1901	76,143	4·0	35,060	1·84	721,407	37·89	1,071,122	56·27
1911	100,713	5·29	46,480	2·45	822,440	43·2	934,098	49·06

FORESTS OF AUSTRALIA, 1911

	Specially reserved for timber, sq. m.	*Total forest area in sq. m.*	*Percentage of State area.* *Specially reserved.*	*Total forest.*
New South Wales	11,530	23,400	3·72	7·55
Victoria	6,500	18,400	7·4	20·98
Queensland	5,805	62,500	0·87	9·32
South Australia	250	6,000	0·03	0·66
Western Australia	17,420	31,800	17·85	3·27
Tasmania	1,564 (approx.)	17,200	5·95	65·56
Commonwealth	43,069	159,300	1·44	5·35

FISHERIES. AVERAGE ANNUAL VALUE OF TAKE (1908–11.)

	Fish. £1,000.	*Lobsters.* £1,000.
New South Wales	101	3·9
Victoria	64·7	7·3
Queensland	33·5	—
South Australia	81·8	4·1
Western Australia	54·1	3·6
Tasmania (refers chiefly to Hobart)	12·0	1·3
Commonwealth	347·1	20·2

PEARL, PEARL-SHELL, AND BÊCHE-DE-MER FISHERIES

Average 1908–11

	Value of pearl-shell. £1,000.	*Value of pearls obtained.* £1,000.	*Value of bêche-de-mer obtained.* £1,000.
Queensland	72	21	14·3
Western Australia	196	56	—
Northern Territory	10·8	—	1·4
Commonwealth	278·8	77	15·7

MINERALS

TOTAL VALUE OF ALL MINERAL PRODUCTION

The Commonwealth

	£		£		£
1861	10,657,533	1881	7,813,523	1901	22,043,104
1871	8,484,728	1891	12,093,837	1910	23,480,211

AVERAGE VALUE OF PRINCIPAL MINERALS PRODUCED, 1907–11

	N.S.W. £1,000.	*Vict.* £1,000.	*Qnsld.* £1,000.	*S.Aus. & N.Terr.* £1,000.	*W.Aus.* £1,000.	*Tas.* £1,000.	*C'wealth.* £1,000.
Coal	3,014·0	142·4	277	—	89·4	29·6	3,552·4
Copper	546·0	1·8	971	407·0	103·0	613·0	2,641·8
Gold	890·0	2,630·0	1,881	46·0	6,611·0	200·0	12,258·0
Silver	2,648·0	2·7	153	4·9	24·8	339·0	3,172·4
Tin	229·0	6·1	327	32·8	82·0	451·0	1,127·9
Zinc	732·3	—	—	—	0·1	—	752·4

COMMONWEALTH MINERAL PRODUCTION TO END OF 1911

	N.S.W. £1,000.	*Vict.* £1,000.	*Qnsld.* £1,000.	*S.Aus. & N.Terr.* £1,000.	*W.Aus.* £1,000.	*Tas.* £1,000.	*C'wealth.* £1,000.
Gold	58,761	289,664	73,740	2,936	103,850	7,246	536,197
Silver & lead	56,476	218	2,124	412	670	5,950	65,850
Copper	11,204	216	9,250	27,610	1,052	9,816	59,148
Tin	8,990	777	7,746	302	984	11,429	30,228
Coal	65,428	2,203	5,039	—	934	548	74,152
Other	15,288	385	1,827	1,366	79	186	19,131
	216,147	293,463	99,726	32,626	107,569	35,175	784,706
% of total	27·55	37·4	12·7	4·16	13·7	4·49	—

GOLD. *The Commonwealth.*

	£		£		£
1861	9,950,000	1881	5,194,390	1901	14,005,732
1871	7,239,106	1891	5,281,861	1911	10,551,624

Production by States.

Year.	*N.S.W.* £1,000.	*Vict.* £1,000.	*Qnsld.* £1,000.	*S.Aus.* £1,000.	*W.Aus.* £1,000.	*Tas.* £1,000.	*N.Terr.* £1,000.	*C'wealth.* £
1861	1,806	8,140	3	—	—	—	—	9,950,000
1871	1,250	5,475	492	6·0	—	14	—	7,239,106
1881	573	3,333	957	0·8	—	217	112	5,194,390
1891	559	2,305	2,030	27·0	115	145	98	5,281,861
1901	737	3,102	2,541	16·6	7,235	295	76	14,005,732
1911	769	2,140	1,640	15·0	5,823	132	31	10,551,624

Percentage of Total Production (relative positions as gold-producers).

1861	18·0	81·0	—	—	—	—	—
1871	17·0	76·0	6·8	—	—	0·2	—
1881	11·0	64·0	18·5	—	—	4·0	2·0
1891	10·5	43·5	38·5	0·5	2·0	2·7	1·8
1901	5·3	22·1	18·1	0·1	51·7	2·1	0·6
1911	7·3	20·3	15·54	0·14	55·18	1·25	0·29

SILVER AND LEAD. *The Commonwealth.* Value of production.

	£		£		£
1861	5,702	1881	31,139	1901	2,367,687
1871	29,488	1891	3,717,825	1911	3,021,219

States. Production of Silver, Silver Lead and Ore, and Lead in each State.

Year.	*N.S.W.* £	*Vict.* £	*Qnsld.* £	*S.Aus.** £	*W.Aus.* £	*Tas.* £	*C'wealth.* £
1881	—	5,239	13,494	1,182	11,224	—	31,139
1891	3,621,614	6,017	21,879	5,927	250	62,138	3,717,825
1901	1,954,964	6,550	69,234	3,886	7,718	325,335	2,367,687
1911	2,652,548	2,070	79,765	140	33,335	253,361	3,021,219

* Includes N. Terr.

COPPER. *The Commonwealth.* Value of Production.

	£		£		£
1861	458,768	1881	673,786	1901	2,208,590
1871	824,111	1891	362,745	1911	2,564,278

Production by States. Average value, 1907–11.

N.S.W. £1,000.	*Vict.* £1,000.	*Qnsld.* £1,000.	*S.Aus.* £1,000.	*W.Aus.* £1,000.	*Tas.* £1,000.	*C'wealth.* £1,000.
546·0	1·77	971·6	407	108·0	613·0	2,647·37
Most productive year, 1907.						
727·8	2·35	1028·2	705	203·4	869·65	3,536·4

COAL. *The Commonwealth.* Value of Produce.

	£		£		£
1861	228,935	1881	636,746	1901	2,602,770
1871	325,747	1891	1,908,028	1911	3,929,672

Production by States. Average production, 1907–11 inclusive (1,000 tons).

N.S.W.	*Vict.*	*Qnsld.*	*W.Aus.*	*Tas.*	*C'wealth.*
8,338·0	282·4	779·8	208·6	65	9,673·8
Production in year (1911) of greatest output.					
8,691·5	660·0	891·5	250·0	57	10,550·0

RAILWAYS. The Commonwealth (*State railways*)

	1861.	1871.	1881.	1891.	1901.	1911.
Length of line open (miles)	205	970	3,832	9,541	12,577	16,078½
Capital cost (£1,000)	6,654	19,269	42,741	99,764	123,587	152,855
Gross rev. (£1,000)	318	1,102	3,910	8,654	11,038	17,848
Working expenses (£1,000)	234	608	2,141	5,630	7,149	11,054
% of working expenses on earnings	73·41	55·17	54·77	65·06	64·76	61·9

Railway Progress by States

	N.S.W. miles.	*Vict.* miles.	*Qnsld.* miles.	*S.Aus.* miles.	*N.Terr.* miles.	*W.Aus.* miles.	*Tas.* miles.	*C'wealth.* miles.
1861	73	114	—	56	—	—	—	243
1871	358	276	218	133	—	12	45	1,042
1881	1,040	1,247	800	845	—	92	168	4,192
1890–1	2,263	2,763	2,205	1,666	145½	656	425	10,123½
1900–1	2,926	3,238	2,904	1,736	145½	1,984	618	13,551½
1910–11	4,027	3,574	4,390	1,993	145½	3,208	675	18,012½
State owned	3,761	3,523	3,868	1,935	145½	2,376	470	16,078½

Per Mile of Line open, 1910–11

Av. cost (£1,000)	13·5	12·5	6·7	7·5	8·0	5·0	8·7	9·5
Pop. No.	411	371	141	206	23	90	280	249
Area, sq. m.	77·1	24·6	152·7	190·7	3,598·8	304·2	38·8	165·1

The average receipts of the Government railways (1907–11) amounted to: passengers, £6,020,000; goods, £9,080,000; miscellaneous, £260,000; total, £15,360,000. Working expenses averaged £9,200,000, or 60 % of gross receipts.

INDUSTRIES IN ORDER OF VALUE OF OUTPUT [1910]

Industries dealing with	*Salaries and wages paid.* £1,000.	*Value of raw materials worked up in factories.* £1,000.	*Value of production.* £1,000.	*Value of output.* £1,000.	*Percentage of total.*
Food and drink	3,682	32,358	10,880	43,238	35·81
Metal, machinery	5,873	11,600	10,642	22,242	18·42
Clothing and textile	4,094	7,685	6,583	14,268	11·81
Agricultural products	754	7,974	1,847	9,821	8·13
Wood	2,380	3,516	3,712	7,228	5·98
Books, paper, &c.	2,298	1,835	3,869	5,704	4·72
Heat, light, and power	845	995	2,945	3,940	3·26
Vehicles, saddlery	984	1,188	1,596	2,784	2·3
Stone, clay, and glass	983	437	1,982	2,419	2·0
		Totals.			
Commonwealth	23,875·0	72,724·0	48,047·0	120,771·0	100·0
New South Wales	8,691·4	31·417·0	18,199·0	49,615·6	41·08
Victoria	7,600·9	21,941·5	14,719·5	36,661·0	30·36
Queensland	2,830·7	9,477·0	6,315·0	15,792·0	13·08
South Australia	2,323·4	6,695·5	4,489·0	11,184·7	9·26
West Australia	1,683·7	1,810·0	2,723·5	4,533·7	3·75
Tasmania	744·9	1,383·0	1,6c1·0	2,984·0	2·47

SHIPPING

Total Shipping Entered and Cleared from Overseas

	Average. 1,000 tons.	Highest year.	1,000 tons.	Average tonnage of British vessels. 1,000 tons.	Foreign vessels. 1,000 tons.	Sailing vessels. 1,000 tons.	Steam vessels. 1,000 tons.
1904*-6	7,364	1906	7,966	5,461	1,903	2,128	5,236
1907-11	9,048	1911	9,985	6,660	2,388	1,700	7,348

* Shipping returns first compiled by Federal Government.

Nationality of Vessels Entered and Cleared

	Average 1907-11. 1,000 tons.	% of total.	Year 1911. 1,000 tons.	% of total.
British:				
United Kingdom	4,977	55·0	5,511·5	55·2
New Zealand	942	10·4	1,008·0	10·1
Australia	719	7·9	848·0	8·5
Other British possessions	22	0·3	39·0	0·4
Total British Empire	6,660	73·6	7,406·5	74·2
Foreign countries:—				
Germany	876	9·65	1,006·0	10·0
French	504	5·55	424·0	4·25
Norway	490	5·4	582·0	5·85
Denmark	102	1·1	139·5	1·4
United States	90	1·0	68·0	0·7
Other countries	326	3·7	359·0	3·6
Total foreign countries	2,388	26·4	2,578·5	25·8
Total	9,048	100·0	9,985·0	100·0

Vessels Registered in the Commonwealth

	Steam. No.	Steam. Net tonnage.	Sailing. No.	Sailing. Net tonnage.	Total. No.	Total. Net tonnage.
1901	943	203,541	1,433	141,722	2,376	345,263
1911	1,235	282,055	1,535	125,692	2,770	407,747

Chief Ports. 1911.	Tonnage entered (oversea and interstate). No. of vessels.	Tonnage entered (oversea and interstate). Tons.	Tonnage entered coastwise. No. of vessels.	Tonnage entered coastwise. Tons.
Sydney, New South Wales	2,181	5,246,000	7,035	2,522,700
Melbourne, Victoria	2,237	5,007,000	2,768	920,800
Newcastle, New South Wales	701	1,357,000	3,990	2,450,000
Port Adelaide, S. Australia	1,043	3,105,000	Not available.	
Brisbane, Queensland	821	1,827,000	577	625,700
Fremantle, W. Australia	543	1,828,000	181	210,500
Townsville, Queensland	343	710,600	764	512,000
Albany, W. Australia	283	931,000	130	233,000

OVERSEAS TRADE

	Imports. £1,000.	*Exports.* £1,000.	*Total.* £1,000.	% *of exports on imports.*
1861	17,651	17,413	35,064	98·7
1871	17,017	21,725	38,742	127·7
1881	29,067	27,528	56,595	94·7
1891	37,711	36,043	73,754	95·6
1901	42,434	49,696	92,130	117·1
1911*	66,967	79,483	146,450	118·7

* Highest year.

IMPORTS ARRANGED IN CLASSES

	Av. 1907–11. £1,000.	% *of total value.*	*H. Y.* 1911. £1,000.
Apparel, &c.	15,860	26·4	17,840
Manufactured metals	11,456	19·1	14,212
Wood and manufactures thereof	2,444	4·1	3,361
Paper	2,338	3·9	2,832
Vegetable food-stuffs	2,150	3·6	2,353
Drugs, &c.	1,970	3·3	2,178
Alcoholic liquors	1,642	2·7	1,921
Non-alcoholic beverages	1,500	2·5	1,673
Metals, unmanufactured	1,446	2·4	1,938
Oils, fats, &c.	1,424	2·4	1,808
Jewellery	1,350	2·3	1,755
Leather and manufactures	1,181	2·0	1,586
Other imports	15,179	25·3	13,510
Total	59,940	100·0	66,967

EXPORTS ARRANGED IN CLASSES

	Av. 1907–11. £1,000.	% *of total.*	*H. Y.* 1911. £1,000.
Animal substances (not food-stuffs)	29,858	41·8	29,723
Metals, unmanufactured, ores, &c.	10,860	15·2	10,693
Vegetable food-stuffs	9,000	12·6	12,121
Specie	6,965	9·8	9,850
Food-stuffs of animal origin	6,791	9·6	9,041
Oils, fats, &c.	1,657	2·3	2,281
Stones, minerals, &c.	1,104	1·6	928
Woods	1,032	1·5	1,116
Leather, &c.	616	0·9	649
Metals, manufactured	446	0·6	519
Other exports	2,961	4·1	2,561
Total	71,290	100·0	79,482

IMPORTS DISTINGUISHING PRINCIPAL COUNTRIES

	Av. 1907–11. £1,000.	% *of total.*	*H.Y.* 1911. £1,000.	% *of total.*
United Kingdom	37,820	63·1	39,499	58·98
New Zealand	2,440	4·07	2,974	4·44
India	2,060	3·44	2,122	3·17
Ceylon	730	1·22	739	1·1
Canada	550	0·91	885	1·32
Straits Settlements	480	0·8	641	0·96
Other British possessions	1,030	1·72	1,251	1·87
Total British possessions	7,290	12·16	8,612	12·86
Total British Empire	45,110	75·26	48,111	71·84
Foreign countries:				
United States	6,030	10·06	7,748	11·57
Germany	3,720	6·2	4,437	6·63
Belgium	1,040	1·73	2,008	3·0
Japan	690	1·15	833	1·24
France	500	0·83	614	0·92
Norway	460	0·77	663	0·99
Other countries	2,390	4·0	2,553	3·81
Total foreign countries	14,830	24·74	18,856	28·16
Total imports	59,940	100·0	66,967	100·0

EXPORTS DISTINGUISHING PRINCIPAL COUNTRIES

	Av. 1907–11. £1,000.	% *of total.*	*H.Y.* 1911. £1,000.	% *of total.*
United Kingdom	33,480	46·95	35,510	44·1
Ceylon	2,560	3·6	5,412	6·7
New Zealand	2,430	3·4	2,655	4·3
India	2,240	3·14	3,319	4·1
Union of South Africa	1,860	2·61	1,718	2·1
Other British possessions	2,060	2·9	2,721	3·4
Total British possessions	11,150	15·65	15,825	20·6
Total British Empire	44,630	62·6	51,135	64·7
Foreign countries:				
France	7,300	10·25	8,180	10·2
Germany	6,945	9·75	6,642	8·3
Belgium	5,245	7·35	6,112	7·6
United States	2,100	2·95	1,464	1·8
Japan	1,070	1·5	833	1·0
Other foreign countries	4,000	5·6	5,116	6·4
Total foreign countries	26,660	37·4	28,347	35·3
Grand total	71,290	100·0	79,482	100·0

PRINCIPAL OVERSEAS EXPORTS

These statistics for intercensal periods show the growth of the Commonwealth's exports by stages from the date when they aggregated but 22 per cent. of the highest year, 1911.

	1861.	1871.	1881.	1891.	1901.	1911.
Wool (£1,000)	5,005·8	9,459·6	13,173·0	19,940·0	15,237·4	26,071
Wheat (1,000 bush.)	87·2	799·9	5,364·6	9,794·8	20,260·0	55,148
Value (£1,000)	24·0	193·7	1,189·7	1,938·8	2,774·6	9,642
Meats (£1,000)	37·5	566·7	362·9	460·8	2,611·2	4,307
Gold (£1,000)	9,957·0	7,184·8	6,445·3	5,703·5	14,315·7	12,045
Butter (1,000 lb.)	664·1	1,812·6	1,298·7	4,239·5	34,607·4	101,722
Value (£,1000)	21·7	45·8	39·3	206·8	1,451·1	4,637
Skins and hides (£1,000)	180·2	100·1	316·8	873·7	1,250·9	3,226
Silver and lead (£1,000)	4·2	37·9	57·9	1,932·2	2,250·2	3,224
Copper (£1,000)	381·7	598·5	676·5	417·7	1,619·0	2,349
Tallow (£1,000)	148·2	914·2	644·1	571·0	677·7	1,937
Flour (tons of 2,000 lb.)	7·6	12·9	49·5	33·3	96·8	176
Value (£1,000)	113·1	170·4	519·6	328·4	589·6	1,392
Timber, undressed (£1,000)	32·3	42·5	118·1	38·4	731·3	1,024
Coal (£1,000)	63·0	134·3	361·0	645·9	986·9	900

POPULATION OF THE COMMONWEALTH. TOTAL POPULATION

	Males.	*Females.*	*Total.*	*Increase in decennial period.*					
				Males.		*Females.*		*Total.*	
	1,000.	1,000.	1,000.	1,000.	%	1,000.	%	1,000.	%
1861	669	499	1,168	—	—	—	—	—	—
1871	929	772	1,701	260	38	273	54	533	45
1881	1,247	1,060	2,307	318	34	288	37	606	35
1891	1,737	1,504	3,241	490	39	444	41	934	40
1901	2,005	1,820	3,825	268	15	316	21	584	18
1911	2,324	2,151	4,475	319	15	331	18	650	17
Increase in last half-century				1,655	347	1,652	331	3,307	283

POPULATION AT LAST FOUR CENSUSES (EXCLUSIVE OF FULL-BLOODED ABORIGINALS)

	Males.	*Females.*	*Total.*	*No. of males per 100 females.*	*Increase in population.*	
	1,000.	1,000.	1,000.		1,000.	%
1881	1,215	1,035	2,250	117·35	—	—
1891	1,704	1,470	3,174	115·89	924	41·07
1901	1,978	1,796	3,774	110·14	600	18·18
1911	2,313	2,142	4,455	107·99	681	18·05

POPULATION BY STATES (EXCLUSIVE OF ABORIGINALS). IN THOUSANDS

	N.S.W.	*Vict.*	*Qnsld.*	*S.Aus.*	*W.Aus.*	*Tas.*
1881	750	861·5	213·5	280·0	29·7	115·7
1891	1,124	1,140·0	394·0	320·0	50·0	146·6
1901	1,355	1,201·0	498·0	363·0	184·0	172·0
1911*	1,647	1,315·5	606·0	408·5	282·0	191·0
	Number of males per 100 females.					
	108·7	99·9	119·2	103·2	134·0	104·2
	Population per square mile.					
	5·31	14·97	0·9	1·07	0·28	7·3

* Northern Territory, 3,310 (previously included in South Australia), and Federated Capital Territory, 1,714 (previously included in New South Wales), bring up the total population of the Commonwealth to 4,455,000, or 1·5 persons per square mile.

AVERAGE NUMBER OF IMMIGRANTS AND EMIGRANTS 1907–11 INCLUSIVE. In Thousands

Arrivals from	*Males.*	*Females.*	*Total.*	*Total, 1911.**
United Kingdom	24·8	13·16	37·96	71·65
New Zealand	19·2	9·9	29·1	33·82
Other British possessions	7·9	3·28	11·18	13·98
Foreign countries	10·98	3·12	14·1	22·46
Races, white	58·52	29·2	87·68	136·24
Races, coloured	4·36	0·26	4·62	5·67
Total	62·88	29·46	92·34	141·91

* Year of heaviest immigration.

Departures to	*Males.*	*Females.*	*Total.*	*Total, 1911.*
United Kingdom	8·04	5·24	13·28	16·98
New Zealand	14·72	8·64	23·36	22·35
Other British possessions	8·76	2·94	11·7	13·04
Foreign countries	7·98	2·06	10·04	11·83
Races, white	33·85	18·57	52·42	58·14
Races, coloured	5·65	0·31	5·96	6·06
Total	39·5	18·88	58·38	64·2

NET IMMIGRATION, OR EXCESS OF ARRIVALS OVER DEPARTURES

Minus sign (—) signifies that the number of departures exceed arrivals

	N.S.W. 1,000.	*Vict.* 1,000.	*Qnsld.* 1,000.	*S.Aus.* 1,000.	*W.Aus.* 1,000.	*Tas.* 1,000.	*C'wealth.* 1,000.
1861–70	44·9	35·9	67·9	17·2	5·8	—4·8	166·89
1871–80	103·2	—11·4	59·1	42·6	—0·15	—1·5	191·804
1881–90	162·4	114·0	115·7	—26·3	11·8	5·0	382·741
1891–1900	20·5	—110·4	13·6	—15·4	116·2	0·35	24·879
1901–10	37·7	—50·5	18·1	—5·6	53·0	—12·3	40·485
1861–1910	368·75	—22·5	274·6	12·57	186·75	—13·3	806·799
1911*	23·9	19·9	12·7	4·3	12·2	—3·8	69·3
1861–1911	392·65	—2·6	287·3	16·87	198·95	—17·1	876·099

* Highest year (1860–1911) apart from 1883, in which year the net immigration was 69,865.

BIRTH-RATE

1861.	1871.	1881.	1891.	1901.	1911.
42·28	38	35·26	34·47	27·16	27·21

Highest birth-rate, 43·27 in 1863. Lowest, 25·29 in 1903.

MARRIAGES

	1861.	1871.	1881.	1891.	1901.	1911.
Marriage-rate, i.e. number of marriages per 1,000 inhabitants	8·84	6·94	7·6	7·47	7·32	8·79

DEATHS

	1861.	1871.	1881.	1891.	1901.	1911.
Rate per 1,000 of mean annual population	17·34	13·24	14·69	14·84	12·22	10·66

Highest death-rate (1860–1911), 20·86 in 1860. Lowest, 10·33 in 1909.

RELIGIOUS CENSUS, 1911 (Exclusive of Aboriginals)

Christian.	*Commonwealth.* 1,000.	*Percentage of total Christian population.*
Church of England	1,710·4	38·4
Roman Catholic	921·5	20·68
Presbyterian	558·3	12·54
Methodist	547·8	12·28
Protestant (undefined)	109·8	2·447
Baptist	97·0	2·2
Catholic (undefined)	75·4	1·684
Congregational	74·0	1·662
Lutheran	72·4	1·632
Total Christians	4,274·4	95·94
Non-Christian and indefinite	180·6	4·06

TOTAL POPULATION OF COMMONWEALTH AT CENSUS OF 1911

Classified according to Birthplace (Exclusive of Aboriginals)

Birthplace.	*N.S.W.* 1,000.	*Vict.* 1,000.	*Qnsld.* 1,000.	*S.Aus.* 1,000.	*W.Aus.* 1,000.	*Tas.* 1.000.	*N.Terr.* 1,000.	*Fed. Cap. Terr.* 1,000.	*Total, C'wealth.* 1,000.
Australasia	1,391	1,119·0	449·0	351·0	212·0	173·7	1·5	1·5	3,699·5
Co'wealth	1,377	1,109·0	446·0	350·0	209·0	172·5	1·5	1·5	3,667·6
Europe	224	172·7	140·0	52·0	60·0	14·6	0·3	0·16	664·6
England	122	86·7	65·0	29·9	32·8	9·0	0·1	0·1	346·0
Wales	4	2·7	2·6	0·9	1·3	0·2	—	—	12·2
Scotland	31	26·6	20·5	5·6	6·9	2·0	—	—	93·0
Ireland	46	41·5	31·6	8·0	9·4	2·0	—	—	139·4
Asia	11	6·7	9·0	1·2	6·0	0·7	1·4	—	36·4
America	4	3·0	1·7	0·7	1·1	0·28	—	—	11·3
Africa	2	1·5	0·5	0·3	0·4	0·1	—	—	5·0
Polynesia	1	0·3	1·7	—	—	—	—	—	3·4

REVENUE

	Av. 1907–11. £1,000.	1910–11. £1,000.	*Increase since* 1901–2. £1,000.
Customs	9,128	10,507	2,837
Postal	3,495	3,906	1,533
Excise	2,214	2,473	1,249
Land tax	— *	1,370	1,370
Other sources	473	550	520
Total	15,310	18,806	7,509

* First imposed, 1910–11.

EXPENDITURE

	Av. 1907–11. £1,000.	1910–11. £1,000.	*Increase since* 1901–2. £1,000.
Postal	3,460	3,560	1,176
Treasury	421	1,960	1,950
Defence	1,270	1,396	534
Trade and customs	843	1,051	789
Other expenditure	1,651	5,191	4,976
Total	7,645	13,158	9,425

The expenditure of 1910–11 included under the heading 'Treasury' £1,875,000 on account of Old Age Pensions, and under 'Trade and Customs' £630,000 in respect to the Sugar Bounty.

PUBLIC DEBT OF AUSTRALIAN STATES

(Including Treasury and Deficiency Bills, &c., outstanding)

	N.S.W. £1,000.	*Vict.* £1,000.	*Qnsld.* £1,000.	*S.Aus.* £1,000.	*W.Aus.* £1,000.	*Tas.* £1,000.	*All States.* £1,000.
Jan. 30, 1911	95,523	57,984	44,613	34,225	23,704	11,078	267,127
Av. 1907–11	90,300	56,900	43,400	31,300	21,700	10,300	253,900

BANKING STATISTICS

Banks of Issue

	1861.	1871.	1881.	1891.	1901.	1911.
Note circulation in mills. st.	2·97	2·45	3·97	4·41	3·4	3·71
Coin and bullion held, mills. st.	4·66	6·17	9·1	16·71	19·73	33·47
Advances, mills. st.	18·26	26·04	57·73	129·74	89·16	108·57
Deposits, mills. st.	13·81	21·85	53·85	98·34	90·96	143·44

Savings Banks

	1861.	1871.	1881.	1891.	1901.	1911.
No. of depositors (1,000)	27·8	100·7	250·0	614·7	964·5	1,600·0
Total deposits (£1,000)	1,320·7	3,193·0	7,854·0	15,537·0	30,882·6	59,394·0
	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*	£ *s. d.*
Av. per depositor	47 7 7	31 14 2	31 8 2	25 5 6	32 0 4	37 2 4
Av. per head of population	0 18 8	1 18 9	3 10 5	4 18 7	8 4 0	13 8 5

FIFTY YEARS' EDUCATIONAL PROGRESS IN THE COMMONWEALTH

	1861.	1871.	1881.	1891.	1901.	1911.
No. of State schools	1,864	2,502	4,494	6,231	7,012	8,060
Teachers (1,000)	2·47	4·64	9·0	12·5	14·5	17·0
Enrolment (1,000)	106·0	236·7	432·3	561·0	638·0	638·9
Av. attend. (1,000)	73·5	137·7	255·1	351·0	450·0	463·8

PAPUA

Area under British flag.—90,540 sq. m., or 74 % of the area of the United Kingdom.

Land Distribution.—Area of land held by natives, June 30, 1911, 56,518,842 acres; Crown land, 1,036,123 acres; freehold land, 26,547 acres; leasehold land, 364,088 acres.

Plantations in 1911.—(1) Private. No. 167. Av. area, 95 acres; coconuts, 9,513 acres; coffee, 132 acres; rubber, 2,889 acres; other cultures, 1,015 acres; sisal hemp, 2,332 acres. Total, 15,881 acres; average, 1907–11, 8,019. (2) Government. No. 6. Area, 229 acres. (3) Native plantations, estimated area, 350,000 acres.

Coffee.—The average area dedicated to the production of coffee during the three years 1909–11 was 163 acres, and the average coffee exported during the years 1904–9 (the latest year available) was 25,500 lb.

Rubber.—The average quantity of rubber exported in the periods 1898–1901, 1902–6, and 1907–11 was 18, 6·1, and 5·8 thousand pounds (avoir.) respectively, the average value of the same being £2,000, £700, and £1,000.

Minerals.—Total gold yield, 1888–1911, 322,537 oz., value £1,166,947; average 5 years, 1906–11, 16,003 oz., value £58,000; twelve months, 1910–11, 18,497 oz., value £68,803. Copper (domestic exports), average, 1907–11, 171 tons, value £4,348; twelve months, 1910–11, 403 tons, value £12,386.

Commerce.—On an annual average in 1907–11: Tonnage of shipping entered and cleared, 224,600 (British, 129,400). Value of imports, £120,000; exports, £88,600. Chief exports—gold and gold ore, £55,100; copra, £14,100; copper ore, £4,300; pearls, £3,680; sandalwood, £3,540.

Population (1911).—European, 1032; half-caste, 280; coloured non-Papuan, 450. The total population was estimated to be 350,000 in 1891 and 1901, and 280,000 in 1911.

Chief occupations of European population.—Miners, 144; planters, 139; Government officials and employés, 120; missionaries, 73; carpenters, plumbers, 52; storekeepers and clerks, 44; traders, 43; native labour recruiters, 25; engineers, 10; armed constabulary officers, 25; patrol and warrant officers, 7; non-commissioned officers and privates, 236.

Finance.—Average annual revenue (1907–11), £31,200. In addition to the revenue raised in Papua the Commonwealth of Australia furnishes a grant of £25,000. Expenditure, £56,200. The Customs Dues averaging £22,500 for the period 1907–11 (£37,750 in 1911–12), and the Postal Receipts averaging £2,400 (£3,294 in 1911–12), are the chief sources of revenue. Public works averaging £6,700, the Magistracy averaging £5,600, the armed Constabulary averaging £4,000, and the Treasury and Postal Departments averaging £3,500, furnish the most important items of expenditure.

NEW ZEALAND

Area.—North Island, 44,468 sq. m.; South Island, 58,525 sq. m.; Stewart Isle and adjacent islands, 665 sq. m.; Chatham Islands, 375 sq. m.; Auckland Islands, 329 sq. m.; Campbell Island, 71 sq.m.; Antipodes Islands, 20 sq. m.; Bounty Islands, 5 sq. m.; Kermadec Islands, 13 sq. m.; Cook Group, 150 sq. m.; other islands, 130 sq. m. Total, 104,751 sq.m., or 87 % of that of the United Kingdom.

AREA IN CULTIVATION, 1910–11

	Total area in cultivation. 1,000 *acres.*	*% of total.*	*In tussock or native grass and unimproved land.* 1,000 *acres.*	*Total area in occupation.* 1,000 *acres.*	*% of whole.*
Auckland	3,546·5	21·8	4,222·5	7,769·0	19·4
Taranaki	1,046·5	6·5	311·5	1,358·0	3·3
Hawke's Bay	1,835·5	11·3	1,375·5	3,211·0	8·0
Wellington	3,184·8	19·6	1,250·0	4,434·8	11·0
Marlborough	576·1	3·5	1,864·0	2,440·1	6·1
Nelson	623·5	3·8	1,690·5	2,314·0	5·6
Westland	87·0	0·5	874·0	961·0	2·4
Canterbury	2,756·9	17·0	3,830·7	6,587·6	16·4
Otago:					
Otago portion	1,428·6	8·8	6,569·4	7,998·0	19·9
Southland portion	1,180·3	7·2	1,983·9	3,164·2	7·9
	16,265·7	100·0	23,972·0	40,237·7	100·0
% of total	40·5	—	59·5	—	—

In 1861 the land under cultivation comprised 227,000 acres; in 1871 it was 1,140,000 in 1881, 4,768,000; in 1891, 8,462,000; and in 1901, 12,636,000.

AGRICULTURE

	Av. 5 yrs.	*Area.* 1,000 *ac.*	*Highest year.*	1,000 *acres.*	*Av. Quant.* 1,000 *bush.*	*Highest year.*	1,000 *bush.*	*Yield pe acre in bush.*
Wheat	1897–1901	271·0	1898	399·0	7,580	1898	13,073	32·76
,,	1902–6	222·0	1904	258·0	7,255	1904	9,124	35·36
,,	1907–12	258·0	1910	322·0	7,710	1908	8,773	34·75
Barley	1907–12	38·4	1908	48·8	1,317	1908	1,938	39·67
Oats	1907–12	375·0	1908	407·0	15,503	1911	19,662	48·71
Maize	1907–12	9·88	1910	13·0	516	1908	714	61·95

WOOL EXPORTS

Av. 5 yrs.	*Mill. lb.*	*Highest year.*	*Mill. lb.*	*Quantity purchased by local mills. Av. of 5 yrs., mill. lb.*
1897–1901	144·0	1898	149	3·84
1902–6	150·9	1902	160	4·56
1907–11	179·5	1910	204	5·14

The exports of wool in 1861 amounted to 7,856,000 lb., valued at £523,728; in 1871 they had risen to 37,800,000 lb. (£1,606,000); in 1881 to 59,416,000 lb. (£2,960,000); in 1891 to 106,000,000 lb. (£4,130,000); in 1901 to 147,000,000 lb. (£3,699,000); and in 1911 to 169,000,000 lb. (£6,492,000).

LIVE STOCK

In Thousands

	Horses.	*Cattle.*	*Sheep.*	*Pigs.*	*Poultry.*
1881	162	699	12,985	200	1,566
1891	211	831	18,128	309	1,790
1900–1	266	1,256	19,355	250	—
1911	404	2,020	23,996	349	3,692

The average annual export of frozen mutton and lamb together with the estimated consumption in the Dominion and export of live sheep for the years 1907–11 amounted to 7,084,000 head.

FORESTS

The total forest area in square miles is said to be 26,678, or 25·65 per cent. of total area.

MINERAL PRODUCTION

Gold

Av. 5 years.	£1,000.	*H.Y.*	£1,000.
1897–1901	1,353	1901	1,754
1902–6	2,068	1906	2,271
1907–11	1,950	1907	2,027

Total value, 1853–1911, £79,254,000.

Silver

Av. 5 years.	£1,000.	*H.Y.*	£1,000.
1897–1901	39·8	1901	65·0
1902–6	108·0	1906	143·6
1907–11	165·8	1909	181·0

Total value, 1853–1911, £1,750,000.

Gold Production of New Zealand, January 1857 to March 31, 1911, in Districts

	£1,000.	% *of total.*
Otago	28,494·0	36·57
West Coast	22,363·0	28·7
Auckland	19,856·0	25·47
Nelson	6,842·0	8·79
Marlborough	352·0	0·45
Wellington	0·7	0·02
Canterbury	0·4	
	77,908·1	100·00

Coal

	Value.			*Quantity.*		
Av. 5 yrs.	£1,000.	*H.Y.*	£1,000.	1,000 *tons.*	*H.Y.*	1,000 *tons.*
1897–1901	525	1901	676·0	1,009	1901	1,228
1902–6	817	1906	916·5	1,528	1906	1,730
1907–11	1,063	1910	1,219·7	1,973	1910	2,197

Total value since 1853, £17,835,906. The quantity mined in the census years 1881, 1891, 1901, and 1911 was respectively 337, 668, 1,227, and 2,066 thousand tons.

Kauri Gum

	Value.			*Quantity.*		
Av. 5 yrs.	£1,000.	*H.Y.*	£1,000.	1,000 *tons.*	*H.Y.*	1,000 *tons.*
1897–1901	532	1900	622	9·06	1899	11·118
1902–6	533	1903	631	9·2	1905	10·883
1907–11	473	1909	553	7·74	1907	8·708

Total value, 1853–1911, £15,809,152.

Various Minerals

Total value, 1853–1911 *inclusive.*—Mixed minerals, £195,000; manganese ore, £62,000; antimony ore, £55,000; scheelite ore, £67,000; chrome ore, £38,000; coke (exported), £25,000; copper ore, £19,000; shale, £7,000.

MANUFACTURES. Census Reports, 1911–1901

	No. of works employing over 2 hands.	*Hands employed. Males.* 1,000.	*Females.* 1,000.		*Wages paid. Males.* £1,000.	*Females.* £1,000.	*Cost of materials.* £1,000.	*Value of products.* £1,000.
1911	4,402	42	13·9	1910	4,865	707	20,810	31,729
1901	3,680	36	10·5	1900	2,972	330	—	17,853

The principal manufacturing districts, with value of products, are Auckland (£8,116,000), Canterbury (£6,821,000), Wellington (£6,720,000), Otago (£3,838,000), Taranaki (£2,022,500).

PRINCIPAL INDUSTRIES. Census, 1911

	No. of works.	*Hands employed.*	*Value of output,* 1910. £1,000.	*Value of output,* 1900. £1,000.	*% of total output,* 1910.
Meat-freezing	41	3,978	7,305	3,835	23·0
Butter- and cheese-making	338	1,504	3,919	1,535	12·35
Saw-mills and sash and door works	534	6,877	2,700	1,268	8·5
Tannery and wool-scouring establishments	79	1,372	2,037	1,888	6·4
Gold production	239	5,374	1,826	1,220	5·75
Printing works	241	4,222	1,378	704	4·34
Grain mills	66	424	1,248	683	3·9
Collieries	118	3,331	800	540	2·5

RAILWAYS

	Length of line open. Miles.	*Train mileage. Millions.*	*Passengers. Millions.*	*Goods and live stock. Mill. tons.*	*Gross receipts.* £1,000.	*Gross expenditure.* £1,000.	*% of expenditure to revenue*
1891–2	1,869	3·01	3·553	2·12	1,115	706	63·34
1901–2	2,235	5·06	7·356	3·667	1,874	1,252	66·8
1911–12	2,798	8·37	11·891	5·888	3,676	2,466	67·07
Av. 5 yrs. 1907–11	2,686	7·77	10·89	5·5	3,224	2,198	68·1

The capital cost of the railways open to the close of 1911 amounted to 30½ mill. averaging £10,864 per mile. The 145 miles open in 1873 increased to 1,333 in 1881, the receipts from £21,000 in 1874 to £892,000 seven years later.

TOTAL SHIPPING ENTERED AND CLEARED

Years.	British vessels.			Steam vessels.		
	Av. net tonnage. 1,000 *tons.*	*H.Y.*	1,000 *tons.*	*Av. net tonnage.* 1,000 *tons.*	*H.Y.*	1,000 *tons.*
1897–1901	1,661	1901	2,139	1,496	1901	1,832	1,389	1901	1,861
1902–6	2,283	1906	2,482	1,953	1906	2,174	2,063	1906	2,287
1907–11	2,679	1911	2,950	2,580	1911	2,856	2,521	1911	2,820

In 1861 the total net tonnage entered and cleared was 403,000 tons; in 1871, 540,000; in 1881 it was 833,000; and in 1891, 1,244,000. 279 sailing and 324 steamships (tonnage 40,588 and 106,815) were registered in New Zealand on an annual average, 1907–11. On an average annually in 1907–11 the tonnage of vessels entered and cleared belonging to the United Kingdom was 1,314,000; other British vessels, 1,264,000; Norwegian, 52,840; American, 16,660; French, 9,780; German, 9,000; The percentage for British vessels was 96·24.

Chief ports.—Average tonnage (in thousands) entered and cleared annually for the period 1907–11: Auckland, 945·9; Wellington, 887·6; Bluff Harbour, 328·0; Dunedin, 172·6; Lyttelton, 110·8; West Port, 54·6; Kaipara, 45·46; Greymouth, 19·0; Napier, 12·45.

IMPORTS AND EXPORTS

THE PROGRESS OF TRADE, 1871–1911

	Total trade. £1,000.	*Imports.* £1,000.	*Exports.* £1,000.	*Imports per head.* £ *s.* *d.*	*Exports per head.* £ *s.* *d.*	*Imports from U.K.* £1,000.	*Exports to U.K.* £1,000
1871	9,360	4,078	5,282	15 12 11	20 5 4	—	—
1881	13,518	7,457	6,061	15 2 3	12 5 8	—	—
1891	16,070	6,504	9,566	10 6 6	15 3 10	4,369	7,14
1901	24,699	11,818	12,881	15 3 10	16 11 2	6,886	9,29
1911	38,574	19,546	19,028	19 5 2*	18 15 0	11,787	15,134

* Highest average since 1878.

Annual averages, 1907–11: imports, £17,409,000; exports, £19,450,000.

CHIEF EXPORTS

	Av. 1907–11. £1,000.	*Census years.* 1911. £1,000.	1901. £1,000.	*Increasse or decrease % in intercensal period.*
Wool, raw	6,819	6,492	4,749	+ 36
Frozen meat	3,498	3,503	2,253	+ 55
Bullion, gold	1,950	1,815	1,440	+ 26
Butter	1,563	1,577	882	+ 78
Cheese	987	1,192	239	+399
Skins, sheep	675	633	265	+138
Tallow and oleo-margarine	611	607	352	+ 72
Kauri gum	473	396	446	— 12
Flax	456	300	196	+ 53
Timber	375	440	234	+ 88

PRINCIPAL COUNTRIES

Imports from	*Av.* 1907–11. £1,000.	% *of total.*	*Census years.* 1911. £1,000.	1901. £1,000.
United Kingdom	10,459	60·12	11,787	6,886
New South Wales	1,601	9·2	1,831	1,222
Victoria	981	5·6	874	641
Fiji	616	3·55	729	349
India	378	2·2	348	334
Canada	249	1·45	283	42
Total British Empire	14,848	85·35	16,497	9,800
Foreign countries:				
United States	1,463	8·4	1,682	1,415
Germany	388	2·2	481	198
France	109	0·62	130	28
Belgium	105	0·6	129	63
Japan	99	0·57	123	45
Other foreign countries	397	2·26	503	269
Total foreign countries	2,561	14·65	3,048	2,018

Exports to	*Av.* 1907–11. £1,000.	% *of total.*	*Census years.* 1911. £1,000.	1901. £1,000.
United Kingdom	15,927·0	81·87	15,135·0	9,295
New South Wales	1,242·0	6·4	1,495·0	1,024
Victoria	828·4	4·26	925·0	755
Canada	128·6	0·67	199·5	2
Total British Empire	18,499·0	95·13	18,101·7	12,202
Foreign countries:				
United States	543	2·79	434·5	519
Pacific Isles (foreign)	176	0·9	229·4	111
Germany	112	0·57	170·5	10
Other foreign countries	120	0·61	92·5	38
Total foreign countries	951	4·87	926·9	678

POPULATION

EXCLUSIVE OF MAORIS AND THE ANNEXED PACIFIC ISLANDS

	Males. 1,000.	*Females.* 1,000.	*Total.*	*Increase % in intercensal period.*	*No. of males to every* 1,000 *females.*
1871	—	—	256,293	—	—
1881	269·6	220·3	489,933	91·0	1,223
1891	332·8	293·8	626,658	27·8	1,133
[Maoris	22·8	19·1	41,993	—	1,194]
1901	406·0	366·7	772,719	23·0	1,107
[Maoris	23·0	20·0	43,143	42·7	1,151]
1911	531·9	476·5	1,008,468	30·5	1,116
[Maoris	26·4	23·3	49,844	15·0	1,113]

POPULATION ACCORDING TO DISTRICTS (EXCLUSIVE OF MAORIS)

	1911. 1,000.	1901. 1,000.	*Increase* %	*% of total.*	*Area, sq. m.*
Auckland	264·5	176·0	50·0	26·24	25,746
Taranaki	51·6	37·9	36·0	5·11	3,308
Hawke's Bay	48·5	35·5	36·0	4·82	4,410
Wellington	199·1	141·4	40·0	19·75	11,003
Marlborough	16·0	13·3	20·0	1·58	4,753
Nelson	48·5	38·0	27·0	4·8	10,269
Westland	15·7	14·5	8·0	1·55	4,641
Canterbury	173·2	143·0	21·0	17·18	14,040
Otago:					
Otago portion	132·4	125·4	5·5	13·13	14,313
Southland portion	58·7	47·8	22·0	5·82	11,174
Chatham Islands	0·258	0·207	24·0	0·025	375
Kermadec Islands	0·004	0·008	—	—	13
			30·5	100·0	104,045

POPULATION OF ADJACENT AND PACIFIC ISLES

Cook Group: Rarotonga, 2,759; Mangaia, 1,471; Aitutaki, 826; Atiu, 1,223; Mauke (Parry I.), 457; Mitiero, 199. Total, 6,935.

Other Pacific islands: Niué (Savage I.), 3,943; Manihiki, 444; Danger (Pukapuka), 490; Penrhyn (Tongareva), 335; Rakaanga, 315; Palmerston, 107. Total, including 29 labourers temporarily employed on Hervey Islands, 5,663.

Total Pacific Isles, 12,598.

Islands adjacent to New Zealand: Great Barrier, 416; Waiheke, 227; Rotorua, 110; D'Urville, 77; Kawau, 60; Ponui, 43; other isles, 146. Total, 1,079.

IMMIGRATION AND EMIGRATION, 1861–1911 (IN THOUSANDS)

	Immigration.						
	From U. K.		*From British Possessions.*		*Total immigration.*	*Emigration.*	*Excess of immigration over emigration.*
	Males.	*Females.*	*Males.*	*Females.*			
1861	2·35	1·597	17·4	0·8	22·339	6·117	16·222
1871	1·77	1·36	5·3	1·1	10·08	5·29	4·78
1881	1·99	1·5	4·37	1·4	9·68	8·07	1·61
1891	1·48	0·95	7·5	3·898	14·4	17·63	—3·198*
1901	1·59	0·96	14·7	6·87	25·0	18·56	6·5
1911	6·39	4·99	17·9	10·6	41·39	37·19	4·2

* Emigration exceeding immigration.

Annual averages, 1907–11: immigrants, 39,377; emigrants, 32,913; excess of immigrants, 6,464.

Vital Statistics.—Annual average, 1907–11, per thousand of mean population: birth-rate, 26·83; death-rate, 9·77; marriage-rate, 8·61.

GROWTH OF URBAN POPULATION

	Counties.	*Boroughs.*	*Percentage.* *Counties.*	*Boroughs.*	*Shipboard and islands.*
1881	291,238	194,981	59·44	39·8	0·76
1891	352,097	270,343	56·18	43·14	0·68
1901	417,596	350,202	54·04	45·32	0·64
1911	496,779	505,598	49·26	50·14	0·6

RELIGIONS (EXCLUSIVE OF MAORIS)

	No. of persons, 1911.	*Increase % in intercensal period.* 1906–11	*% of total.*
Church of England	413,842	12·44	41·14
Presbyterians	234,662	15·26	23·32
Roman Catholics	140,523	10·65	13·97
Methodists	94,827	6·5	9·43
Baptists	20,042	12·93	1·99
Congregationalists	8,756	18·97	0·87
Other Christian denominations	6,205	3·7	0·61
Hebrews	2,128	13·98	0·21
Unspecified	87,483	28·7	8·46
	1,008,468	13·49	100·0

BIRTHPLACES

	No. of persons.	*Movement % in intercensal period.* 1906–11
New Zealand	702,779	+15·92
Australian States	50,029	+ 5·9
England	133,811	+14·8
Wales	2,206	+ 2·89
Scotland	51,709	+ 8·25
Ireland	40,958	− 3·53
Other British possessions	5,234	+ 4·7
Foreign countries *	19,571	− 1·75
Unspecified	779	+65·0
Total (inclu. persons born at sea)	1,008,468	+13·49

* Germany, 4,015 (−3·8 %); China, 2,611 (0·34 %); Denmark, 2,262 (−0·65 %); Austria-Hungary, 2,131 (−3·66 %).

Finance (annual average, 1907–11).—Revenue, £9,829,000; expenditure, £9,172,000 (excluding receipts and expenditure connected with State coal mines). Chief items of expenditure: railways, £2,074,000; post office, £779,600; education, £891,000; constabulary and defence, £412,700; old age pensions, £358,000; interest, &c., on public debt, £2,294,400. Public debt, £75,540,000. Banking: capital, £8,155,000; assets, £27,690,000; liabilities, £25,610,000. Savings-bank depositors (post office), 361,000, having to their credit £13,200,000; (others) 49,200, credit £1,444,000.

EDUCATION

ATTENDANCE (IN THOUSANDS) AT SCHOOLS IN THE THREE CENSUS YEARS 1891, 1901, 1911

	At Government Primary Schools.	*At College, High, Grammar, or Private Schools.*	*Being taught at home.*
	Total.	*Total.*	*Total.*
1891	124	17·0	8·1
1901	133	20·0	5·0
1911	154	33·5	4·8

COOK AND NORTHERN ISLES

Average revenue, 1907–11, £6,893; expenditure, £6,920. Imports, excluding specie (£13,000 in 1910), amount to about £70,000; exports, excluding specie (£9,500 in 1910), to about £80,000. Chief exports: bananas, £36,000 (£25,000 in 1911); copra, £28,000 (£31,000 in 1911); and oranges, £27,000 (£20,000 in 1911).

OTHER ISLANDS IN THE PACIFIC OCEAN

	Fiji.	*Solomon Islands.*	*Tonga.*	*Gilbert, Ellice.*[a]
Area, sq. m.	7,435	14,800	390	180
Shipping[b]	516,000	60,910	155,200	—
Imports[c]	£777,400	£62,000	£169,500	£63,560
Exports[c]	£999,200	£57,700[l]	£94,200	£63,400
Population	139,541[d]	150,500[e]	21,712[f]	31,121[g]
Revenue	£196,400[h]	£11,920[h]	£37,100[l]	£10,560[k]
Expenditure	£209,000[h]	£12,060[h]	£36,440[l]	£11,810[k]

[a] Including Ocean Island and Union Islands.
[b] Average tonnage entered and cleared annually in 1907–11, excluding coastwise or local shipping.
[c] Average annual value, 1907–11.
[d] Census of 1911, an increase of 16·2 per cent. in the preceding decade. Males per thousand females, 1,344. In 1909–11 immigrants averaged annually 3,507; emigrants, 820.
[e] Estimate (1912), including 500 Europeans.
[f] Census 1911. Tongans only.
[g] Estimate (1911), including 598 non-natives.
[h] Average annual, 1907–11.
[l] Average annual, 1906–10.
[k] Average annual, January 1907—June 1912.

About 4,000 tons of copra and nearly 2,000 tons of vegetable ivory nuts are exported annually from the British Solomon Is., about 22,000 acres planted by white planters being under coco-nuts.

In Fiji, quoting annual averages for the years indicated, 4,333 acres were under bananas (1908–11); 359 acres under cocoa (1907–11), 6,600 lb. being exported; 31,775 acres under coco-nuts (1908–11); 763 acres under rubber (1908–11); 46,540 acres under sugar (1907–11), producing 1,379,000 cwt. Rice, maize, tea, tobacco, and cotton are other crops. Public debt, annual average (1907–11), £114,000. £4,460 was the annual average sum standing to credit of depositors in savings banks in 1908–11 (£8,200 in 1911).

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