WILEY

The Geographical Factors That Control the Development of Australia

Author(s): J. W. Gregory

Source: *The Geographical Journal*, Vol. 35, No. 6 (Jun., 1910), pp. 658-676

Published by: geographicalj

Stable URL: <http://www.jstor.org/stable/1777237>

Accessed: 19-06-2016 16:22 UTC

REFERENCES

Linked references are available on JSTOR for this article:

http://www.jstor.org/stable/1777237?seq=1&cid=pdf-reference#references_tab_contents

You may need to log in to JSTOR to access the linked references.

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at

<http://about.jstor.org/terms>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

Wiley, The Royal Geographical Society (with the Institute of British Geographers) are collaborating with JSTOR to digitize, preserve and extend access to *The Geographical Journal*

Kangri, previously unknown, which may make the proud position of Mount Everest no longer tenable. He has told us in his paper how he manipulated his observations in order to make that mountain appear lower than it would otherwise appear, a proceeding probably unique in mountaineering records. The result is, that Mount Everest still occupies her royal position, though her sovereignty must remain doubtful. If I may say so, Dr. Longstaff has been very wise in the attitude he has adopted. If in the end his first calculations are proved to be accurate, and Teram Kangri is, in fact, the highest mountain in the world, he will still have the satisfaction of having his name associated with its discovery. On the other hand, he will have nothing to retract if his more modest figures are substantiated; whilst, in any case, this journey will always be remembered as a most admirable and conscientious bit of work.

Dr. LONGSTAFF: All the gentlemen who have been so kind as to take part in the discussion have been so complimentary that there is hardly any point which calls for an answer. I should, however, like to protect myself from the incredulity of Mr. Freshfield concerning the glacier reported to have advanced at the alarming rate of several yards an hour. Following the example of Herodotus, I sheltered myself behind my authority. I referred, of course, to the Hassanabad glacier in Hunza, which I have never visited, and was quoting from the 'Records of the Geological Survey of India.'

THE GEOGRAPHICAL FACTORS THAT CONTROL THE DEVELOPMENT OF AUSTRALIA.*

By Prof. J. W. GREGORY, F.R.S.

I. THE MAIN FACTORS.

IN those remote times when the primæval forests that produced our coal were growing on the British area, a wide continent extended across two-thirds of the southern hemisphere. It included the highlands of Brazil on the west, the peninsula of India on the north, and probably most of Australia on the east. That vast continent, Gondwanaland, is now represented by some scattered remnants, most of which have been merged in continents of later growth; thus, its most western fragment is part of America; India has become an Asiatic peninsula; and Africa has grown northward and united with an area that is essentially European. Australia, however, although the Malay archipelago, like giant stepping-stones, links it to Southern Asia, has been left isolated in the far Southern seas.

The first fundamental factor in the geography of Australia is then its isolation. It was the last of the inhabited continents, as far as existing evidence goes, to be reached by man, and the last to be discovered and colonized from Europe. It stands apart, almost as distant as any great land-area can be, from the region that contains the chief centres of modern progress. Nevertheless, in spite of its isolation and recent occupation, Australia has already become the greatest White Man's

* Royal Geographical Society, February 7, 1910. Map, p. 744.

country in the southern hemisphere, and with the growing importance of the Pacific, its great political and strategic value to the empire is being more widely recognized.

The second fundamental geographical factor controlling Australian development is its unity of origin. Australia is all one continental fragment, and the compact shape and unique simplicity of structure due to this fact occasion the striking difference in physical and economic geography between Australia and the other continents. They all, excepting, of course, Antarctica, owe to their complex constitution, or, using a biological term, to their polygenetic origin, the existence of vast fertile internal plains, which are rendered easily accessible by long inland seas and great rivers. But though the sea, in later geological times, has twice penetrated far into Australia,* both these submergences were partial and temporary. All parts of Australia have been connected by land since very early times †; and largely owing to its long existence as an unbroken land mass, Australia has no large areas of rich agricultural land in the interior, and its farms and forests are confined to the outer zone of the continent. The last incursion of the sea into Australia was up the basin of the Murray, and it is on the plains that replaced that arm of the sea that agricultural occupation has gone farthest inland; but even there the wheatfields of the Mallee and the Riverina are only 200 or 300 miles from the coast.

The third great geographical factor in the development of Australia is the extreme contrast between the central and coastal districts. The most easily settled and most attractive districts are all on the margin of the continent. The interior is difficult of approach and forbidding in aspect, and offers to the average settler an arduous life and unluxurious home, though it has a fascination that is irresistible to those who know the spell of the free life on its open plains.

Every continent necessarily shows some climatic contrast between its interior and its coastal margin, as in Europe between Central Russia and Ireland, or in Asia between Tibet and Calcutta. But the sharpness of the contrast is usually blurred by numerous exceptions, which, though they may prove the geographical rules, confuse their statement. In Australia the contrast stands out with almost the artificial clearness of a text-book diagram.

The essential climatic conditions of a continent are five in number :—

- (1) A continent should be occupied in winter by an area of high atmospheric pressure;
- (2) The interior should show a marked difference in temperature between winter and summer, and

* In Cretaceous times, from the northern coast as far south as Lake Eyre; and in later times from the southern coast for some distance inland from the Great Bight and up the Murray.

† At least since the Ordovician.

(3) Also between day and night;

(4) There should tend to be an inversion in weather changes between the interior and the oceanic margin; and

(5) The rainfall, and consequently the luxuriance of the vegetation, should diminish steadily from the margin to the centre.

Australia satisfies these requirements more simply and completely than any other continent, and each condition may be illustrated as follows:—

(1) The winter weather is controlled by the passage of high-pressure areas across the continent from west to east.

(2) The difference in variation of summer and winter temperature between the coast and the interior may be illustrated by the fact that the differences between the mean temperature of the hottest and coldest months of the year are only $8\frac{1}{2}^{\circ}$ at Port Darwin, and $19\frac{1}{3}^{\circ}$ at Brisbane, as examples of coastal stations, in contrast with 30° at Alice Springs, in Central Australia.

(3) The daily range in temperature in the central districts sometimes amounts to as much as 57° Fahr.*

(4) The inversion of weather change between the coast and the interior is often almost as regular as the movement of a see-saw.

(5) These four climatic factors exercise their greatest influence by control of the rainfall, which steadily diminishes from the highlands near the coast to a scanty 5 inches in part of the central plains. The other continents, owing to their more complex constitution, have areas of very high rainfall, sometimes even their highest, in the interior. Thus the largest area in Africa, with a rainfall of over 60 inches, includes the centre of the continent, and South America has a large area with a rainfall of over 80 inches in the upper basin of the Amazon. Rainfall records in Australia only go back some seventy years, but the average rainfall for a longer period is shown by the vegetation. The gum forests with their giant trees—the highest in the world, and especially valuable owing to the hardness and heaviness of their wood—are all confined to the coastal regions. Further inland, the forests are gradually replaced by scrub, and that in turn by turf-covered plains. Still further from the coast the turf is reduced to tufts of dry grass, which become sparser, until the last vegetation consists only of scattered desert plants and occasional stunted trees along the river courses.

II. THE CONTRAST BETWEEN THE INTERIOR AND THE MARGINAL ZONE.

The contrast between the central plains and their mountain frame dominates all Australian geography, and explains why the economic

* For example, D. Lindsay, *Journal of the Elder Scientific Exploring Expedition*, 1891–2, 1893, p. 94.

development of the continent must proceed on very different lines from those followed in Europe or America. In Europe, for example, all the chief capitals are situated inland, whereas those of the six Australian states are all on or near the coast; and the instinct that guided the early settlers in their choice has been justified by subsequent development, for there is not yet in the whole continent a single inland city with over 50,000 inhabitants. Bourke, on the Darling, was, according to a fond prediction, to be the Chicago of Australia; but its population, according to the returns in 1905, was only 2600, and is said to be falling.

The extreme development of the central-marginal contrast in Australia is due to its compact shape and uniform structure. Australia is truly described as "the island continent," for, like typical islands, it is essentially one geographical unit; it is not, like the other continents, a collection of diverse fragments that have grown together. Its continental size, however, robs it of many of the advantages of its insular nature. Several factors tend to give Australia more uniform and homogeneous conditions than those enjoyed by any other continent. Thus, its greatest length lies east and west, and its shorter diameter lies north and south, and it is swept by wind systems, which travel from west to east and move the air in great advancing eddies, which tend to equalize the temperature between north and south. There are no great mountain ranges to disturb the progress of these colossal eddies, for the mountains of Australia are comparatively low. All the other continents have peaks two or three times as high as Australia's highest summit, Mount Kosciusko, which is even lower than those of smaller lands, such as New Zealand and New Guinea, and of small islands like Teneriffe.

Australia's limited range in latitude, its comparatively even surface and absence of high mountains, are factors tending, therefore, to give the continent a uniform temperature and climate. But these beneficial influences are opposed by an unfortunate combination of geographical drawbacks, which has given Australia its extreme difference between the interior and the coast lands. Thus the shape of the continent is unusually compact and solid. There are few great gulfs or seas running far inland, and they are either narrow, such as Spencer gulf, or are so situated, that, like the Gulf of Carpentaria, they influence only a small portion of the continent.

Another unfavourable factor is that the western coasts of Australia are washed by cold water flowing northward from the Southern ocean, so that the winds there pass from a cold sea to a warmer land. Their temperature is accordingly raised as they cross the land, and instead of their moisture being precipitated in rain, they can actually carry more. Their sudden unlift as they rise over the edge of the western plateau chills them and produces some rain; but the amount is small

compared with that which would fall if the sea off Western Australia were not cooled by a current from the south.

The west winds therefore sweep inland, withering the country with the curse of aridity instead of blessing it with plentiful rain. The eastern coast enjoys the reverse arrangement. The coasts of New South Wales and Queensland are washed by a warm current flowing southward from the tropics. The winds blow ashore over water which in winter is warmer than the adjacent land; and so they not only arrive laden with moisture, but their temperature is lowered as they reach the land. The air is therefore quickly chilled, and its moisture precipitated in abundant rains. Thus, whereas the western coast, traversed by winds that have travelled over an ocean 4500 miles wide, has a rainfall of only from 10 to 40 inches; on the other hand, at Geraldton, on the Queensland coast, the rainfall amounts to an average of 120 inches.

Again, the plateau structure of Australia injures the climate by intensifying the inequality of rainfall between the coast and the interior. Though the mountain summits in Australia are comparatively low, the mean elevation of the continent is high. Thus the railways have to begin their course inland by a steep ascent within a few miles of the sea. For instance, the two northern lines from Melbourne have to ascend, in the course of 33 and 46 miles respectively, to the height of 1145 and about 1900 feet. The western railway from Sydney, after crossing low plains for 36 miles, has to climb 3406 feet high in the next 36 miles on to the Blue Mountains. All the lines that connect the Queensland coast with the western plains are hampered by the steep ascent on to the Eastern Highlands. The winds, like the trains, have to be lifted on to the plateau as soon as they begin their journey inland. Hence, the rainfall is unusually concentrated near the coasts, and decreases with deplorable rapidity from the shore to the interior. The arid conditions reach the southern shore along the Great Australian Bight, probably owing to the coldness of the sea-water; but even there the rains are more abundant on the coast than they are inland. The uplift of the air and its consequent chilling is effected near the coast, and when the winds have once arrived inland they have practically no further considerable elevation to encounter, and there is nothing to produce further rain. Hence, no less than 938,000 square miles of the interior have a mean rainfall of less than 10 inches.

Another unfortunate influence on the distribution of the Australian rainfall is that the moistest air is carried into the interior in the summer, at the season when the land is warmest. Heavy clouds often float irritatingly across the central plains at the very time when they most want water; but as there are no mountains to uplift and chill the air its moisture is not precipitated, and it passes on to areas where rain is of less value, and may, at that season, even be injurious.

The restriction of the heavy rains in Australia to the outer zone of the continent has produced the remarkable contrast in topographic form and scenery between the vast central plains, levelled by the winds, and the surrounding highlands dissected into a maze of mountains and valleys by the rivers. The highlands of eastern Australia have been called Cordillera in comparison with the Andes; but they have been carved out of an old plateau. These highlands were once plateaus, which have been cut up by a labyrinth of canyons and gorges by the powerful rivers maintained by the heavy rainfall. In New South Wales the rocks that formed the top of the plateau are horizontal, and in consequence remnants of the old level surface end with theatrical suddenness on the brink of lofty precipices, and the Blue Mountains west of Sydney probably afford the most perfect and beautiful representative of this type of structure and scenery in the world.

In the Victorian Highlands the rocks are steeply tilted or stand on edge, so the precipices are less vertical and relics of the original surface less extensive than in New South Wales. That the complex valleys of the Victorian Highlands have been cut in an old plateau block may, however, be recognized by inspection of the country from many commanding view points, or of such maps as that by A. O. L. Whitelaw of Woods Point.

It was the forest-clad slopes of these plateaus, the most delightful forest country that I know, which disappointed the early visitors to Australia. It was the plains between the mountains and the sea, close to land sold for agricultural purposes at £60 to £80 an acre, which Tuckey declared were useless, and would be for ever left to the kangaroos! How would he have expressed his verdict if he could have seen the treeless, turfless plains of the far interior?

III. WATER SUPPLY.

The development of the interior is, of course, controlled by the water supply, of which an ample amount is necessary owing to the warmth of the climate and the greed of Australian evaporation. I fear there is no prospect of extensive irrigation being ever possible in the interior of Australia, except on the banks of the Murray and the Darling. Elsewhere, there seems to be no hope of the large quantities of water required for irrigation. I may be reminded of the flowing wells of western Queensland, New South Wales, and the Lake Eyre district; but their yield is inadequate in amount, and their waters are usually unsuitable for continued irrigation. These wells are of incalculable benefit for stock-routes, domestic supplies, for gardens, and the cultivation of occasional patches of fodder; and they should, I think, be reserved for such purposes, as their yield in many or most localities is waning. Five years ago I objected to the arguments in support of the view that this water is being renewed from the rain more rapidly than

the wells are withdrawing it; and though my conclusions have been denied, a recent visit to Queensland has satisfied me more than ever of their truth.

The flowing wells are limited to the coastal belt, and to one wide area in the eastern half of Australia. In the western interior, the water supply depends upon the storage of rain-water, and on shallow wells, which are fortunately more prolific, more widely distributed, and more often yield fresh water than was suspected a few years ago. Instead of the rainfall in the interior of Westralia being lower than in the Lake Eyre country, it appears to be more than twice as great, averaging over 10 inches per annum; and this rain supplies shallow wells, which, when the country has fair drainage, yield fresh water. The pessimistic views once prevalent as to the well waters of the interior of Westralia were due to the first important settlements being in the Kalgoorlie district, where the waters are so salt that they can only be used after distillation. But 90 miles further north, the well waters are fresh, and though their amount is doubtless inadequate for irrigation, except for gardens, they are of priceless value for domestic and urban supplies and for the maintenance of stock routes.

The remarkable spread in the pastoral settlement of Westralia (illustrated by the Map) during the last few years has been rendered possible by the discovery of this widespread sheet of subterranean fresh water. Owing to the courtesy of the Minister for Mines of Western Australia, I was able to travel last June by motor-car to the central point of that state, excluding the northern peninsula. I passed through country that a few years ago was regarded as impracticable to anything but an organized expedition; instead of this area being a useless desert, most of it is covered with scrub and low trees, and it has abundant food for stock, and sufficient water for mining and pastoral purposes. The conditions gradually become less favourable to the east, where the climate is more arid. But even the worst of the Australian desert country, as in the area of minimum rainfall around Lake Eyre, is not always useless. For desert soil is usually exceptionally fertile, unless poisoned by some saline constituent, and after rain vegetation grows on it with astonishing rapidity. In good seasons the driest districts produce valuable pasturage. Nevertheless, owing to its geographical conditions, Central Australia is never likely to maintain a thick population, except upon its mining fields. They are, however, very widely distributed, and the newly discovered goldfield at Tanami, near the frontier between the Northern Territory and Western Australia, and that at Arltunga, show that the goldfields occur in the centre of the continent. Except in the mining fields, we can only expect the country to be sparsely occupied, and to be developed by a pastoral industry, so organized as to use the land in suitable seasons, withdrawing the stock from drought-stricken districts till rain has renewed the supply of food.

IV. ECONOMIC RESOURCES.

The second series of geographical factors on which the development of a country depends are its economic resources, and they have divided Australian history into three stages, in which the dominant interests respectively were pastoral, mining and general commerce and manufactures. Pastoral wealth is the most easily discovered and used, and the development of Australia began with its occupation for sheep-runs. Australia was fortunate in having among its early colonists such men as Macarthur, who spared no trouble or expense in securing the very best possible breeds of sheep, and continued care has raised the wool in quality till it includes the most valuable sold on the London wool market. Drought has occasionally reduced the flocks, notably during the disastrous years of 1902-3; but sheep breed fast, and in 1907 the flocks again numbered 87,650,000 (they are now estimated at 110,000,000), and the wool exported yielded £28,861,000. New Zealand, in the same year, contributed wool to the value of an additional £7,650,000.

The vast sheep and cattle runs enabled Australasia to send London, still the wool mart of the world, 66 per cent. in value of its total supply, and to export frozen mutton of the value of £1,377,000. The total value of the pastoral produce in Australia in 1907 was nearly £35,000,000.

The pastoral industries were the first founded, because they depend so little on mechanical appliances and transport, though shearing by machinery has done much to facilitate wool production, and milking-machines may ultimately remove some existing difficulties in dairy farming. Wheat production for export followed later, and received a great stimulus from the invention of the stump jump plough and the stripping harvester. In 1907-8, in spite of the crop having been greatly reduced by the unfavourable season, the total value of the wheat crop was £9,245,000. But though wheat-farming has spread slowly inland with the extension of railways, it cannot expect permanent success in regions with less than a 10-inch, or perhaps a 14-inch rainfall, even with the special methods of agriculture devised for dry climates. Wheat production is therefore not likely to help much in the settlement of Central Australia; while vineyards, forests of hardwoods, sugar plantations, dairying, and fruit cultivation are all confined to the regions sharing the coastal rains.

Mining in Australia has been the most influential industrial pioneer. The first valuable mineral discovered was the copper ore of South Australia. Gold-mining was begun in 1851, and its goldfields have placed Australia in the front rank of mining countries. From 1851 to 1908 the gold yield of Australia has been £490,787,522; New Zealand has added £71,739,454 more, making a total for Australasia of £562,526,993. The gold yield of the United States, since mining began in 1792, has

been £632,447,387; the total yield of Canada up to 1908 is £51,546,391, and of British South Africa £237,101,786. The Australian supplies of coal and iron have been less used, but they also are enormous.

The discovery of its gold-mines gave Australia the most effective advertisement it has had. At the beginning of the year 1851, the total population was only 403,889, while ten years later it had reached 1,153,973.

The success of the mining industry led to the third stage in Australian development, the foundation of manufactures, and there again Australia has done well. In 1907, four of the six states produced manufactures worth almost £87,000,000, or £23·4 per head of the population. It is, however, in the yield of primary products that Australia has been pre-eminently successful, and its output per head of population is unrivalled. Owing to these vast stores of wealth, Australia enjoys the glorious distinction of being the one continent where the maxim "The poor ye have always with you" has so far proved practically untrue.

V. THE POPULATION.

Australia has, therefore, vast natural resources, and the use that can be made of them depends on the population. Till a century ago they lay quite neglected, as the Australian aborigines were so few in number that the continent was practically empty. The aborigines, though intelligent and amiable, are inadaptably, and, as has usually happened with nomadic races, they have died out or withdrawn upon the establishment of settled conditions.

(a) *The Disappearing Aborigines.*

Australia has often been charged with having deliberately killed off its aborigines, but this accusation appears to be untrue. Victoria is the state on the mainland in which the fewest aborigines are left. There was no doubt some fighting there between the aborigines and the settlers in the early days of the occupation of the country, but I have searched in vain for any evidence that the almost complete disappearance of the aborigines in that state was due even in part to their murder by the colonists. So far from the aborigines having been slain for stealing sheep, I was assured by more than one squatter that the aborigines were never grudging an occasional sheep, and only punished when they committed indiscriminate and wasteful slaughter. Aborigines were several times tried in Melbourne for sheep-stealing, and acquitted on the ground that they did not understand the nature of legal proceedings. One such verdict, in 1843, resulted in the acquittal of a black fellow accused of the theft of ninety sheep and lambs.

There were, of course, occasional murders, both of Europeans by aborigines and of aborigines by Europeans. In both cases the law did

its best to bring the criminals to justice. Three white men were tried in Melbourne in 1843, on the charge of having murdered three aboriginal women and a child at Colac. The evidence broke down, and the men were acquitted; but Judge Jeffcott told the accused that, "had they been convicted, no interest would have saved them from the gallows." McCombie, who reports the case in his 'History of the Colony of Victoria' (1858, p. 92), remarks that after this statement from the judicial bench, "no atrocities of a similar character were afterwards perpetrated by the settlers of Port Philip."

Queensland is said to have the worst record for the treatment of its aborigines. The blood feud was no doubt most severe and lasted longest in that colony, owing to the greater number and more warlike character of the aborigines and the slower settlement of the country. But even in the sixties, the period when the troubles with the aborigines were at their worst, Ling Roth, in his recent history of Port Mackay, tells us that a collector from the Berlin Museum, who spent several years on the Queensland coast, was unable to secure a specimen of an aboriginal skeleton. If aboriginal life had been held as lightly as is often stated, the collector could have readily procured a choice collection of skeletons.

(b) *The Growth of Population.*

Australia was practically empty when the British colonists first arrived there, and they naturally settled on the well-watered temperate country in the south-eastern quarter, and thence they have gradually spread northward and westward. The growth of population is often regarded as disappointingly slow, but it has really been unusually rapid. It may be compared, as standards of reference, with the progress of Cape Colony, Canada, and the United States.

States.	Area in square miles.	Date of first European settlement.	Population.	Date.
Cape Colony	276,995	1652	{ 580,380 (White) }	Census of 1900-1.
Canada and Newfound- land }	3,750,000	{ 1608 (Quebec) }	{ 7,184,000 (1900) }	{ Official estimate for March 31, 1909.
U.S.A.	3,622,933	1607	{ 76,356,000 (1900) }	Census of 1900.
Australia	2,974,581	1788	{ 4,197,037 (1907) }	Official estimate for 1907.
Australia and New Zealand }	3,075,232	—	{ 5,197,919 (1908) }	{ (N.Z. population in 1908).

That Australia has done well in the rate of increase of population during the last half-century is shown by comparison of the population of Australia, Canada, and the United States at different dates:—

	Australia.	U.S.A.*	Canada.†
1800	5,217	5,308,000	476,000
1820	33,543	9,655,000	840,000
1830	70,039	12,866,000	910,000
1840	190,408	17,063,000	1,690,000
1850	405,356	23,192,000	—
1900	3,765,339	76,356,000 ‡	5,371,315 (1901) ‡

It took Canada two and a half centuries to reach the population that Australia secured in less than one; and if we compare the rate of growth in the sixty years from 1840 to 1900, the population of the United States has been multiplied four and a half times, that of Canada three and a quarter times, and that of Australia almost twenty-fold.

The special feature of the Australian population is its high percentage of the British race. The voyage to Australia is so lengthy and expensive that it has the deterrent effect that emigrants cannot easily retrace their steps or pay short visits home. Nevertheless, of the population of Australia at the last census (1901), 95·94, or almost 96 per cent., were born either in Australasia or the United Kingdom. § Of the population of Queensland, 25·34 per cent. were born in the United Kingdom. || In Canada, on the other hand, in 1901, the population of 5,371,315 included 1,649,371, *i.e.* 30·5 per cent. people of French origin, and 658,749, *i.e.* 12·3 per cent. of various other non-British races. ¶ The great advantages of homogeneity have necessarily cost some retardation in the increase of the Australian population, as the source of supply is more limited.

Much stress has been laid in recent years on the decline in the Australian birth-rate, so it may be remarked that the natural increase of population is above the average. In Australia and New Zealand together the natural increase is higher than in the British Isles, and is exceeded in Europe only by Bulgaria, Holland, and Servia.

The rates quoted in the Commonwealth Year Book (No. 2, 1909, p. 168) are as follows :—

Australasia	...	...	...	...	...	...	15·38
Commonwealth	...	...	...	...	...	...	15·00
Bulgaria	...	...	...	...	...	...	18·29
Servia	...	...	...	...	...	...	16·37
Holland	...	...	...	...	...	...	15·59
German Empire	...	...	...	...	...	...	14·44

* Mulhall, M. G., 'Dictionary of Statistics,' p. 450. London: 1892.

† *Ibid.*, p. 455.

‡ The figures for 1900 for U.S.A. are taken from Whitaker's Almanack, 1909, p. 657, and that for Canada from the Canada Year Book, 1907. Second Series, 1908, p. 2.

§ 'The Commonwealth Year Book,' No. II., 1909, pp. 157-158.

|| *Ibid.*, p. 160.

¶ 'The Canada Year Book,' 1907, pp. 2, 3. Second Series, 1908.

England and Wales	12.13
Scotland	12.09
Austria	11.33
Belgium	10.15
Ireland	5.89
France	1.42

Sir Athelstane Baines, in his Presidential Address to the Statistical Society last November—modifying Dr. Rubin's measure of progress in population (the square of the death-rate divided by the birth-rate) so as to express "humanly probable perfection" by the figure 1000—shows that the rate for the years 1891–1900 is for France 792, for England 889, and for the best European country, Norway, 908. Australia is as high as 941, and is beaten only by New Zealand, "Where a death-rate of 10 indicates the nearest approach to immortality yet on record, and imparts to a comparatively low birth-rate the borrowed lustre of 963 points."*

It is true that the rate of increase in Australia is less now than formerly, but even from 1901–1906, the years including the great drought, it was 14.9 per 1000 per annum, whereas the corresponding figure for Canada was only 13.3 per 1000, and that of the United States 16.2 per 1000. Taking the last ten years for which the census returns are available, Sir Athelstane Baines has shown in his 'Census of the Empire' † that the percentage of increase is as follows:—

1891–1901.							
Canada	...	...	...	...	...	...	11.13
New South Wales	...	...	...	...	...	...	20.92
Victoria	...	...	...	...	...	...	5.34 ‡
South Australia	...	...	...	...	...	...	13.16
Queensland	...	...	...	...	...	...	27.82
Western Australia	...	...	...	...	...	...	269.86 ‡
Tasmania	...	...	...	...	...	...	17.60
New Zealand	...	...	...	...	...	...	21.98

The Australian population increase is still above the average, though, considering the vast spaces still unoccupied, it would be all the better if it were faster.

VI. THE PROBLEM OF TROPICAL COLONIZATION.

The settlement of Australia has been rapid, but it is still only partial, and the policy of "Australia for the Australians" requires as

* J. A. Baines, 'The Recent Growth of Population in Western Europe: an Essay in International Comparison,' *Jour. Roy. Statistical Soc.*, vol. 72, Pt. iv. (Dec. 31, 1909), 1910.

† J. A. Baines, 'A Census of the Empire,' *Jour. Roy. Statistical Soc.*, 66, Pt. i. (March 31, 1903), 1903, p. 43.

‡ The migration from Victoria to Western Australia was largely responsible for the low increase in the former.

its complement, to use Lord Northcote's phrase, more Australians for Australia. The settled parts of south-eastern and eastern Australia have already, for agricultural districts, a fair population, as has been pointed out by so authoritative a statistician as Sir Athelstane Baines. The inclusion of the tracts that are practically unoccupied, however, renders the average for the continent deplorably low. Australia is being frequently warned that the doctrine that there are no rights of sovereignty unless supported by effective occupation may be applied to it. That doctrine was, however, promulgated to regulate the partition of Africa, and it has not been extended to any other continent. There would be no more justice in applying it to the unsettled parts of Australia than to the empty spaces of Brazil, of Northern Canada, of German South-West Africa, or of Asia, which are as empty as Australia, or even emptier. The uneven distribution of settlement in Australia is a necessary consequence of its geographical conditions. The first colonies were naturally formed in the south-eastern quarter of the continent, where the conditions most resemble those of Europe; and it was not until the settlements in the temperate regions were well established that much effort could be spared for the more difficult and novel problems in the northern regions.

The slow progress in the tropical areas is, however, sometimes explained as due to the belief that white people cannot colonize the tropics. If that theory be true, Australia must either leave all its tropical regions unoccupied, or permit the entrance of Asiatics and Polynesians. The admission of coloured races would throw away Australia's opportunity of becoming the one continent occupied by a single nation and a single race; and in consideration of the grave political and social difficulties elsewhere, due to the association of coloured and white races, that is an opportunity not to be lightly lost.

All political parties in Australia are agreed that the White Australia policy must be given a full and most patient trial. Whatever opinions may be held as to the wisdom of this policy, there is no doubt that the experiment will be tried. It is, therefore, advisable to consider the geographical evidence as to its chances of success; for of all the geographical problems connected with the future development of Australia, the most important at present is the possibility of the white colonization of the tropical areas.

The available evidence comes from three main sources—history, physiology, and experience under modern conditions. The historical evidence usually quoted is that from India, where it is claimed that a century and a half's experience has shown that white races degenerate in the tropics. It is now usually admitted that, with proper care, most white men can withstand a tropical climate; the real difficulty, it is said, is with the children. But the idea that the Indian climate is

more fatal to white than to native children, and is more deadly to white children than the British climate, is not supported by the facts. For instance, the mortality in Calcutta for white infants is 58 per 1000, while that for native infants is over 300 per 1000; and for Mohammedan children there it is 363 per 1000. In England the average infant mortality is 150 per 1000; in Burnley, the average rate for the ten years 1897-1905 was 208 per 1000, and was as much as 233 per 1000 in 1904.

The experience of India has little bearing on the possibility of white people colonizing tropical Australia; for India only proves the difficulty of maintaining the health and standards of life of a white race living among an overwhelming number of a more primitive coloured people. India, in fact, supplies an impressive warning of the evils to public health that would follow the entrance to Australia of a large coloured population.

Turning to physiological arguments that tropical climates are injurious to the white race, the difficulty with them is that they are generally so indefinite. Prof. W. A. Osborne has recently exposed the futility of some of the traditional assertions on the subject. He writes: *—

"A well known text-book on this subject, published in 1908, states that in the tropics there is a 'surexcitation of the kidneys'—which is rather vague; 'an increased activity of the liver'—which I do not understand; 'there is a deficiency in the number of the red corpuscles in consequence of the diminished proportion of oxygen in the air'—which is untrue; and 'the blood becomes more diluted' as 'evaporation from the lungs is slight'—which is sheer nonsense."

There is an increasing body of the highest expert opinion that white people can colonize the tropics, and that the ill effects of tropical climate have been greatly exaggerated in the past. Thus, Sir Patrick Manson, the leading authority on tropical diseases, tells us that "In former years, under the influence of early teaching, I shared in the pessimistic opinions then current about tropical colonization by the white races. In recent years, however, my views on this subject have undergone a complete revolution. . . . I now firmly believe in the possibility of tropical colonization by the white races. Its practicability has already been proved for many countries. I believe the time will come when it will be proved for all countries; theoretically, it is already proved, but how long we shall have to wait for the practical proof, I cannot pretend to say. Its postponement is entirely a matter depending, in the first place, on the growth of knowledge, and in the second, on the general assimilation and common-sense application of this knowledge. Knowledge in this department of science is advancing very rapidly, so rapidly that I think we cannot have many more years to wait." †

* *Argus*, Melbourne, April 10, 1909.

† *Geog. Journ.*, vol. 12, 1898, pp. 599, 600.

Dr. Martin, Director of the Lister Institute, after experience gained from residence in Sydney and Melbourne, and repeated visits to India, is of the opinion that the effect of climate has been greatly exaggerated; and he tells me that it has been proved that the amount of carbonic dioxide produced by a European is precisely the same in Berlin as in tropical East Africa.

I have asked several expert physiologists to tell me what exactly is the factor in tropical climate that could render it more healthy to coloured than to white people. Apparently there is no such factor. In the extensive literature of this subject the supposed unhealthiness of the tropical climate has been attributed to heat, monotony in temperature, extreme humidity, excessive sunlight, and such a combination of heat and moisture as to occasion a high wet-bulb temperature.

Heat seems at first sight the most probable factor, but it may be readily dismissed, as the hottest parts of a country are often the healthiest. Monotony of temperature is no more valid, as many tropical localities have a wide daily range in temperature, and there is no apparent connection between the healthiness of a locality and its variations in temperature. Again, moisture alone supplies no explanation of the alleged unhealthiness of the tropics; for though very damp climates may be unpleasant, they are not necessarily unhealthy, and they are, alas! not confined to the tropics.

The alleged degeneration of the Europeans in the tropics has also been attributed to the brilliant sunshine, from which the negro is protected by the pigment in his skin and the white man by his clothes. A black man would unquestionably have a great advantage in the tropics over a white man if they both worked naked; but clothing of suitable materials, opaque to the actinic rays, provides adequate protection.

The combined effect of heat and moisture requires more careful consideration, for they together may produce a condition that is fatal to human life. The researches of Dr. J. S. Haldane, Prof. Cadman, and others have shown that in still air hard work is impossible when the air is so moist and the temperature is so high that the wet-bulb thermometer registers over 78° , and that life itself may be threatened at wet-bulb temperatures of 85° and 88° . Custom may slightly raise the power of tolerating these high wet-bulb temperatures; but it is claimed that active continuous existence is impossible in an area with a wet-bulb temperature of over 85° or 88° . But this limit has no practical bearing on the problems of a White Australia, for the limit would apparently be as effective to blacks as to whites, and there is as yet no proof that any considerable tracts of Northern Australia have wet-bulb temperatures above this limit, though they probably occur on the northern coasts.*

* There appear to be no adequate wet-bulb thermometer observations available for tropical Australia. Prof. Osborne, in an interesting article on the "Problem of

It therefore appears that of the climatic factors which are said to prohibit the white colonization of the tropics, four may be dismissed as useless, and the fifth—the high wet-bulb temperature—may be non-effective, as it would be as fatal to the blacks as to the whites.

VII. THE EXPERIENCE OF QUEENSLAND AND PANAMA.

The problem of white acclimatization is so complex that the facts of experience are more reliable than theoretical considerations or laboratory experiments. Australia has recently supplied a most striking refutation of the impossibility or economic impracticability of white labour even under such extreme conditions as sugar-cane cultivation in a typically tropical climate. The Australian sugar industry was formerly dependent, except in New South Wales and Southern Queensland, on coloured labourers, Kanakas imported from the South Sea islands. In 1901 the Commonwealth Parliament prohibited the introduction of any more Kanakas, and ordered the return of those already in the country on the termination of their agreements. Kanakas who had made homes in Australia were allowed to remain, but all the rest were sent back in 1905-6.

The passage of this law was strenuously opposed on the ground that it meant the immediate ruin of the sugar industry. It was declared that the climate rendered it impossible for white men to work in such a Turkish-bath atmosphere as that of the sugar-fields of Mackay, and that the industry could not afford to pay white men's wages. Australia was warned by British authorities, who have written on tropical development, that white colonization of the tropics is impossible, and it was positively declared in Queensland that no Kanakas meant no sugar. I pointed out to this Society in March, 1906,* that, though most of the Kanakas had already left Australia, there was no indication of the approaching ruin of the sugar industry. The extent of sugar-cultivation in Queensland was in fact increasing; but at that date it was possible to explain the increase as the last spurt of a dying industry. Now, however, the new policy can be judged by the experience of the eight years since the anti-Kanaka Bill was passed, and of the four years since

Tropical Colonization" (*Argus*, Melbourne, April 10, 1909), calls attention to this gap in our knowledge, and, accepting the view that the wet-bulb temperature of 83° is the working limit, urges that means should be taken to discover any areas in Northern Australia that may exceed it. Owing to the kindness of Dr. W. N. Shaw, Mr. Lempfert has kindly supplied me with the records of wet-bulb temperature at various tropical localities. A wet-bulb temperature over 80° , and even over 86° , is not uncommon. In North Borneo, in January, the wet-bulb temperature is usually over 80° , and readings of close on 90° are "by no means uncommon." Mr. A. H. Merrin records wet-bulb temperatures up to 92° in Bendigo.

* J. W. Gregory, 'The Economic Geography and Development of Australia,' *Geog. Journ.*, vol. 28, No. 2, 1906, pp. 233, 234.

the deportation of the Kanakas was completed.* The new law has been applied so thoroughly that, whereas in 1904, 62.1 per cent. of the sugar grown in Queensland was produced by coloured labour and only 37.9 per cent. by white, the proportions are now more than reversed, and in 1908, 89.2 per cent. was produced by white labour, and 10.8 per cent. by coloured. There has been a nearly complete substitution of coloured by white labour. Nevertheless, instead of the ruin of the industry, it has increased in area, in yield, and in profit. Instead of Australia raising less than half the sugar it needs, it now raises more than it can use, and exports the surplus. The cost of sugar-cane production appears to have fallen instead of having risen, justifying the view of those who hold that white labour is actually cheaper than black, in spite of the great difference in the nominal wages.

This increase in sugar cultivation in tropical Australia is all the more striking, as there has been a decrease during the same period in many sugar-producing British colonies, including Mauritius, the Straits Settlements, Natal, Barbados, Trinidad, Tobago, and British Honduras, where there has been no interference with the coloured labour.

One especially satisfactory feature of the substitution of white for coloured labour has been that, although the Kanakas were all picked men, in the prime of life, and although they were medically inspected at the port of entry and doubtful cases were refused admittance, yet their average death-rate was higher than that of the whole white population of Queensland.

The death-rate of Queensland is unusually low, as that tropical state, according to its official statistics, is one of the healthiest in Australia. Dr. Macdonald, in a recent speech at Ingham, in northern Queensland, predicted that in time to come people will flock to the tropics to benefit by the invigorating effects of the brightness and sunshine.

Another recent practical demonstration that the tropics are not necessarily unhealthy to white people has been supplied at Panama, which was once notoriously deadly. The American Government provided the construction camps for the canal with the most careful scientific sanitation, and the results have proved that the former unhealthiness was due to curable diseases, or to remediable conditions. The reports of Colonel Gorgas, the head of the Health Department at Panama, shows that the health of the white labourers is as good, and their death-rate as low, as among those engaged in similar work in the United States. The white women and children, of whom there were eight hundred in the canal camps, had, in 1907, an even lower death-rate than in the States. There were 2674 American women and children on the Isthmus, and their death-rate was only 9.72 per

* A fuller account of this question has been given in the *Nineteenth Century* for February (No. 396, Feb. 1910, pp. 368-380).

1000. So far from the whites being less healthy than the blacks, Colonel Gorgas appears especially proud of the achievement, when the death-rate of the black labourers was reduced as low as that of the whites.

VIII. THE POSITION OF NORTHERN AUSTRALIA.

Actual experience and theoretical considerations, therefore, alike show that there is nothing in the climate of tropical Australia to prevent its colonization by white races. No doubt many eminent authorities will differ from this conclusion, and it must therefore be advanced with due deference.

Lord Northcote, whose opinion is of unique weight from his especial knowledge of the country, his Indian experience, and his generous sympathy with Australian ideals, has stated that he can express no definite verdict upon this question. Those who have not had Lord Northcote's very exceptional opportunities for judgment are bound to hesitate before coming to any conclusion. But I should be untrue to my faith in science if I hesitated to express the conviction that there is no region in the tropics which the European could not colonize, provided it be sufficiently fertile and productive to enable the colonists to live under suitable conditions, and provided that they are not swamped by a large black population.

The only doubt, in the case of tropical Australia, that seems to me serious, is whether the natural increase of the population and the immigration from Europe will be sufficient in the near future to enable Australia to spare enough settlers for the occupation of the tropical districts.

The weakest point in the Australian position is the Northern Territory, with its area of 523,620 square miles and a white population, in 1903, of 868. It is true that the southern part of the territory shares the aridity of Central Australia, but the north has a rich soil and ample rainfall, and can unquestionably grow cotton and other high-priced tropical produce, and contains mineral deposits that must some day be a source of wealth.

The development of the Northern Territory will probably be hampered by its unscientific frontiers. It is bounded to the east and west by meridians of longitude, the most unnatural of all boundary-lines. According to Mr. H. Y. L. Browne, the Government Geologist of South Australia, the Northern Territory includes large areas which will probably remain useless for a long time to come, but it has three very promising areas, viz. the northern peninsula and two large tracts of excellent pastoral country in the interior. These two tracts, however, are not well placed for development through Port Darwin; one lies along the south-eastern frontier, and its natural port is Burketown, in Western Queensland; and the other, including the Tanami goldfield, is in the south-western part of the territory, and its natural outlet is

through Wyndham, in Western Australia. If when the Federal Government takes over the Northern Territory it acquired the adjacent strips of Western Australia and Queensland, which belong to the same natural geographical division of Australia, this rectification of frontier would give the areas in the interior of the Northern Territory their most convenient outlets to the sea.

The subdivision of both Western Australia and Queensland has been often proposed, and is probably ultimately inevitable. The northern peninsula of Western Australia, the north-western corner of Queensland, and the Northern Territory would together form a great tropical territory with a convenient and natural boundary. Its Government would train a staff expert in its special tropical problems; and in twenty years' time, it would be possible to tell whether the colonization of the country by a white race is practicable within a reasonable time. If not, then coloured races might be admitted into this federal territory under restrictions that could not be enforced in any of the existing states, and the coloured people could be confined to this area owing to the desert moat that separates it from the more settled districts.

But that the Northern Territory will fail I do not believe, for it appears certain that it contains large tracts of fertile land and considerable mineral wealth. Its stock-raising capacity is undoubted, and its magnificent harbour, Port Darwin, is only six days' voyage from the great markets of Southern China, where meat will probably be increasingly used. It is, however, this very proximity to Asia that makes the empty tropical regions the chief element of danger, for the region most tempting and exposed to attack is that which Australia could least easily defend. We may, however, conclude, I think with confidence, that if the development of the Northern Territory be undertaken wisely and continued patiently, the country can be successfully colonized by white people. That, however, is not the easiest path of progress. The admission of Asiatics would cause a more rapid increase in the population and quicken agricultural development, but at the price of future difficulties and dangers.

There is an Indian saying, "No one need be lost on a straight road," and Australia has chosen the straight, but more laborious, road. It leads towards a great ideal—the development of the whole continent as one country and occupied by a people of one race. We cannot do much directly to help Australia in its progress towards its goal. Australians know better than we do how progress towards it can be most surely won. But, after children have passed the stage of direct dependence, the best gifts a parent can give them are sympathy and encouragement. We can best strengthen the bonds between us by sympathetic appreciation of Australian loyalty to our national traditions and our recognition of the high idealism that inspires so much of Australian policy.