

REPORT

OF THE

TWENTY-SECOND MEETING

OF THE

Australian and New Zealand Association
for the Advancement of Science

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Australian and New Zealand Association for the Advancement of Science.

PRESIDENTIAL ADDRESS:

THE UNVEILING OF ANTARCTICA.

By DOUGLAS MAWSON, Kt., D.Sc., F.R.S.

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The Subject for Review.

The presidential address delivered by His Excellency Sir Hubert Murray at the last meeting of this Association dealt with the administration of the equatorial territory of the Commonwealth. On this occasion, I propose to divert your attention to the other extreme, to the stark solitudes that sentinel the Pole, for thus far extends the jurisdiction of the Commonwealth of Australia and the Dominion of New Zealand.

One cannot yet discourse upon the administration of this vast polar land, after the manner of treatment accorded to Papua by your late president, for the political mind in regard to it, like the great country itself, is still frozen. Doubtless the glow of light shed, in ever increasing intensity, by science over South Polar lands and seas will, eventually, thaw out some scheme for wise and progressive development.

The subject-matter of my address will be in the nature of a survey of the salient facts relating to Antarctica, followed by an indication of the future of those frozen fastnesses in the economy of mankind.

To begin with, I shall briefly outline and appraise the successive advances in exploration*, which have led up to the almost complete unveiling of the great South Polar Land—Antarctica—the Seventh Continent, if Australia is accorded, as is its due, the sixth place.

*The principal recent historical works dealing with the earlier phases of Antarctic Exploration are those of Mill(1) and Eriker(2), *vide* bibliography at the conclusion of this account. I have drawn considerably upon both these works. The map scheme employed by Mill to illustrate successive advances in Antarctic exploration is herein adopted with certain modifications and extensions.

The historical summary to follow in this address is designed as the briefest possible statement capable of outlining the motives and the main progress in the evolution of geographic knowledge concerning the far south, with special reference to the continent itself. For greater detail, the works quoted may be consulted. Some new data and much comment are here published for the first time.

Outline of the Record of Discovery.

Speculation.

The theoretical and deductive speculation of the Greek philosophers postulated the existence of an extensive land mass terminating the earth to the south of the then-known world.

This erroneous conclusion, as well as the good of Greek learning, was kept alive by the Arabs in the Middle Ages. Their legacy to Christendom on the awakening of intellectual expansion in the fifteenth century was, so far as our present problem is concerned, the perpetuation of the fallacy of a great South Land in the maps of three centuries of notable geographical achievement. Even after the globular form of the earth was demonstrated and geographic knowledge vastly enriched by the remarkable activity of the fifteenth and sixteenth centuries, the belief in a great Southern Continent extending in places northward even into the tropics still persisted.

Thus it was that the great navigators of that awakening period, after the invention of the compass and great improvements effected in the art of navigation, all fared forth fully imbued with this mistaken conception and ready to hail any land discoveries in that quarter of the globe, however trifling, as fragments of the coastline of the great hypothetical Southern Continent.

The current ideas of those ages are well illustrated in the maps of Orontius Finne (1531) and of Ortelius (1571). Through several centuries of active maritime expansion, the limits assigned to this *Terra Australis nondum cognita*, as Ortelius charted it, were somewhat modified, but it remained for Captain James Cook to produce overwhelming evidence to the contrary; then only was the fallacy finally and irrevocably quashed.

Exploration.

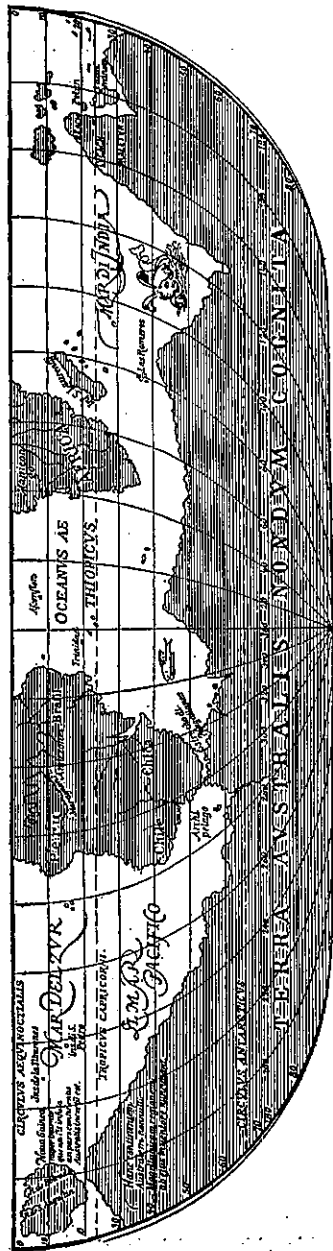
In its earliest conception, principally based on the views of Ptolemy, this "great South Land" was conceived as stretching from Africa to the Indies, enclosing the Indian Ocean. It was the persevering efforts of Prince Henry of Portugal (died 1480), sustained over forty years of his life, to promote maritime exploration that first began to set limits to the hypothetical South Land. Speculation began to give way to exploration. The Navigator, as Prince Henry was called, sent forth a succession of well-found and manned ships which succeeded in outlining the west coast of Africa and led on to the subsequent voyage of Vasco da Gama (1497), which, by rounding Africa and initiating the sea route to India, clearly demonstrated the non-attachment of Africa with the fabulous South Land.

The Early Circumnavigators.

In the meantime the New World had been discovered, and Magellan (1520), sailing south along the west coast of South America, had discovered a passage, subsequently to bear his name, leading through to the Pacific Ocean. The land which he charted to the south of the Straits, and to which the name Tierra del Fuego has been attached, Magellan believed to be a portion of the coast of the great South Land.

It fell to the lot of Sir Francis Drake first to demonstrate the insularity of Tierra del Fuego, and to dissociate it from any land that may have existed still further to the south. At that time (1578) Drake had just completed a passage to the Pacific Ocean through Magellan Straits when a great storm drove his ship to 57 degrees south latitude, the farthest

MAP I.



Terra australis, after Ortelius (Theatrum orbis terrarum, 1571).

south recorded to that date. Working north again, they then fell in with the southern extremity of Tierra del Fuego, around which they reported "the Atlanticke and the South Sea, meete in a most large and free scope."

The Lure of the Mythical South Land.

The conception of a great South Land which figured in one form or another in the charts of the sixteenth and seventeenth centuries proved to be a great stimulus to exploration. Many expeditions fared forth in search of it, and such land discoveries as they were fortunate enough to make in those south seas were hailed as portions of the great "South Land."

Juan Fernandez (1563), fell in with the island bearing his name and perhaps other islands as well. Mendana touched on the Solomon Islands in 1567; Quiros (1605) thought he had arrived at the long-sought coast when he touched on the Island of Espiritu Santo, one of the New Hebrides group. These, and observations by sundry other navigators, were strung together by cartographers in an arbitrary fashion, and a great coast line appeared across the chart of the south Pacific, extending from south of Cape Horn to New Guinea.

Meanwhile, in the first half of the seventeenth century the Dutch had been busy operating from Java. Their vessels rapidly outlined the north and west coasts of what is now known as Australia, but which at that time, in accordance with current views, was regarded as part of the great South Land. It fell to the lot of the greatest navigator of the seventeenth century, the Hollander, Abel Tasman (1642) to completely isolate from the hypothetical continent what was charted as Nieuw Holland. His track on that famous voyage passed south of Australia. He touched on Tasmania and then discovered the west coast of New Zealand which he named Staten Land. He then bore away to the north-east without attempting to circumnavigate his Staten Land, assuming it to be part of the coast of the great "South Land."

The seventeenth century closed without effecting much more of real importance as bearing upon the Antarctic problem, though a fuller knowledge of the known southern regions was acquired. The Falkland Islands and South Georgia were definitely located on the map, though, according to some vague reports, they had been sighted in the sixteenth century.

In 1721 a Dutch expedition under Roggeveen, whilst rounding the Horn to enter the Pacific Ocean, met with tempestuous weather which drove them far to the south. One of the vessels reported thus having reached a record south latitude, 64° 58', without sighting land.

An event of great interest was the despatch in 1738 of two ships equipped by the French *Compagnie des Indes* for the avowed object of exploring and claiming the great *Terra Australis* of the cartographers. Having this definite object in view, the enterprise has been recorded as the first real Antarctic expedition. An able French navigator, a captain in the service of the East India Company, M. J.B.C. Bouvet de Lozier, was the organizer and commander of the expedition. A principal object of the enterprise, which set forth in two ships, the *Aigle* and *Marie*, was to establish a port of call and trading base on the prospective coast, somewhere south of Africa, for the use of their vessels plying to India. In foggy weather, the expedition fell in with a corner of the coast of what is now known as Bouvet Island (the location of the centre of the island is lat. 54° 26' S., long. 3° 24' E.), but which they regarded as a cape (*Cap de la Circoncision*) on the coast of the South Land. Bouvet was disappointed in his further search for land, which carried him through about

48 degrees of longitude in the approximate latitude of 55° S. In its failure to achieve useful commercial results, the expedition was no doubt unsatisfactory to the French East India Company, but it did useful work in demonstrating that no land exists over a large part of the South Atlantic north of 55° S. latitude.

In the middle of the eighteenth century, both in France and in England, there was a revival of speculative interest in the existence of the great South Land, which eventually culminated in the despatch of Captain James Cook with a special commission to investigate the fascinating problem.

In the meantime, interest in the subject ran high amongst French savants and resulted in the despatch of two French expeditions of note in relation to Subantarctic geographical history. The first, which went forth in 1772 under command of M. Marion du Fresne, when bound for the Pacific Ocean via the Cape of Good Hope, had the good fortune to fall in with two small islands in the South Indian Ocean. These are known respectively as Marion Island and the Crozet Islands. The other expedition, under command of Chevalier Yves Joseph de Kerguelen-Trémarec, aimed at locating the coast of *Terra Australis* to the south of the mid-Indian Ocean. Up to a point the expedition was successful, for in February, 1772, they came upon what is now known as the Kerguelen Archipelago. This discovery was heralded by Kerguelen as forming part of the sought-for "Antarctic Continent," but on return to France he found his compatriots sceptical. He was eventually thoroughly disillusioned when, on a second voyage the following year, he ascertained his "South France" to be merely an isolated archipelago of small islands.

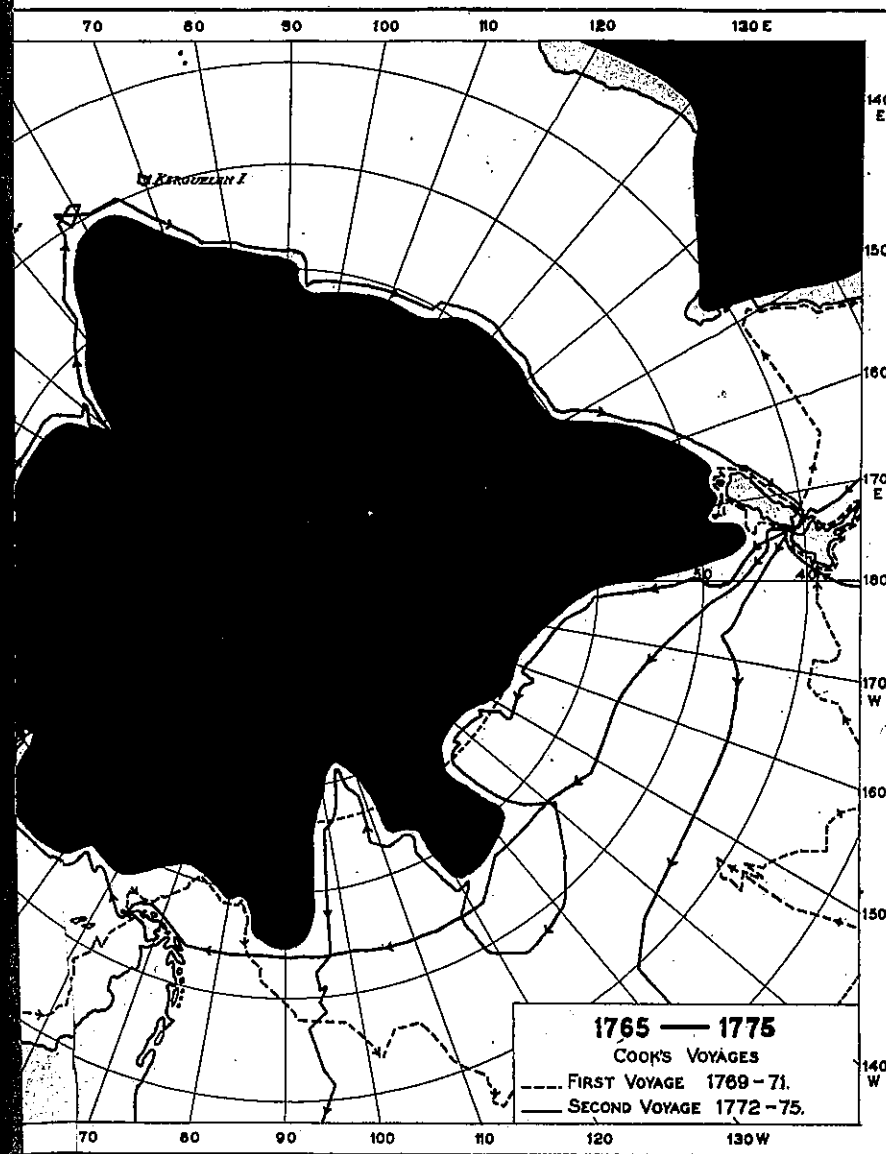
About this time the British Admiralty instructed the captains of several of its vessels proceeding on voyages across the Pacific Ocean to look for land "which there was reason to believe might be found"—meaning the coast of the speculative *Terra Australis*. Thus instructed were Captains Byron, Wallis, and Carteret, respectively voyaging across the Southern Pacific. So also was Lieutenant James Cook when despatched in 1768 to circumnavigate the world in command of a scientific expedition with Otaheite, in the mid-South Pacific Ocean, as chief objective.

The Laying of the Spell.

Every citizen of these shores knows the story of that famous voyage of the *Endeavour*; how, after rounding South America, they proceeded across the South Pacific to Otaheite, where an astronomical programme was executed. Then the *Endeavour* sailed south on a voyage of discovery in the almost unknown region to the south and west, including a circumnavigation of New Zealand, and delineation of the east coast of New Holland.

Even in the matter of the Antarctic problem, Cook accomplished much on that, his first voyage of discovery, for he had shown New Zealand to be unconnected with the fabulous South Land and had shown only ocean to exist over a large area formerly appearing on charts as hypothetical land. Cook himself in his log, under date of March, 1770, during the later stages of his first voyage, writes as follows (3): "Thus far our navigation has certainly been unfavorable to the notion of a Southern Continent, for it has swept away at least three-fourths of the positions upon which it has been founded." He then elaborates "reasons for thinking that there is no continent* to the northward of 40° S.; of what can be farther to the southward than 40° I can give no opinion."

* Already New Holland had been eliminated from the South Land by Tasman.



Face p. 6.

On his return to England, Cook was soon in the throes of preparation for a second and larger expedition with the special object of further investigating the extent of the fabled "Southern Continent," the existence of which was still insisted upon in some quarters. The expedition sailed in 1772 in two staunch vessels, the *Adventure* and the *Resolution*, chosen by Captain Cook as suitable for the big work ahead.

The task was to circumnavigate the globe in the farthest south latitude practicable. The execution of the work occupied three years. It resolved itself into a series of incursions into high latitudes, alternating with visits to the temperate and tropical regions as reliefs from the stress and hardship endured in the stormy frozen seas of the fifties and sixties. The undertaking was executed in a masterly fashion and set a high-water mark to exploratory achievement up to that time, in fact inaugurating a new era of exploration.

The 17th January, 1773, was a notable date in geographical history, for on that day, in about long. 39° E., the Antarctic Circle was first crossed by human beings. On that occasion they pushed on to 67° 15' S. before being held up by impenetrable pack-ice, which prevented their discovery of the Antarctic Continent which we now know lay only 70 nautical miles ahead. During the two ensuing years the Circle was crossed on several occasions, the farthest south of the cruise and of the century being 71° 10' S. reached in 106° 54' W., achieved on 30th January, 1773. Finally in the southward extension of the Atlantic Ocean, just prior to turning north towards home, Cook fell in with and charted the island since known as South Georgia. He was not, however, the discoverer, for the vague records of early navigators suggest that it may have been sighted long before; and in any case the discovery and the naming of it as San Pedro by a Spanish trading vessel, the *Leon*, in 1756, is well authenticated. Cook then discovered the southern islands of the South Sandwich Group, which, however, he did not circumnavigate on account of impenetrable pack-ice then enveloping the land. He thought that the more southerly of the peaks he then sighted within the pack-ice might possibly be the northern limit of land which extended south beneath Antarctic ice and snow. He then proved Bouvet's discovery could be no more than a small island, though he failed* to actually locate it.

Cook returned with a vast amount of data relating to the regions visited, and he had demonstrated the existence of continuous sea over a large part of the globe, certainly to the 60th degree of south latitude, where formerly land was conjectured.

During this voyage Cook became convinced, and rightly so, that the amazing number of icebergs met with in high southern latitudes was an indication of the existence of extensive land within the Antarctic Circle. Whilst finally heading towards home on that voyage, Cook writes(4) as follows: "I had now made the circuit of the Southern Ocean in a high latitude, and traversed it in such a manner as to leave not the least room for the possibility of there being a continent, unless near the pole, and out of reach of navigation." He considered as one result of his labours "a final end put to the searching after a southern continent, which has, at times, engrossed the attention of some of the maritime powers, for near two centuries past, and been a favourite theory amongst the geographers of all ages."

* Cook and several succeeding navigators searched for but failed to locate Bouvet's Cap Circoncision. This is explained by the fact that Bouvet gave the position as 8 deg. 13 min. too far to the east (see *The Antarctic Pilot*, Admiralty publication.)

Cook Concludes that a Large Land Mass Exists Within the Polar Ice.

A very important conclusion reached by Captain Cook and recorded in his published work is stated (4) as follows:—"That there may be a continent or large tract of land near the pole, I will not deny. On the contrary, I am of opinion that there is; and it is probable that we have seen a part of it. The excessive cold, the many islands, and the vast floats of ice, all tend to prove that there must be land to the south; and for any persuasion that this southern land must lie, or extend, farthest to the north opposite to the Southern Atlantic and Indian Oceans, I have already assigned some reasons, to which I may add the greater degree of cold experienced by us in these seas than the Southern Pacific Ocean under the same parallels of latitude."

Thus Cook's contribution to the Antarctic problem, so far as concerns the distribution of land and sea, included firstly, the elimination of the great mythical South Land from the charts and the substitution of a vast free ocean extending to at least 60° S. latitude; secondly, a general indication of the northern limit of the Antarctic pack-ice; thirdly, a picture of such Antarctic lands as may exist from analogy with features of South Georgia and the South Sandwich Islands as reported by him; fourthly, his conclusion based upon the extent and distribution of icebergs and pack-ice that a considerable land mass, if not a continent, must exist within the impenetrable ice-bound region; and finally, he produced evidence which led him to forecast that the mass of such Antarctic land would be found to lie farthest north to the south of the Indian and Atlantic Oceans rather than in the Pacific sector. In all these conclusions subsequent exploration has proved Cook to be right.

This last of the great pioneer circumnavigators had thus placed on a precise basis knowledge concerning the vast southern region through which for several years his ships had thrashed relentlessly. Also, he had accurately deduced the broader nature of the inaccessible frigid region still further south. Cook's work in the South Seas had been so thorough, and his description of the Antarctic land he had sighted so unattractive, that such exploratory efforts as the political situation in troubled Europe would allow were, for several succeeding generations, devoted to the investigation of the little-known lands in the habitable areas of the globe.

The Early Sealers—American and British.

With the passing of Cook, the myth of a great habitable South Land with facilities for trade was gone, and a fresh incentive was required to draw men to the far southern seas. But a new lure soon arose, largely originating from Cook's own reports of abundant seal life on the shores of the island of South Georgia and of southern New Zealand. Thus it was not long before great activity was developed in the southern sealing grounds. The valuable Fur Seal was first virtually extinguished; then the blubber-bearing creatures such as Sea-elephants and the Southern Right Whale were decimated. Consequently new localities were constantly being sought. In the American region the slaughter commenced around the coasts of Tierra del Fuego and the Falkland Islands, then spread to South Georgia, and finally, on their subsequent discovery, to the Antarctic island groups usually indicated on charts as the South Shetlands and the South Orkneys.

Concurrently operations of a similar nature were progressing in the Australasian region. The close of the eighteenth and beginning of the nineteenth century was a period of great activity centred in Dusky Sound, southern New Zealand, and in the Subantarctic islands to the south. Much of the industry in the young days of Sydney and Hobart was

comprised in sealing and whaling enterprises (5). All the Subantarctic islands south of New Zealand were located after Cook's time. The last to be charted were Macquarie Island and Campbell Island, discovered in 1810 by Frederick Hasselborough*, master of a sealing brig, *Perseverance*, operating from Sydney, New South Wales. Ships went out from these ports combing the southern seas to the edge of the pack-ice. The rich harvest of fur-seal skins from these islands soon attracted the American sealers also to the Australasian region.

As the years went by, the whalers and sealers directed their attention more and more to the remote islands of the South Indian Ocean, Marion Island, the Crozet Islands, and, chiefest of all, Kerguelen. So great was the competition in this commercial field that the sealers were for ever on the lookout for new sealing grounds and, as a consequence, knowledge of the Antarctic regions benefited.

In those early sealing and whaling days, the New England States, America, sent forth annually to the southern seas a fleet manned by virile sailors who ransacked the world for seal skins and blubber oils. Their chief hunting ground in the earlier period was the region south of America. It is vaguely reported (6) that these American sailors possibly knew of the South Shetland Islands before they were sighted by William Smith, who, in the brig *Williams*, in 1819, on a trading voyage between Montevideo and Valparaiso, sighted land of that archipelago. In October of the same year he returned, and making a landing on the north-eastern extremity of King George Island, he raised the Union Jack. Later Edward Bransfield, R.N., was despatched to follow up this discovery and to chart the land, thus strengthening the British title. Bransfield arrived at the South Shetlands on 16th January, 1820, and continued surveying operations thereabouts until 21st March. During that time "he explored nearly as far south as 65° S. in the Weddell Sea, and definitely charted Trinity Land, now called (on Admiralty charts) Trinity Peninsula, and d'Urville Island from approximately 56° W. to 60° W. and 63° S. to 64° S." (7). Bransfield's chart, though unpublished, is still extant, and clearly demonstrates priority in sighting the large island designated Graham Land on the Admiralty charts.

On some of the older charts the name Dirk Gerritz Archipelago is attached to the South Shetland Islands. The claim is based on a confused and quite inadequately-authenticated report relating to one Dirk Gerritz, captain of a Dutch vessel, one of a squadron of five ships which had cleared Magellan Straits going west in the year 1599. Reports states that then a great storm drove the vessel to 64°† within sight of ice-capped mountainous land. Dirk Gerritz himself, in his report to the leader of the expedition, makes no mention of such discovery. If it were true that land was sighted so far south, then it could hardly be other than that later known as the South Shetlands.

An American sealing expedition appears to have reached the South Shetlands in 1820 soon after Bransfield arrived to map the group. They returned home with a good cargo of seal skins. A wave of sealing activity now ensued. The following season a fleet of five American sealing vessels, under command of Benjamin Pendleton, found head-quarters in Yankee Harbor, Greenwich Island,‡ South Shetlands. Sighting several mountain tops rising from the sea to the south of the South Shetlands, Pendleton early in 1821 despatched Captain Palmer in the cutter *Hero* to investigate. Extensive snow-capped islands were discovered, including a sighting of

* Spelt Hasselborough in some records.

† Whether S. lat. or W. long. is not stated.

‡ Not Deception Island as has sometimes been stated.

portion of the large island recorded as Graham Land on the Admiralty charts. This landfall has appeared on the charts as Palmer Land. On some charts this name has been applied to the whole island mass, which, however, was first sighted the preceding year by Bransfield, as already detailed. Fanning records (8) that Palmer proceeded south in a stouter vessel the following season (1821-22) until he met fast ice firmly attached to the shore of "Palmer's Land," and then traced the coast eastward. "In this way he coasted along this continent upwards of fifteen degrees, viz., from 64° and odd, down below the 49th of west longitude." On investigation, it transpires that what Palmer probably did follow was, in the main, the pack edge extending from "Palmer's Land," the land lying south of the South Shetlands, out into the Weddell Sea to the 49th degree west longitude. Fanning's use of the term "continent" in this connexion illustrates the little significance that can be attached to the use of the term in accounts of some of the early explorations.

Captain George Powell, in the sloop *Dove*, discovered and charted the South Orkney Islands in 1821. In some of the earlier charts they appear as "The Powell Islands."

Von Bellingshausen's Fine Achievement.

In the midst of this period of sealing enterprise there enters the field of South Polar exploration a very important Russian expedition of two ships under the command of Captain Fabian Gottlieb von Bellingshausen. The expedition was despatched in the vessels *Vostock* and *Mirny* in 1819 by Emperor Alexander I. to make a circumnavigation in high southern latitudes. A period of three years was occupied in the task, which was executed with highly successful results. On their outward voyage, after reaching South Georgia, the expedition sailed east about the South Polar regions. The South Sandwich landfall of Cook was mapped and shown to be merely a chain of small islands, to which von Bellingshausen added three new ones at the northern end of the group.

Von Bellingshausen's voyage continued in high southern latitudes, closely in touch with the pack-ice around the entire Antarctic regions. At two points the Russians actually came very close to sighting the ice coast of the Continent, having penetrated to within about 15 miles of the approximate coastline of Princess Martha Land and 30 miles of the approximate coast of Princess Ragnhild Land as recently laid down by the Norwegians. He discovered Peter I. Island and Alexander I. Land, both islands lying within the Antarctic Circle to the south of the eastern Pacific. In 1821 the Russians dramatically appeared amongst the American sealers in the South Shetlands, which had been discovered and charted subsequent to von Bellingshausen's departure south, and whose existence therefore was unknown to him until his own ships arrived on the spot.

Von Bellingshausen's effort was, like Cook's, a great achievement. He circumnavigated the Antarctic in a considerably higher average latitude than had his predecessor. In this, however, he had the advantage of greatly-improved technique both in the preservation of foods and in shipcraft; also, at that date mariners operating in the far south must have benefited greatly in knowledge of that region from the experience of the sealers during the 45 years since Cook laid a foundation for the successful prosecution of long voyages under such difficult circumstances.

The Russians justly deserve the highest commendation for the complete success of their undertaking; our only regret is that the intimate and complete account of their adventures has appeared only in Russian, and is thus inaccessible to most historians. In the progress of von Bellingshausen's voyage, the Antarctic Circle had been crossed and recrossed



no less than six times, and the vessels had navigated through no less than 243 meridians of longitude beyond 60° S. latitude, 46 being within the Antarctic Circle. Though his farthest south record fell 77 nautical miles short of Cook's, yet Bellingshausen was the first to discover land within the Antarctic Circle. As a result of von Bellingshausen's voyage and the operation of sealers in the interval post-dating Cook's effort, the unknown in the Southern Hemisphere was considerably reduced by the year 1821.

Triumphs of the Later British Sealers—First Sighting of the Continent.

About the time of von Bellingshausen's return, James Weddell, who in connexion with sealing and exploratory operations had already visited the newly-discovered South Shetlands, again set out from the Thames bound for the southern seas. The intention was again to combine sealing with exploration. Departing from the South Orkney Islands on 22nd January 1823, his two small vessels made a course to the south-east, and eventually on 20th February, reached 74° 15' S. latitude, 34° 17' W. longitude. Though there was open sea around them at the time, he decided to retreat north on account of the condition of the crew and the lateness of the season. Weddell, in ordinary sealing vessels, had thus penetrated to 3 deg. beyond Cook's farthest south, securing a record which in that sector of the Antarctic remained unbroken until comparatively recent times.

Almost all the more outstanding advances in Antarctic geography effected by the sealing and whaling interests in the first half of the nineteenth century were connected with the firm of Enderby Brothers, a British mercantile firm of high standing which operated throughout the southern hemisphere for a period of well over 65 years. Their ships already plied the Antarctic seas in 1785. The Enderbys, whilst conducting a mercantile business, were prepared to spend much effort and expense in advancing knowledge of the far southern regions, without receiving any encouragement in the way of pecuniary returns. Their ships were usually well found as sealing vessels go, and the officers and crew well chosen. At the date of the foundation of the Royal Geographical Society (1830), the senior member of the firm, Mr. Charles Enderby, became an original Fellow, and continued actively interested in the work of the Society for 47 years. Their vessels frequented Australian and New Zealand ports in those early Colonial days, and they held exclusive concessions of the fisheries of the Auckland Islands about the year 1849, when, for a time, Mr. Charles Enderby resided there, and held the title of Lieutenant-Governor.

As early as 1808, two of their vessels earned fame by again sighting Bouvet Island, which had hitherto evaded attempts to locate it since Bouvet's somewhat indefinite record of 69 years earlier. Again, in 1825, two more of their vessels fell in with the island.* On that occasion, Captain Norris, the senior officer, landed, and being the first human being to effect a landing,† he raised the Union Jack on the shore.

In the year 1830, Messrs. Enderby equipped for Antarctic exploration two vessels, the schooner *Tula* (150 tons), and the cutter *Lively* (50 tons),

*At the time, they were ignorant of Bouvet's discovery, and thought they had made a new find. They came in sight of an island which was promptly named Liverpool Island, but bad weather drove them off. In fine weather, three days later, they again sighted an island which they named Thompson Island. Their description leaves no doubt that it was Bouvet Island upon which they landed, and recent investigation by a Norwegian Expedition has established that there is only one island in that vicinity, and that is Bouvet Island.

†Morrell's account of a voyage in those seas, including a landing on Bouvet Island in 1823, is, of course, chiefly fiction.

under command of John Biscoe, a retired master of the Royal Navy. The voyage commenced from Gravesend. Leaving the Falkland Islands late in November, a course was set to the South Sandwich Islands, then eastwards as far south as the pack-ice would allow.

On the 28th and 29th of January, Biscoe's track as charted is practically right on the coast of the eastern side of Princess Martha Land, as now roughly mapped. Two weeks later, Biscoe's vessels were in about latitude $68^{\circ} 24' S.$, longitude $31\frac{1}{2}$ deg. E., which is about 30 miles off the coast of the recently discovered Princess Ragnhild Land. Six days later still, in longitude $40^{\circ} 40' E.$, they were within about 25 miles of the coast of Queen Maud Land. Heavy pack-ice and grounded bergs of the coastal zone prevented them pressing farther to the south, but signs of land were repeatedly recorded in an accession of bird life, &c. It is interesting to note how very closely ice-covered Antarctic land within the pack-ice can be approached, even by experienced navigators, without its presence being confidently affirmed. This is, of course, particularly so in the case of but moderately elevated land.

Eventually, on 25th February, 1831, in latitude $66^{\circ} 29' S.$ and longitude $45^{\circ} 17' E.$, they remarked the appearance of land along the southern horizon.* What they described corresponded to ice-covered highland descending gradually to the sea, and terminated by a vertical ice-cliff wall, which reminded them of the chalk cliffs of the North Foreland on the Kentish coast. This description, in general terms, tallies with the ice-covered land recently proved to exist in that longitude, but it would appear that the ice-cliff coast line seen by Biscoe in 1831 was situated very many miles farther north than it is to-day. Possibly a shelf-ice extension of the land-ice existed at that period.

During the next couple of days, in squally and cloudy weather, with "a most distressing E.S.E. sea," they worked their way further to the east, though driven a little to the north. Eventually at 4 p.m., on 28th February, they sighted the black tops of mountains projecting through the ice slopes of elevated land.

This land is now known as Enderby Land. Subsequent exploration has shown that, in discovering Enderby Land, Biscoe was the first ever to catch sight of any portion of the coastline of the Antarctic Continent; and for this reason alone his exploit is a most memorable one. Unfortunately, on account of the lateness of the season, constant gales and an impenetrable belt of pack-ice, Biscoe was not able actually to reach the shore, though he persevered until 14th March. By that time there was much sickness amongst members of the crews, and any further attempt had to be abandoned. Biscoe continued for another three weeks beating to the east in the hope of again meeting with land. On 4th April Biscoe wrote, "The vessel, now a complete mass of ice, only three of the crew who can stand, and being likewise well convinced that any land to the southward of that latitude would be inaccessible, I find myself from these most imperious considerations obliged, although very reluctantly, to give up any further pursuit this season." He hoped to make New Zealand as a wintering base, but had finally to put into Hobart, for scurvy carried off several of the men, and only one of the crew was able to stand when the *Tula* eventually reached Hobart Town.

The cutter *Lively* had been separated from the *Tula* during a storm off the coast of Enderby Land. Captain Avery eventually succeeded in reaching Western Port (Victorian coast, near Port Phillip), after seven of the crew of ten had died of scurvy and privation (9).

*From the deck of the *Discovery*, in 1930, in stormy weather, when in latitude 66 deg. 36 min. S. and longitude 45 deg. 30 min. E., we clearly saw the snow-domed surface of the land to the south standing well above the horizon.

Eventually both vessels joined up again on the Derwent (Hobart). After three months' sealing around southern New Zealand, the vessels commenced the homeward journey, including on the way a far-south exploratory cruise across the Pacific. During this voyage Biscoe again fell in with new Antarctic islands in the neighbourhood of longitude $72^{\circ} W.$ These were named Adelaide Island and the Biscoe Islands. He also set foot on and took formal possession of what he believed to be an unknown mainland which appeared in his chart as Graham Land, named after the then First Lord of the Admiralty. His Graham Land, however, was subsequently accounted part of the island, the northern tip of which had been earlier discovered and charted as Trinity Land by Bransfield.

On arrival at the South Shetlands, Biscoe undertook sealing operations. Whilst there the *Tula* was very badly damaged; but she was eventually repaired and the voyage home via the Falkland Islands commenced. While at the Falkland Islands the *Lively* was wrecked. Thus only the *Tula* finally reached the Thames.

Biscoe's effort, considering the vessels and equipment at his disposal, is one of the finest in the annals of Antarctic exploration; for not only did he meet with new Antarctic land in two different sectors and establish the record of first sighting some portion of the Antarctic Continent, but he sailed through 160 degrees of longitude south of $60^{\circ} S.$ and through almost 50 degrees within the Antarctic Circle.

Another of Enderby's vessels, the two-masted square-rigged vessel *Magnet* (147 tons), under command of Captain Peter Kemp, made a notable voyage in the year 1833. The manuscript account of this voyage has been lost, but a contemporary chart with Kemp's track and sundry remarks is still extant amongst records at the Admiralty. Kemp's track is shown proceeding nearly due south from Royal Sound, Kerguelen. At that time Heard and McDonald islands were undiscovered, but Kemp appears to have sighted one or other of them, almost certainly Heard Island on account of its great elevation, for in the approximate latitude of Heard Island the remark "saw land" is written across the track. Farther south the track trends to the south-west and Antarctic land is shown as sighted from the *Magnet* when in about $66^{\circ} S.$ latitude. This discovery has appeared on the charts as Kemp Land, located on the meridian of $59^{\circ} E.$ But as Kemp had only two chronometers, each equally unreliable and varying considerably at the time of his landfall, the correct longitude might be indicated by either or by neither of them. For plotting his track in the chart referred to above, the longitude by one of the chronometers has been adopted, whereas our subsequent exploration in that locality suggests that reliance should have been placed on his other chronometer which gives a position somewhat further to the west.

Kemp was apparently unable to land upon the shore owing to an intervening belt of pack-ice. He did not tarry, but proceeded on a course north-west towards Cape Town. Kemp's voyage is notable in that it was the second to sight and discover a section of the Antarctic Continent.

At this time, in the region south of New Zealand, sealers from Sydney and Hobart were active searching for new sealing grounds. It is recorded (10) that Samuel Harvey, master of the barque *Venus*, 238 tons, sailed from Sydney on 9th January, 1831. After calling at Macquarie Island he proceeded as far as 72 degrees south latitude (evidently the entrance to the Ross Sea) before turning back. Then after securing a cargo of skins and sperm oil at Campbell Island and southern New Zealand the *Venus* arrived back in Sydney on 31st December, 1831.

Still another of Enderby's captains earned fame in Antarctic seas. This was John Balleny, who in 1838 was despatched to investigate a particular sector of the circumpolar region, most of which sector had not, at that

time, been traversed in high southern latitudes. The region selected was that south of Australia between the 163rd and 100th degree of east longitude. Two small vessels, the schooner *Eliza Scott* and the cutter *Sabrina*, were selected. Balleny sailed from southern New Zealand on 7th January, 1839, and proceeded south via the Campbell Islands. The Antarctic Circle was reached in longitude 178° E., from thence a passage west was commenced. On 9th February they fell in with what has since been charted as the Balleny Islands. A landing in breaking surf, on a submerged pebble-strewn beach, below ice cliffs was effected by Captain Freeman of the *Sabrina*, and a few pebbles of volcanic rock were collected.

The voyage was continued west maintaining a latitude as far south as the pack-ice would allow. On 2nd and 3rd March they thought they saw land beyond the pack-ice. They were then in latitude 65° 10' S. and 117° E. longitude. Their report has been vaguely recorded on the chart as Sabrina Land. Three weeks later, whilst making a long slant west and north from the ice towards Cape Town, the *Sabrina* was lost with all hands during a gale.

The spectacular voyages of Wilkes, d'Urville and Ross in this same area, commencing in the year following Balleny's voyage, tend to detract from the credit that is due to one who was undeniably a fine navigator and who located the pack-ice edge, as defined in the summer of 1838-39, through 62° of longitude, thus in some degree forestalling the big expeditions immediately following.

The Early Scientific Explorations of Modern Times.

Balleny's achievement was the last of the notable voyages of the early sealers. The stimulus that the exploitation of seal pelts and blubber oils had given to Antarctic exploration had run its course. Where the earlier circumnavigators had relegated to the pack-ice zone the *Terra Australis* of the speculative cartographers of the middle ages, the hardy sailors of the southern seal fisheries had continued the good work, pressing still farther south, amongst the pack-ice within sight of ice-clad land, since proved to be part of a real Antarctic Continent. Knowledge of that inhospitable region might have ended there, but for a new force rapidly developing in the civilized world between the years 1820 and 1840. The rising tide of Science had resulted in the foundation during this period of the principal geographical societies of western Europe, as well as other scientific bodies such as the British Association for the Advancement of Science (1831). In those now far-off days of 100 years ago, the virile growth of the youthful tree of knowledge was already unduly curbed for want of data from the vast South Polar void. The need for observations in high southern latitudes was felt most acutely in the department of terrestrial magnetism, the study of which had at that time reached a peculiarly important phase.

In 1837 proposals were advanced for a British expedition, specially equipped for magnetic observations, to visit the Antarctic Regions in the locality where theory indicated the South Magnetic Pole should lie. At the meeting of the British Association in 1838 the proposals were crystallized and the enterprise launched.

James Clarke Ross (afterwards Sir James), already famous for his explorations in the Arctic and his achievement of the North Magnetic Pole, was chosen to command the expedition. Whilst Ross's ships, the *Erebus* and *Terror*, were being equipped for the work ahead, two great expeditions of other nations were already in the field. These were, respectively, a French undertaking in two corvettes, the *Astrolabe* and the *Zélée*, commanded by Admiral Dumont d'Urville, and a squadron of five vessels despatched by the Government of the United States under Lieutenant Charles Wilkes as Commodore. Both these important expeditions were

designed for large-scale scientific explorations to be effected principally in the temperate and tropical zones of the Pacific Ocean. As part of their original plans, also, investigations were to be conducted in the Antarctic regions south of America, and in the case of Wilkes's expedition a cruise was to be conducted into the Antarctic to the south of Australia and the Indian Ocean. However, they both finally included in their scope of operations a diversion into the Antarctic regions to the south of Hobart. The addition to their Antarctic programmes of this latter region was doubtless owing to the fact that about that time that locality began to loom importantly in the scientific mind, for the great mathematician, Gauss, had assumed, on the basis of theoretical considerations, that the South Magnetic Pole was to be found in approximately latitude 66° S. and longitude 146° E.

The French expedition during the early months of 1838 operated in the Antarctic south of Cape Horn. Their work centered around the South Shetland and adjacent islands. The charts were improved and enriched in detail, and some entirely new features incorporated.

The following year Wilkes arrived at that locality, but too late in the season (March) to accomplish anything of great geographic importance. Some detail was added to the chart in the neighbourhood of Palmer's landfall; also two of the squadron, the *Peacock* and *Flying Fish*, made a long run to the south-east towards the spot where Cook had made his farthest south, but they were not able to penetrate so far.

After executing valuable researches amongst the Pacific Islands, both the French and American expeditions appeared in Australian waters in the summer of 1839 and sailed south to the region for the investigation of which Ross's expedition was also being equipped.

The French expedition, on 19th January, 1840, came within sight of new land on the Antarctic Circle in the neighbourhood of longitude 140° E. On the 21st some of the party landed and raised the tricolour on a rocky islet situated 500 or 600 metres from the shore of the mainland, which appeared to them to be unscaleable. This very important discovery, d'Urville's *Terre Adélie*, which has since been proved to be part of the Antarctic Continent, was traced by d'Urville through at least 5 degrees of longitude. Efforts to trace the high ice-covered land farther to the west were frustrated by a congestion of pack-ice and bergs which drove their vessels far to the north out of sight of land. Since what they did do was well done, it is to be regretted that they remained only a fortnight within the ice zone. Immediately on return to Hobart, d'Urville caused to be inserted in the *Hobart Town Courier and Van Dieman's Land Gazette* (11) an official account of their discovery as an advertisement advising their territorial claims. The new territory is there described as follows:—

La partie reconnue, d'environ 150 milles d'étendu est comprise entre le 66° et 67° degré de latitude Sud d'une part; entre 136° au 142° degré longitude E. de l'autre.

Four of Wilkes's vessels proceeded south from Sydney late in December, 1839. They reached the pack-ice zone not far from the longitude of the Balleny Islands, which, though unbeknown to Wilkes at the time, had been discovered by the sealing captain Balleny during the previous summer. They planned to work their way west as far as the 100th meridian, keeping as high a southern latitude as possible. Several of the vessels suffered severely from storm and ice, but two succeeded in executing the full programme. Their craft, propelled by sail alone, could not attempt to drive through the pack-ice. Consequently their track was that of the northern margin of the pack-ice. Only in one locality was the pack-ice so far absent that one of the vessels could sail right up to land. This was off the Adélie Land coast which d'Urville had reached a few days earlier. Much further to the west, in about longitude 107° E., Wilkes

approached very closely to new ice-covered land which he called Knox Land, also situated in the neighbourhood of the Antarctic Circle. In addition to these two new land discoveries, the record of the voyage includes reports of appearances of land, and the sighting of land at many other points along their route, to the west. That some of these appearances of land were distorted views of distant cloudbanks or floating ice formations appears certain. The subject has been the cause of much controversy, even to this day (12). A careful inquiry in the light of present knowledge (13) of that very region traversed by Wilkes, after making every allowance for exceptional conditions of the atmosphere concurrently with abnormally favorable mirage conditions, appears to indicate that it is possible that Wilkes did see land in two other localities, namely, between $110\frac{1}{2}$ and $112\frac{1}{2}$ degrees of east longitude, which he refers to as Budd's Land, and again about longitude 127° east, a portion of his North's Land. It seems to me, however, that there is but a slender prospect that Wilkes did actually see land even in those localities. Wilkes seems to have been over-ready to accept appearances of land as definite land, and then upon such acceptances to conjure up a continent.

It is true that Captain Cook, after his long circumnavigation of the south Polar regions, though he failed to find a continent extending beyond the ice, inferred from the nature and distribution of the floating ice that a considerable land mass, perhaps a continent, existed within the pack-ice zone.

In the case of Wilkes, it is to be noted that on the eighth day after reaching the Antarctic pack-ice in the Australian sector, at a time when he had recorded merely several isolated and distant appearances of land, he referred to the "Continent"* in view at the time (14). He was then unaware of any other Antarctic land discovery within 2,300 miles, nor had he made a single sounding in the region where no soundings had ever been made.

Again, a few days later, when in longitude $147^\circ 30' E.$, the pack-ice prevented his reaching what he took to be distant ice-covered land, he writes, "We were again foiled in our endeavour to reach the Antarctic Continent." Wilkes's use of the term in this loose fashion indicates that either he was not aware of what the term Continent connotes, or else his mind was already made up by a pre-conceived notion of the existence of such a continent. Anyway, his use of the term was premature.

Wilkes (*ibid* p. 329) enumerates arguments supporting the assumptions of a large land mass within the ice-bound area. A principal general consideration advanced is practically the same as that which Cook promulgated 65 years earlier. Even at the conclusion of the cruise, Wilkes had advanced but a stage further the argument for a continent within the ice.

*An argument that has been advanced to strengthen Wilkes's case for discovery of a continent in the Antarctic relates to soundings. It has been stated (12):—"By a number of soundings he (Wilkes) was able further to prove that a continental shelf lay along its front." I have searched Wilkes's records for soundings, and can locate that the squadron got bottom only in two localities. Once when in a small rock-bound bay, Piner's Bay, on the coast of Adelle Land, the *Vincennes* found bottom at 30 fathoms. The other case was when the *Peacock*, on the 23rd and 24th January, 1840, was standing W.N.W. of their Cape Hudson, near the meridian of $153^\circ E.$, they got bottom in three separate shoots of the sounding line, respectively at about 500, 320, and 800 fathoms, all within about 15 miles of each other. In his record, Wilkes repeatedly complains of the inadequacy of their sounding equipment.

Another argument advanced in support of Wilkes's assumption of the existence of a continent is that the numerous rock fragments they collected from icebergs were found to be predominantly continental in character. This is so, but such were sighted and collected only in one limited locality, off Knox Land, at the extreme western end of their cruise, and weeks after the term "continent" had been adopted in the report of the cruise.



In addition to his land discoveries, Wilkes was successful in defining the edge of the solid pack-ice, as it appeared in January, 1840, through 65° longitude in the neighbourhood of the Antarctic circle; also additional light was shed upon the climatic and other conditions existing in that, at that time, little known sector.

Ross, on reaching Hobart en route south, learnt of the exploits of Brille and Wilkes. Thus forestalled in the locality to which he had been heading, Ross decided to direct his efforts to new ground by sailing south somewhat farther to the east. There he succeeded in breaking through the pack-ice to open waters farther south—what is now known as the Ross Sea. They returned with an account of a wonderful mountainous coast, of volcanoes in a land of ice, and with considerable information regarding the life of the very far south. A landing had been made upon Possession Island, off the coast of the new mainland.

The following summer, after wintering in Australia and New Zealand, they again proceeded to the Ross Sea, and completed the outline of some 650 nautical miles of new coastline, and some 390 nautical miles of the face of the Ross Barrier in that region. The second winter was spent at the Falkland Islands, and a third summer campaign was conducted along Antarctic shores, south of the South Shetlands, and amongst the pack-ice of the Weddell Sea. In that region they made additions to the knowledge of the Trinity Land neighbourhood, and farther east in the neighbourhood of latitude 71° 30' S. longitude 15° W., they penetrated to within 56 miles of Cape Norvegia in the lately discovered coast of Princess Martha Land.

The expedition returned eminently successful in its mission. In the Ross Sea region alone, not only had they quite definitely outlined the coast of Antarctic land and of the land-ice of the Ross Barrier through 34° of longitude, but they had enriched the chart by securing many soundings. They had succeeded in determining, with great accuracy, the position of the South Magnetic Pole, though, as it was situated far inland, they had not been able to visit it. Also they had attained a farthest south record, having sailed to 78° 10' S. in longitude 161° 27' W. Ross had returned with the magnetic data of high southern latitudes around the South Polar regions, save in the sector south of the Indian Ocean. The Admiralty therefore resolved to despatch a small vessel with naval crew to complete the job. Thus Lieutenant T. E. L. Moore, in command of the *Pagoda*, proceeded south from Cape Town in 1845, and voyaged east in high southern latitudes, eventually arriving at King George's Sound, in Western Australia. This voyage, though conducted in the far southern seas, did not break new ground excepting perhaps for a mile or two at their farthest south, when they reached 67° 50' S. in about longitude 40° E., having just crossed Biscoe's track. Their track as charted shows that they approached within about 30 nautical miles of the coast of Queen Maud Land.

The Period of Averted Interest.

With a foundation so well laid it was unfortunate that the good work was not quickly followed up. Instead, there now intervened a period of 50 years without further really important contributions to the geography of Antarctica. This halt in the march of events has been referred to by Dr. Mill as the "period of averted interest."

During this time, war and other activities served to turn the current of public interest away from the South. Nevertheless there were those who, from time to time, pressed the claims of Antarctica. Of these in the earlier years of the period there were two outstanding personalities. The first was Captain Matthew Fontaine Maury, Superintendent of the

United States Hydrographic Department, famous for his *Physical Geography of the Sea*, who pressed for international co-operation in the exploration of Antarctica. The other chief advocate was Professor Georg von Neumayer, who later in life held the post of director of the Deutsche Seewarte at Hamburg. It was Dr. von Neumayer's enthusiasm for anything that bore on Antarctic research that led him to secure, for the study of terrestrial magnetism, the establishment of the old Flagstaff Observatory here in Melbourne. Whilst residing in Melbourne in charge of the observatory, Dr. von Neumayer exerted a considerable influence in fostering interest in the frozen regions. Such advocacy was then timely, for the association of Australia and New Zealand with the far south during the boom period in sealing and southern whaling had ceased with the waning of the industry, which followed upon the discovery and exploitation of the petroleum oil fields of America, and the virtual extermination of the Southern Fur Seals and Right Whales.

During the period of averted interest there were garnered, nevertheless, some minor discoveries and scientific records.

Of such may be mentioned the sighting of Heard Island in 1853 by Captain Heard, master of an American merchant vessel. About that time also a British vessel sighted another Subantarctic island near Heard Island, now known as McDonald Island. Later, in 1874, the great *Challenger* Expedition, despatched from England to carry out an oceanographical programme throughout the seas of the world, reached latitude 66° 40' S. in longitude 78° 22' E., a new area,* and thus brought the first throb of steam power within the Antarctic Circle. That same year a German steam whaling vessel, under Captain Dallmann, revisited and effected some improvements in the charting of the haunts of the early sealers to the south of Cape Horn.

At a meeting of the British Association for the Advancement of Science held at Aberdeen in 1885, a strong committee was formed "for the purpose of drawing attention to the desirability of further research in the Antarctic regions."

About this time the people of Melbourne were thoroughly awake to the importance of forwarding the cause of Antarctic exploration. The Victorian Branch of the Royal Geographical Society of Australia and the Royal Society of Victoria took up the cause, appointing a joint Committee in 1886. After deliberations extending over seven months, the Committee addressed a report to the State Government (15). Included in their statement is the following:—"Your Committee, in reviewing the position, feels strongly the great advantages to be secured by losing no time in prosecuting researches in the South Polar seas. The proximity of Australian ports gives these colonies a great facility for securing a share in the lucrative Antarctic whaling and sealing trade. To neglect these any longer would be not only to forgo handsome commercial profits, but to abandon also our natural maritime interest in these southern seas, and all the great advantages in relation to the Antarctic regions of our unique geographical position." As a result the Victorian Government promised liberal premiums to sealers or whalers landing in Victoria cargoes procured south of 60° S. latitude. This encouragement was followed by an offer of £5,000 towards the expense of a British expedition. Eventually, by 1891, the official grants promised, together with amounts privately subscribed, reached the sum of £15,000, which was considered about sufficient for the

* Our recent investigations in that same area have established that the *Challenger* had penetrated to a belt of grounded bergs off the coast of high land which has been named Princess Elizabeth Land.

prosecution of a voyage of scientific investigation to the Ross Sea. But the end came swiftly, for, before the undertaking was finalized, the Australian Colonies were embroiled in the most acute financial crisis of their history.

In the United Kingdom the British Association Committee, further strengthened, continued to press the matter, but nothing on the scale hoped for immediately eventuated.

In 1892 Arctic steam whalers, chiefly from Dundee, visited the Weddell Sea region, but they did not effect any important addition to the map. Though the economic outlook was not encouraging, and largely owing to Captain C. A. Larsen's keen interest in exploration, the *Jason*, of the Oceana Company of Hamburg, accompanied by two other whalers, returned the following year. On that occasion the ice conditions were very favorable and they sighted new land, Foyn Land, and otherwise extended further south the knowledge of Antarctica in the American sector. Captain Larsen, in the *Jason*, penetrated as far south as 68° 10' S. on the east side of the island chain of West Antarctica, whilst the other vessels, the *Hertha* and *Castor*, reached 69° 10' near Alexander Land on the Pacific side. The following year, 1894, Mr. H. J. Bull, a Norwegian who had been resident in Melbourne for some time and was fired with the local enthusiasm in Antarctic matters then prevailing, induced the veteran Norwegian whaling magnate, Svend Foyn, to despatch a ship to the Ross Sea to investigate the whale fisheries. Proceeding south in the *Antarctic*, Bull revisited some of the Ross Sea region explored by Ross. A landing was effected on Possession Island and at Cape Adare, the latter event being memorable as the first occasion that a human foot had been set on any part of the actual mainland of the continent.

Recent Scientific Explorations.

In the year 1895 the International Geographical Congress met in London. The claims of the Antarctic regions were strongly pressed, and a resolution passed urging all nations to undertake a share of the work. The President, Sir Clements Markham, devoted himself to the launching of a British National Expedition, but several years were to elapse before the undertaking took form.

In the meantime a Belgian expedition, under Lieutenant Adrien de Gerlache, took the field. Their vessel, the *Belgica*, steamed south from Cape Horn. They added to and improved the charts of the Pacific shores of the Antarctic island archipelago. Eventually pushing south and west, they became frozen into the pack-ice and drifted helplessly during the winter of 1898, touching as far south as 71° 31' S. and as far west as 103° W. longitude. Gerlache's party were the first human beings to experience an Antarctic winter. They did not break out of the ice until the 14th March in the following year. Though they did not add much to the map in the nature of new coast-line, the results of the expedition greatly enriched knowledge of that region.

As the Belgian expedition was returning, a British expedition financed by Sir George Newnes had taken the field in the Australasian region. This was commanded by C. E. Borchgrevink, a young Norwegian who had taken up residence in Australia and who had already visited the Ross Sea, signed on as a member of the crew of Bull's whaling expedition. Borchgrevink's ship, the *Southern Cross*, was directed to Cape Adare, which was reached on 17th February, 1899. There a wintering party was landed, the ship returning to New Zealand. This expedition has the distinction of having been the first to spend a winter on the Antarctic Continent.

The following summer the party was relieved by the *Southern Cross*, which then proceeded down the coast of Victoria Land, and along the face of the Great Ross Barrier to near its eastern limit, where a landing was made. A sledge journey of a few miles, south over the Barrier, secured them a farthest south record of 78° 50' S. This expedition added detail to Ross's chart, and secured a harvest of scientific facts relating to the land and climate.

In the last years of the nineteenth century a very important oceanographical expedition in the *Valdivia* was despatched from Germany. It was mainly concerned with investigations in lower latitudes, but comes under notice here in that they relocated Bouvet Island and fixed its position with accuracy. Their work was conducted as far south as latitude 64° 15' S. in longitude 54° 20' E., which position was reached on 16th December, 1898. They were then within 97 nautical miles of Cape Batterbee, the most northerly point of Enderby Land.

Prior to the departure south of Borchgrevink the Royal Society of London held an Antarctic conference to discuss the merit of pressing forward further explorations (16). Many of the leading geographers of the period were present. The principal oration was delivered by Sir John Murray, of *Challenger* fame, who ever since that memorable voyage had advocated continuance of investigations in the far south. In the course of his address, when contrasting the North with the South, he said: "In the Southern Hemisphere there is, almost certainly, a continent at the South Pole which is completely surrounded by oceans, and in those latitudes the most simple and extended oceanic conditions on the surface of the globe are encountered."

Following Murray, Dr. Frithjof Nansen stated he "doubted whether Dr. Murray's theory of a continuous continent was correct, possibly there was only a number of groups of islands."

The probability that Nansen's view, thus expressed, was the correct one was, some thirteen years later, put to me in a personal communication by Sir Clements Markham. In the year 1911, as we were setting out for the south, he expressed his belief that we would find, not continuous rocky land, but only islands cemented by ice accumulations. Thus, the continent within the ice, conjectured by Cook, was not confirmed until recent times.

During the years 1899-1900, a joint committee of the Royal Society and the Royal Geographical Society in London pressed the cause of a national expedition and eventually succeeded in securing the necessary funds from public and private sources. A strongly constructed vessel was specially built at Dundee for the work and named *Discovery*. A naval lieutenant, R. F. Scott, was placed in command of the expedition at the head of a fine personnel, largely naval with some merchant service and scientific members of staff. The *Discovery* spent the summer of 1901-2 exploring the Ross Sea. Late in the season she was moored at a location at the head of McMurdo Sound, selected as a wintering station. From this base exploratory operations were extended far and wide.

The bay ice still remained frozen throughout the next summer, and it was not until the summer of 1903-4 that the ship was freed and able to return home with a splendid record of discovery.

The success achieved by this expedition is a classic and resulted in an immense forward advance in knowledge concerning the far south. The broader features of their geographic achievements were the following:— By observations from the ship detail was added to charts of the Ross Sea coast, and King Edward Land east of the Ross Barrier was discovered; by means of sledging journeys from the wintering base at McMurdo Sound surveys were made of a very considerable area of mainland and off-lying islands of the land margin on the western side of the Ross

Barrier for a distance of about 380 miles south of their winter quarters. Also by journeys extended far across the Ross Barrier they were able to throw much light upon the nature and genesis of that, at that time, uncertain feature. Finally, by scaling the high mountains of the mainland, and then sledging due west at an elevation of eight or nine thousand feet above sea level, over the high icy plateau of Antarctica, to longitude 146° 33' E., they demonstrated, for the first time, the character of the interior of the Antarctic mainland.

Captain Colbeck in the *Morning*, a relief vessel bringing supplies to Scott's vessel, discovered Scott Island, which lies at the entrance to the Ross Sea about 310 miles north-east of Cape Adare.

While the British were busy in the Ross Sea, expeditions of other nations were also afoot. A splendidly equipped and manned national expedition had gone forth from Germany in the *Gauss*, a vessel specially constructed to withstand ice pressures. Professor Erich von Drygalski, who had already seen service in Greenland, was appointed in command of the expedition. The unknown region between Wilkes's Termination Land and Enderby Land, lying south of Kerguelen Island, was selected for attack. In the summer of 1901-2, after landing a subsidiary co-operating party at Kerguelen, the *Gauss* proceeded further south to the pack-ice in the neighbourhood of 92° E. After some days working a way south through the ice the ship finally became firmly frozen in a position several miles south-west of the intersection of the 66th degree of S. latitude and the 90th degree of E. longitude. There the ship remained held in place by grounded bergs, until the following summer, when it gradually drifted with the pack-ice until released late in the autumn.

The scientific programme of Drygalski's expedition was well executed and yielded results of the highest order. Oceanography was a feature of their work. In the matter of land discoveries they also added detail in a blank region of the map. From a captive balloon ascent above the ship when frozen into the pack, ice-covered land of uncertain character was seen at a distance to the east-north-east (mapped by our subsequent expedition as Drygalski Island). At about 45 miles to the south an extensive ice-covered highland, which they named Kaiser Wilhelm Land, was observed. An extinct volcano peak, Gauss Berg, was subsequently visited by sledging across the intervening frozen pack-ice during the winter.

An important Swedish expedition, organized by and in command of Dr. Otto Nordenskjöld, reached the Antarctic in the summer of 1901-2. The region selected for investigation was the Antarctic land chain south of Cape Horn referred to by Nordenskjöld as West Antarctica. A party of scientists was landed and a hut erected on Snow Hill Island in 64° 25' S. latitude. A splendid scientific programme was executed extending over two years, for their vessel, the *Antarctic*, under Captain C. A. Larsen, was crushed by the ice when trying to relieve them at the end of a year. Final relief did not come for two years. They greatly improved the maps of the localities visited and added new land to the map under the title of King Oscar Land.

A well planned Scottish expedition in the *Scotia* was organized and led by Dr. W. S. Bruce, a naturalist who had already accompanied various expeditions to the Arctic and Antarctic. The *Scotia* spent the summers of 1902-3 and 1903-4 pushing south amongst the pack-ice of the Weddell Sea. One of the South Orkney Islands was selected as a wintering base. A first-class scientific programme, including oceanography, was duly executed. A fine stretch of undulating ice-clad land, which they named Coats Land, was discovered on the east side of the Weddell Sea at about 74° S. latitude. As this was the first land found within wide limits in that region it constituted a very important discovery.

About this time Dr. Jean Charcot, the famous French scientist and explorer, contributed considerably to the detailed charting of the island chain of West Antarctica, and sighting a new coast line named it Loubet Land. In his vessel, the *Français*, he spent two summers and the intervening winter of 1904 in that region.

At the Eighth International Geographical Congress held in New York in 1904, the success of the various Antarctic expeditions of the opening years of this century resulted in the recording of a resolution urging the continuance of Antarctic exploration whilst men already experienced in the work were still available.

Fortunately there was practically no delay in the continuation of the work, for Lieutenant Ernest Shackleton, formerly a member of the staff of the *Discovery* expedition, secured sufficient financial assistance to purchase a small vessel, the *Nimrod*, and sailed for the Ross Sea in 1907. The Australian and New Zealand Governments contributed substantially to the cost of this expedition. Furthermore, the scientific personnel of the party was strengthened at the last moment by the addition of Australian members. Most notable was the inclusion of Professor T. W. E. David (afterwards Sir Edgeworth), who acquitted himself magnificently in the south and contributed notably to the success of the enterprise. The recent passing of this grand old man of Australian science has left a real gap in our ranks, for he twice held the office of President and has always been a tower of strength to this Science Association.

Shackleton's avowed object was the attainment of the pole. The ship was to act as transport to convey a hut and wintering party to the Ross Barrier. A wintering station was to be established near the eastern limit of the Barrier, where a low stretch of the ice front had been observed during the cruise of the *Discovery*. However, on arriving at that spot, now known as the Bay of Wales, Shackleton had misgivings as to its suitability as a location for a wintering station.* After consultation with some members of the party, his plans were changed. The ship was turned west and his land base established at McMurdo Sound.

Considering the limited staff and facilities for scientific work, the results achieved by the expedition were very notable. The outstanding event was the attainment of a high southern latitude, actually within 97 geographic miles of the Pole, a record for proximity to the spinning axis of the earth not even, at that time, attained in the Arctic. Several hundred miles of mountainous coastline beyond Scott's farthest south were charted, evidence gained as to the southern limit of the Ross Sea, and the plateau nature of the polar locality established. Other parties made respectively the first ascent of Mt. Erebus (13,200 feet) and a sledge journey to the South Magnetic Pole. In the course of the latter, improvements and additions were effected to the charts of portion of the coast of Victoria Land and the plateau region of the interior.

Dr. Charcot set out on a second Antarctic Expedition in 1908, in a small, well-found vessel, the *Pourquoi Pas?*. He visited his old haunts on the

*It is interesting to note that it subsequently transpired that the Bay of Wales is eminently suited as a locality for a wintering base, and had Shackleton not changed his original plan, but landed there, he should have succeeded in reaching the Pole. Had the *Nimrod* been discharged on the ice surface of the Bay of Wales, the whole of the eight Manchurian ponies that had survived the rough sea passage down would have been available for transport on the southern journey. As it was, half of them died as a result of eating volcanic gravel when later tethered on the foothills of Mt. Erebus. Further, the Bay of Wales is quite 60 nautical miles nearer the Pole and in a region of infinitely better weather conditions than where winter quarters was established at Cape Royds, McMurdo Sound. Again, the open water of the Sound cuts off Cape Royds from communication with the south in the late summer and autumn, whereas at the Bay of Wales the way is free for laying depots to the south at all times.

Pacific coast of the Archipelago of West Antarctica, and discovered Fallière Land and Charcot Land further to the south in the same island chain. He then cruised far to the west along the pack edge in a high southern latitude, eventually reaching as far as 118 deg. 50 min. W. in latitude 70 deg. S. Very valuable oceanographic and other scientific data were secured.

Before Shackleton returned, Scott was again making elaborate preparations for a well-equipped expedition to proceed south in 1910. The attainment of the Pole was to be the central object, but the prosecution of a complete scientific programme was also a main platform of the expedition.

At the same time, the already famous Norwegian explorer, Roald Amundsen, was equipping an expedition which, it was believed, was to sail in the *Fram* for the North Polar Seas. However, shortly after the vessel set sail, the world and Captain Scott were advised that they were heading for the South Pole, though nothing was said as to where in Antarctica a landing was intended. Amundsen selected as a landing and wintering station the Bay of Whales in the Ross Sea. He had evidently assessed the suitability of the locality from published descriptions of the area. In doing so he accepted a risk that had not appealed to his predecessors. However, it turned out to be most suitable; with many factors, particularly climate, in its favour. Employing dogs for transport, Amundsen's party reached the South Pole on 14th December, 1911, the first human beings to arrive at that remote spot, forestalling Scott's party by 34 days. The sledging operations were conducted in a masterful fashion and in no way strained their resources. A subsidiary party sledged to King Edward Land. Little general scientific work was attempted on this expedition, but a new region leading to the pole, including an extension of the high mountainous coastline, which Amundsen named Carmen Land, was placed on the map. Also knowledge of the extent of the Ross Barrier was greatly advanced though no south-eastern limit was yet assigned to it.

Returning to Scott's adventures, his ship the *Terra Nova* reached the Ross Sea in the summer of 1910-11. After landing the main party at McMurdo Sound, the ship proceeded east along the Ross Barrier to effect the landing of a subsidiary party to explore King Edward Land in accordance with their published programme. Great was their surprise to find Amundsen's party establishing winter quarters at the Bay of Whales. Plans were changed accordingly, and Scott's subsidiary party was landed at Cape Adare. The scientific programme of Scott's expedition was very complete and highly successful. The Polar sledge party was also successful in reaching its goal, but Scott and all his sledge party perished on the return journey. From a national viewpoint, the immortal story of their efforts in the face of adversity is one of the richest results of the expedition. Corrections and additions of details were effected in the chart of the Ross Sea coast and about 140 miles of new coastline of the mainland sighted. This latter discovery, named Oates Land, lies west of Cape Adare.

A Japanese expedition under Lieutenant Shiraze which visited the Ross Sea at this time did not effect any new geographical discoveries.

Even prior to 1910 the question had been raised of the possibility of the continuance of the waters of the Weddell Sea through to the Ross Sea below a floating sheet of ice. In order to investigate this matter, Lieutenant Filchner, with a competent staff, set out from Hamburg in 1911 on board the *Deutschland*, a vessel well fitted for ice work. They were successful in reaching a record high latitude in the Weddell Sea, namely

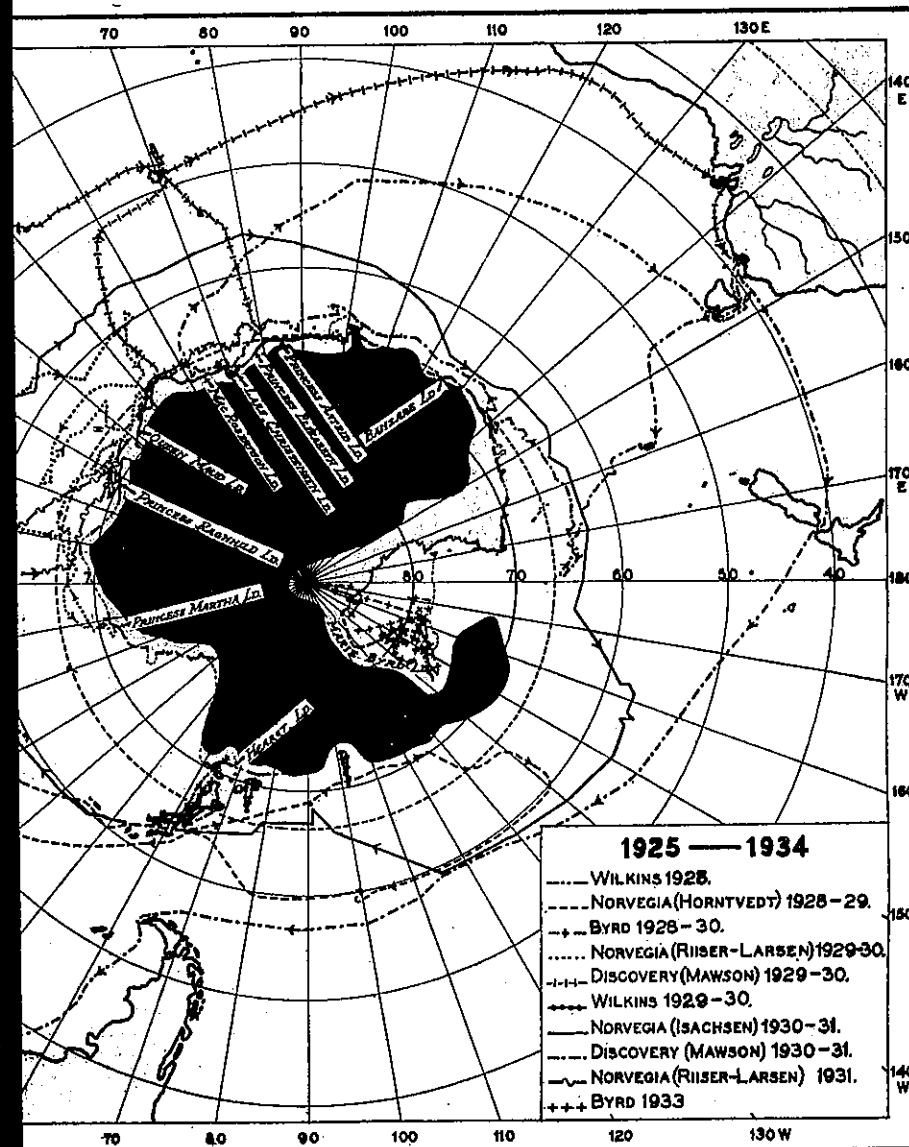
77° 45' S. There they had come to what is evidently the head of navigation in those waters, but probably attainable only in favorable seasons. They discovered a high ice-covered land, promptly named Prince Luitpold Land, forming the eastern shore of the Weddell Sea. Extending from the land to some distance to the west, as the southern limit of the Weddell Sea, a floating barrier-ice formation like that of the Ross Sea was observed. Filchner's intention was to winter upon and explore this important discovery. In this, however, they were disappointed, for after they had landed hut timbers and stores upon what appeared to be permanent ice, it suddenly broke up and drifted away. Then their ship became frozen into the pack and drifted helplessly north during the ensuing winter, until liberated, fortunately without serious damage, the following summer. During the drift, a short sledge journey over the frozen pack-ice to the west in search of Morrell's fictitious New South Greenland was undertaken. No trace of land was found.

Next in order came the Australasian Antarctic Expedition of 1911-14. After returning from the Shackleton expedition in 1909, plans for continuing exploration in the region immediately south of Australia were formulating in my mind. The plans were formally brought forward at the Sydney meeting of this Association in January, 1911. The main feature proposed was the simultaneous operation of several shore parties wintering at suitable intervals apart.

Largely through the advocacy of the then President, Sir David Orme Masson, and with the support of Sir Edgeworth David, who was then absent in England, the Science Association gave the undertaking its full approval. An Antarctic Committee was appointed, and one-third of the entire capital of the Association was voted, which definitely placed the hallmark of Science upon the proposals. The necessary funds were eventually secured from private and government sources. The vessel *Aurora* was purchased. In the summer of 1911-12 three parties were landed: one on Macquarie Island, chiefly as a weather station and "wireless" connecting link with the Antarctic, and two others on newly discovered Antarctic shores named respectively King George Land and Queen Mary Land. As a repercussion of Amundsen's invasion, the landing of a party at Cape Adare, which was part of the original plan, had to be abandoned as it was already occupied by one of Scott's parties. The newly-discovered lands were explored by sledge journeys, one of which carried knowledge of the Antarctic plateau 300 miles to the south near to the Magnetic Pole. The ship's party, under Captain J. K. Davis, also located new land which was charted as Wilkes Land.* The geographical

*My action in naming this section of coast "Wilkes Land" was solely prompted with the intention of honouring Wilkes, who had named several of his landfalls after officers of his staff, but, of course, none after himself. Having satisfied ourselves that we had met a coastline which certainly was not sighted by Wilkes's Expedition, his name was attached to it. For this I have recently been criticized in America on the grounds, firstly, that Wilkes had seen this part of the coast, and, secondly, that the term Wilkes Land has appeared on many maps, for long past, signifying the whole of the region between 100 deg. E. and about 160 deg. E. longitude. The accusation is that by attaching Wilkes's name to a section of the whole of that area, which some maps record as Wilkes Land, a negative compliment is being paid to Wilkes.

My view-point has been, firstly, that evidence is conclusive that Wilkes did not sight the coast we charted as Wilkes Land. Secondly, the appearance of the words "Land reported by Wilkes" or in other cases "Wilkes Land" over the wider areas in some maps was intended to convey the fact that there was the sector through which Wilkes believed continuous land to exist within the pack-ice. As, however, the record of his cruise in no way definitely established the continuity of land through that sector, and as a portion of it already had the prior title "Adelie Land," it had not appealed to me that the application of the title Wilkes Land as a geographic term could be correctly applied thereto. I should still like to honour Wilkes if I may.



addition to the map amounted to about 1,000 miles of new coastline. A wealth of scientific information was secured by the staffs at each of the land bases, and from the ship abundant soundings and dredgings were effected. As a consequence, knowledge of the whole of the formerly vague sector 155 degrees to 90 degrees east longitude was put on a sounder basis. By examination of the lands located, and by soundings made in the seas around this sector and by inferences drawn from the examination of dredged bottom deposits, there was left little doubt that there extends from the Ross Sea to beyond Gaussberg a continuous land mass. However, the ship was not able to come within sight of a very considerable length of the coast thus anticipated. After operations extending over three summers and two winters, the Expedition returned just as the Great War broke out. This event was catastrophic in that it eliminated the means both of adequately financing and rapidly producing the reports of the Expedition. A brake was imposed upon further Antarctic exploration for some time.

However, Sir Ernest Shackleton was just on the point of sailing south on his second expedition as hostilities began. Notwithstanding this extraordinary circumstance he was ordered to proceed. His main party in the *Endurance* was bound for the southern Weddell Sea. From there it was planned that a land party should cross Antarctica by way of the Pole, and be picked up at McMurdo Sound by a supporting party which was to proceed south from Australia in the *Aurora*.

Alas! after sighting new coast, the Caird Coast, between Coats Land and Prince Luitpold Land, on the eastern side of the Weddell Sea, the *Endurance* became frozen in and drifted helplessly during the winter until crushed and finally sunk on 21st November, 1915. The story of the escape of the party from the disintegrating floe to an asylum on Elephant Island and of Sir Ernest Shackleton's boat journey to South Georgia in search of help is an epic. The drift of the *Aurora* in the pack-ice of the Ross Sea during the winter of 1915, after breaking from her moorings at McMurdo Sound, was also a startling adventure.

Soon after the cessation of hostilities Shackleton again began preparations for a further adventure. He sailed on his third expedition on 21st September, 1921. His vessel, the *Quest*, 125 tons, was very small for the work. The proposal was to proceed south-east from South Georgia and explore the sector between Coats Land and Enderby Land. Unfortunately Sir Ernest Shackleton died suddenly whilst the *Quest* was in harbour at South Georgia. The voyage was continued in charge of Commander Wild, formerly second in command. In a shoaling sea the *Quest* reached a farthest south in latitude 69° 17' S. and 17° 9' E. long. The pack-ice everywhere stemmed them off from further approach towards possible land. It is now known that they were then within 30 nautical miles of the coast of Princess Ragnhild Land as charted by the Norwegians.

This brings us to the end of that section of modern scientific exploration in Antarctica which Hayes (17) refers to as the "Heroic Era," and still leaves for review Hayes's "Mechanical Era," in which aviation and tractor sledges figure importantly.

The next important advance in Antarctic geography was made by Sir George Hubert Wilkins, a South Australian, who had already earned fame in the Arctic regions. Wilkins's special interest lay in the sector south of the Pacific Ocean, between the Weddell and Ross Seas. He, for the first time, employed with success aviation as a means of exploration in the Antarctic. In 1928 he, in company with Lieutenant Eilson as pilot, set out on a venture sponsored by the American Geographical Society. Two planes were transported to the whaling station at Deception Island of the South Shetlands, which was adopted as a flying base. On 20th December they set off on a very notable non-stop flight of ten hours' duration, which took

them to 71° 20' S. latitude and 64° 15' W. longitude and back to their base. In the course of this flight they had crossed over the high tableland of Graham Land* (Trinity Land) to the Weddell Sea side and there proceeded south along the land chain, discovering it to be merely an archipelago of islands. Near the southern limit of their flight, the island chain was found to be attached by fast ice, in part shelf-ice, to extensive ice-capped land, which Wilkins named Hearst Land, and which is in all probability part of the Antarctic Continent.

This splendid advance in knowledge of West Antarctica was, with the financial assistance of the British Government, followed up by Wilkins the next year. On this occasion his plane was transported south from Deception Island by the research vessel *William Scoresby*. Taking off from the water, several exploratory flights across the pack-strewn seas were made that season. One flight proved Charcot Land to be an island, and located a mainland extension of his Hearst Land situated further to the south.

Another important flight made on 1st February, 1930, south across the pack-ice for about 200 miles from the ship in 70° 10' S. and 100° 45' W., did not penetrate to land. In his several flights Wilkins had used aviation with good effect and accomplished a fine piece of work.

In the person of Rear-Admiral Richard E. Byrd, who had already achieved the North Pole by air, the United States was splendidly represented in Antarctic exploration at this time. The expedition, which was on a grand scale, had for its main object the attainment of the South Pole by air. It had also in view a background of general exploration in the unknown region east of the Ross Barrier. In two vessels, the *City of New York*, 515 tons, and the *Eleanor Bolling*, 800 tons, and with the assistance of one of the whaling factory ships, the expedition landed and built at the Bay of Whales quite a township of structures to be known as Little America. There the land party wintered in 1929. In the preceding autumn and the succeeding summer large-scale explorations were conducted by air and by dog team. Land was found to extend far to the east and south of Scott's King Edward Land. That to the south of the latter was named Scott Land, whilst extensive high, mountainous, ice-clad country east of the 150th meridian was named Marie Byrd Land. Far to the south an extension of the great mountain system, bounding the head of the Ross Barrier, was discovered and mapped. In addition to all this new geographical discovery and a magnificent 19-hour flight from Little America to the Pole and back, valuable detailed cartographical, geological and other scientific work was accomplished by air and by dog sledge in this difficult region.

At this stage modern whaling enterprise in Antarctic waters began directly and indirectly, to make itself felt as an important agency for extending geographical and oceanographical knowledge of that region. The whales so numerous in the cold Antarctic waters are the Blue and Finner whales, too powerful to be taken in the old-fashioned way. The modern whaling method developed by the Norwegians for the taking of these whales, utilizing explosive harpoons fired from a powerful gun mounted in the bow of small fast steam craft, has revolutionized the industry in Antarctic seas.

The beginning of the modern phase of Antarctic whaling dates from the first few years of this century, and in those days was centred in South Georgia and the South Shetland Islands. By 1920 the industry had grown to very large proportions, and the question of its permanence was

*The Admiralty chart still adopts the name Graham Land for this large island mass part of which, it was believed, Biscoe sighted in 1832 and named after the then First Lord of the Admiralty. More recently it has been clearly demonstrated that Bransfield was the first to sight part of this island, which he charted in 1821 as Trinity Land in compliment to the Trinity Board. On the basis of priority "Trinity Land" has displaced "Graham Land" on some maps.

exercising the minds of those interested in its maintenance. With a view to the promulgation of measures of control of the industry, investigations into all that relates to the existence of the southern whales were instituted under the direction of a Government interdepartmental committee in London, known as the "Discovery Committee." The old *Discovery* of Scott's first expedition was acquired and fitted for prosecuting these investigations in the southern seas. Later two other vessels were added. By means of this fleet a continuous programme of oceanographic research has, during the last ten years, been prosecuted in the Southern Ocean and extended into the Antarctic. The operations of the whalers and of "Discovery Investigations" under direction of Dr. Stanley Kemp have gradually accumulated a vast amount of oceanographic and other scientific data concerning the far south.

Reference must now be made to the operations of the Norwegian whalers (18). It is to be noted that Mr. Chr. Christensen and his son Consul Lars Christensen, pioneers and commercial magnates in Antarctic whaling, have been referred to as Norwegian Enderbys, on account of their interest in furthering the exploration of Antarctica. An extended programme of Antarctic exploration was inaugurated by Lars Christensen in 1927, for which work a small wooden vessel, the *Norvegia*, 285 tons, was fitted out.

During the summer seasons 1927-28 and 1928-29, visits were made to Bouvet Island and Peter I. Island. The first, as we have seen, was a French discovery, but rediscovered and first landed upon by a Britisher, the second was a Russian discovery. Both were promptly annexed for Norway. For the summer campaign of 1929-30, two of Norway's leading aviators, with efficient aeroplanes, accompanied the *Norvegia* on an extensive exploratory cruise south from Bouvet Island. Commander H. Riiser-Larsen, who had accompanied Amundsen on his Arctic flights, was in command of the *Norvegia* on that cruise. It subsequently transpired that one of their objectives was to raise the Norwegian flag on Enderby Land. On 22nd December, 1929, Riiser-Larsen and his assistant aviator, Captain Lutzu-Holm, the *Norvegia* being held off by the pack-ice, flew from her to the coast, and landing in a lane of open water raised the Norwegian flag on what appears to have been grounded ice, or an ice-covered shoal or islet, not far from the ice-cliff coast of the land. We of the B.A.N.Z.A.R. Expedition, also in those waters at that time, arrived in the *Discovery* three weeks later, and took formal possession for the British Crown of Biscoe's discovery* and other land to the east which we had discovered during the previous month. The Norwegian Government, upon representation from His Britannic Majesty's Government, requested, by radio, their explorers to take no further action in regard to Enderby Land.

Throughout the cruise, the *Norvegia* had as a supporting mother-ship the whaling factory ship *Thorshammer*. They were thus able to reconal and re-provision at frequent intervals, allowing their exploratory operations to continue throughout the entire season. In the later season, when working west along the pack-ice from Enderby Land towards Coats Land, they made a number of flights across the pack-ice to within sight of two extensive stretches of new coast line. That west of Enderby Land was named Queen Maud Land. The other area extending north-east of Coats Land was styled Crown Princess Martha Land.

The following year, 1929-30, the *Norvegia*, under Captain Gunnar Isachsen, circumnavigated the Antarctic region, pursuing oceanographical

* Biscoe's observations showed Enderby Land to extend as far west as 45 deg. E. longitude.

investigations, but towards the end of the summer season Riiser-Larsen again joined her, and visiting the region between his two previous discoveries, located another stretch of the Antarctic coast charted as Princess Ragnhild Land.

More recently still, in the 1933-34 season, a new section of the coastline of the continent was sighted, in the neighbourhood of 86° E. longitude, by an aeroplane reconnaissance from one of Consul Lars Christensen's whalers. This was named Princess Astrid Land. It is a link between Princess Elizabeth Land, seen to extend eastward to about the eighty-second meridian of east longitude, and Kaiser Wilhelm Land, seen to extend west to about the eighty-seventh meridian of east longitude.

Our British, Australian, New Zealand Expedition which departed south in the *Discovery* in 1929 was, at its inception, sponsored by the Commonwealth Government. I was offered and accepted command of it. A committee of control was set up, composed of Government representatives and members of the Antarctic Committee of the National Research Council. Whilst fundamentally Australian, it received strong support from the British Government and from the other Empire units of the southern hemisphere, namely, New Zealand and the Union of South Africa. Some of the leading citizens of the Commonwealth also contributed to the cost, most notably Sir MacPherson Robertson. The famous old *Discovery*, which had been reconditioned by the Discovery Investigations Committee, was obtained under charter, and equipped for an extended cruise in the sector between Enderby Land and King George Land. A full scientific programme, especially stressing oceanography, was arranged. A small "Moth" sea-plane was taken for making reconnaissances when amongst the pack-ice. My old friend, Captain J. K. Davis, secured the necessary leave from his post as Commonwealth Director of Navigation, and, as second in command, took charge of the handling of the ship for the first cruise.

The work conducted in Antarctic waters through the two summer seasons 1929-30 and 1930-31 resulted in the amassing of an immense amount of data regarding the region lying south of Australia and the Indian Ocean, between the forty-fifth and the one hundred and eightieth meridians of east longitude. Long stretches of new coast line were discovered. There have been added to the map MacRobertson Land, Princess Elizabeth Land, Banzare Land, and Lars Christensen Land; also Kemp Land and Enderby Land were rediscovered and mapped. The approximate coastline thus entered upon the chart extends through about 40° of longitude. Furthermore the existence of Wilkes's Knox Land was confirmed, and an appearance of land was recorded near where Balleny's Sabrina Land has appeared on the map. By means of an echo sounder installed in the keel of the ship, an elaborate record of sea-floor depths was obtained, sufficient to establish the limit of a continental shelf throughout the sector. Thus perhaps the most important outcome of the expedition is that, in conjunction with the discoveries made on the former Australasian Expedition to the same sector, and observations by British and other expeditions elsewhere, the presence of a real continent within the ice has been finally established, with its main bulk towards the Indian Ocean, as prognosticated by Captain James Cook 160 years ago.

Unfortunately, the scientific data secured on our expedition are so voluminous that our Committee has not yet been able to secure the necessary finance to cover the cost of printing the reports.*

*Since this was written, the Commonwealth Government has arranged to have printed such reports as are presented for publication.

During 1932, the *Discovery* Investigation Committee prosecuted an extended circumpolar oceanographical programme in *Discovery II*. At present they are making a more exhaustive examination of the Southern Ocean to the south of the western Indian Ocean.

During the summer of 1932-33, Riiser-Larsen was again in the Antarctic. With several companions and extensive dog-sledging equipment, he was landed on thick bay-ice along the ice-capped coast he himself had discovered west of Enderby Land. The intention was to sledge west around the whole coastline as far as the northern extremity of Trinity Land (Graham Land). Unfortunately, within the first day or two the apparently very solid bay-ice broke up, and drifted away with them to the north-west. By good luck the party were rescued by a Norwegian whaling vessel which had picked up their S.O.S. wireless signals.

Recently important developments have proceeded elsewhere. The Pacific Quadrant, which has been the most neglected of all Antarctica, is now receiving the attention that it deserves.

Admiral Byrd has returned to the attack again, and once more established at Little America has been engaged during the past year rolling back the unknown still further to the east. By aeroplane, dog sledge, and-motor tractor, the work has progressed apace, and his programme is not yet completed. However, we have learnt by wireless of one geographical discovery of supreme importance made by his expedition, namely, that the land of the high plateau of East Antarctica is joined to Marie Byrd Land of West Antarctica, thus determining the existence of only one really large land mass in the Antarctic Regions—the Antarctic Continent, Antarctica.

Further light may yet be shed this season on the distribution of land in Nordenskjold's West Antarctic region by Lincoln Ellsworth's expedition now at Deception Island. Sir Hubert Wilkins is once more in the Antarctic associated with Ellsworth's expedition.

Finally, we may confidently hope that the efforts of another South Australian explorer, John Rymill, now proceeding to establish a wintering base in the West Antarctic archipelago, will meet with a full measure of success.

The Nature and Area of the Polar Continent.

Having reviewed the story of the discovery of a continent beneath Antarctic ice, we may pass on to take stock of it.

To commence with, be it observed, this seventh continent is not as other continents are. It is, however, as northern Europe and northern North America were a hundred thousand or more years ago, in the height of the great Pleistocene ice age. Still longer ago, perhaps as much as a million years ago, it is probable that there were no snow-fields or glaciers anywhere in the world, except on high mountains—not even at the poles.

It was a climatic revolution, the real cause of which is yet undecided, that caused the mild conditions formerly existing even to the poles, to give way to frigidify. There ensued a canopy of snow and ice which crept irresistibly from higher to lower latitudes. Perhaps several hundred thousand years passed by as the ice gathered force and extended its kingdom over land and sea, obliterating plant and animal life from whole regions where formerly they flourished. Then a halt was called and, as certain as had been the advance, the retreat began, in spasms perhaps, oscillating and uncertain at times, until vast regions of the earth were reclaimed. So, gradually, the incubus of ice retreated to the Polar

zones, where, to-day, alone can be found large regions thus buried Greenland in the Arctic, and the Antarctic Continent and the West Antarctic Archipelago in the south, are now the only great land areas still remaining beneath the yoke of ice. The story of the past forces the conviction that in time these last strongholds of the frost king will be captured, the armour of ice silently returning to the ocean basins, as in pre-glacial times. Then, and not till then, will our great Antarctic Continent bear the full fruits of all that is implied in the term "land."

But that will be a long time hence. So we must take it as we now find it, for the most part a slab of ice. Doubtless a topography of wonderful relief lies below the smooth surface, but no hint of this is evidenced, except in specially favoured regions where mountain ridges or coastal cliffs peer through the ubiquitous shroud. The total area of such rock outcrops occurring on the Continent itself can scarcely be less than but may not exceed 10,000 square miles, the bulk of which is certainly distributed along the Ross Sea coasts.

A careful estimate of the approximate area of the continent, based on present knowledge concerning its limits, gives a figure, in round numbers, of 4,600,000 square miles. Thus on the basis of these figures the rocky pediment of the land is accessible to the extent of scarcely more than one-fifth of 1 per cent. of the total area.

There is every reason to believe that beneath the ice cap a diverse land topography lies buried. In some localities near the land margin, where the ice sheet is able to make its way slowly down to the sea, bold, brave mountains raise their heads triumphantly to heaven. The highest summit yet recorded is Mt. Nansen, estimated to exceed 13,000 feet in height, which stands near the Pole in the Ross Sea region. Farther from the coast the rising tide of ice has submerged every vestige of rock beneath a vast flat dome which reaches an elevation exceeding 10,000 feet, as at the Pole. A very large part of this ice-cap appears to have an elevation above 3,000 feet, and only quite a narrow coastal zone is anywhere below 3,000 feet above sea-level. There is no reason to suppose that the underlying continent is without its lowland areas, consequently the probability is that, in some places, the thickness of the ice sheet measures many thousands of feet. Colossal though this ice-cap is, it is but a shrunken remnant of its former self—as developed in the culminating phase of the ice-age.

Record of the Culminating Phase of the Ice Flood.

The ice flood has written its own story, indelibly recorded in geological features of unmistakable import. Undeniable criteria have been found to indicate that rocky mountains, which to-day rise high above the margin of the ice-cap, were formerly submerged. At that time the great ice-cap extended considerably beyond its present boundaries. Everywhere beyond the margin of the continent are to be found, beneath the sea, immense terminal moraines which outline the former maximum extension of the ice-cap. These built-up mounds on the sea floor are often 50 to 100 or more miles from the real land front, and they are of the order of hundreds of feet high. Off the coast of Adelie Land, the height of the main off-shore moraine is possibly to be reckoned at something of the order of 3,000 feet.

It is the existence of this submarine terminal-moraine ringing the Continent that imposes difficulties in approach to many sections of the coast, for gigantic bergs shed from the present ice face become grounded

in 600 to 1,000 feet of water upon these off-shore banks. The grounded bergs then hold up the floating pack-ice and impose an ice blockade of the coastal waters. Of course, where the seafloor suddenly plunges to a considerable depth immediately along the margin of the land, such as on the faulted coast of the western shores of the Ross Sea and the eastern shore of the Weddell Sea, the submarine moraine dump may not shoal the waters sufficiently to obstruct floating bergs, in which case a relatively ice-free, navigable coast is presented.

Large areas of ice-decked ocean thus held by grounded bergs may endure for years; but, from time to time, sections of it will be cleared away for a season, doubtless chiefly owing to the operation of periodic tidal influences of abnormal magnitude. The application of these periodic supertides in explanation of certain movements of the Polar ice has been made by Dr. Otto Petterssen (19). This periodic release to lower latitudes of exceptional quantities of Antarctic ice must in turn have some climatic repercussion.

Extreme Frigidity and Climatic Repercussions.

The great ice slab, continental in proportions, has, as we have seen, rather simple surface features—a high plateau descending with rapidly increasing curvature as the sea is approached. Many features conspire to make its surface the coldest region of the earth. Firstly, its circum-polar location not only reduces its quota of direct heat from the sun, but limits its participation in the facilities, enjoyed by the Arctic regions, for receiving sun's heat indirectly by ocean currents. Secondly, the great average height of the surface, greater than that of any other continent, limits the blanketing effect of the atmosphere. Thirdly, as the temperature is perpetually below the frost point, the maximum possible water-vapour content of the atmosphere is extremely low and, over the interior, clouds are at an absolute minimum. These features of the atmosphere, aqueous vapour in its invisible and in its condensed form as clouds, exert an important blanketing influence in the retention of earth heat. Finally, the whiteness of the surface and its dazzling reflectivity allow the ice-capping of the land small opportunity of trapping radiant solar heat.

It is thus that the Antarctic is the world's greatest refrigerator. Greenland, in the Arctic, acts in like manner, but on a very much smaller scale. There is ever a vast outpouring of cold dense air from the high plateau of Antarctica down the coastal slopes and away to the north. Periodically the outward rush of air is vastly accelerated, then is developed the pent-up fury of an Antarctic hurricane, which, when experienced in the coastal zone, is never to be forgotten.

The climate of the world is a function of solar radiation acting through the equatorial regions, which serve as the boiler of the heat engine, the Polar regions being the condensers. The intensity of the atmospheric movements is in relation to the range between the temperature of the tropical lands and of the Polar lands. The Antarctic, being the principal condenser, is, therefore, a prime factor in world climate. Obviously the Antarctic regions exert a very important controlling influence on the climate of the Southern Hemisphere, but before knowledge is sufficient to draw useful deductions, observations on a vastly more extended scale are necessary.

Nature and Structure of the Underlying Rock Platform

Returning to the consideration of the real land beneath the mantle of ice, it appears to be constituted of two somewhat distinct blocks. The main unit extends from the Weddell Sea around, south of Africa and Australia, to the Ross Sea. This has the character of a region of block uplift. Both in its geological structure and in its history it has much in common with Australia and South Africa. On the side facing the Pacific, from the Ross Sea to the Weddell Sea, it is limited by a great fault line, which marks the west coast of the Ross Sea and extends to the east coast of the Weddell Sea. Both the Ross Sea and the Weddell Sea appear to owe their origin to this faulting. The fracture zone is marked by volcanic outpourings of Tertiary to Recent age. The Ross Island volcanic series, with the present active Mt. Erebus, is one of the numerous centres of extrusion along this line. Stratigraphically, the outstanding characteristic of this section of Antarctica, styled by Nordenskjöld as East Antarctica, is the immense development of a crystalline Pre-Cambrian complex and the limited nature of post-Gondwana sediments. Earlier Palaeozoic beds including Cambrian and Devonian, are notable. Permian and Triassic (Gondwana) beds are widely spread, and carry thin seams of a poor grade of coal. From this period on there is a gap in the evidence as yet available until we come to late Tertiary, Pleistocene and Recent times. Of this group, basaltic lavas, including alkaline types, have a considerable development, and, of course, morainic debris is scattered far and wide. That there are at least limited areas of Tertiary age beneath the ice is strongly suggested by the occurrence of lignite in morainic mud brought up in our dredges off the coast of King George Land.

The subsidiary section of the Antarctic Continent is that styled by Nordenskjöld as West Antarctica. This lies on the Pacific side of the great fault line postulated as joining the Ross and Weddell Seas. The King Edward Land and Marie Byrd Land section appears to be composed of rocks generally similar to those distinguishing the main division of the continent; but little geological information concerning this region is yet available. The Archipelago of West Antarctica, extending south from the South Shetlands, heads into this lesser section of the continent, but the structural relation of the one with the other is yet unknown. This is an interesting problem for the future, for the island chain has been shown to have the characteristics of the Andean belt of South America. The rocks there exhibit folding, which is characteristically wanting in East Antarctica. Intrusive magmas are there met with comparable to Andean types, which fact has been stressed as indicative of continuity. Unlike East Antarctica, there is there a notable succession of post-Gondwana beds of Cretaceous and Tertiary.

In surveying the stratigraphy of this region, a feature of note is that while Cambrian sub-corals and Permian land plants are found fossil in strata practically at the Pole, both attesting a mild climate at some time in the past, there has not yet been discovered in the sedimentary records any sure evidence of glaciation in bygone ages previous to the present glacial onslaught. This is remarkable, for even here in Australia is splendid evidence of recurrent glaciations.

It certainly seems paradoxical that there is in Australian strata splendid evidence of recurrent glaciations through geological time; whereas in Antarctica, at the Pole itself, no older tillites have yet been found. It may be argued, of course, that the glacial periods recorded in Australia also prevailed in Antarctica, but on an overwhelming scale, on each occasion sweeping its own debris into the deep sea, thus sinking the major evidence of the event so far as the Antarctic Continent is concerned. Also as only a small part of the strata of Antarctica has yet been sighted, it may well be that future explorations may yet reveal recurrent glacial interludes in the history of the continent.

Catastrophic Effect of Glaciation on Pre-existing Life.

The fossil evidence already to hand indicates that Antarctica in past times has been favoured with a wide range of animal and plant life. The present glaciation has been catastrophic in regard thereto. All life on the mainland was doubtless swept into the sea. The lichens and mosses which are very scarce and the few types of microscopic animal life existing there today in specially favoured locations are probably recent re-introductions.

Even the marine shallow-water life has suffered strange modifications and eliminations owing to the usurpation by the ice sheet of the whole of the zone of continental shelf during the peak period of ice invasion. The effect is not so noticeable in the case of invertebrate life as it is with the fish, which exhibit curious restrictions in the range of genera represented.

The Life of the Environing Seas.

The glacial epoch, however, has not had the same retrograde influence upon the plankton population. Cold polar waters are notoriously rich in microscopic plant life. The annual flush in growth comes with the brilliant sunlit period of spring and summer, when in high latitudes there is each day 24 hours' daylight to foster plant growth. Further, these cold waters are characteristically rich in nitrate content, which is so necessary for plant development. The consequent growth of diatoms in these seas is thus usually so prolific that the colour of the sea water is determined thereby.

With a rich basal vegetable population, Antarctic seas are able to support an unexcelled concentration of small planktonic crustaceans, principally copepods, amphipods and the like. In turn these are the food supply of fish, and directly and indirectly of seals and penguins, and pre-eminently of the whales. The baleen whales are designed to live almost exclusively upon amphipods, the "krill" of the whalers. Thus it is that the existence of the Antarctic Blue Whale, the culminating feature of the life of those seas, is based upon the microscopic plant population. The immense area of the Antarctic seas and their rich plankton concentration results in a stupendous whale community. Antarctic Blue Whales have been caught as much as 110 feet in length and weighing 200 tons. No creatures, even of the prehistoric past, approach the bulk of these southern whales of to-day.

Seals in great number and representing four species inhabit the pack-ice and the shores of Antarctica. However, the most characteristic feature of the shore life is the ubiquitous penguin. Rookeries of these hardy creatures in untold numbers are found at every vantage point along those otherwise desolate shores. Flying birds, including several species of petrel which also derive their sustenance fundamentally from the surface plankton, are richly represented in Antarctic seas. In summer time these feathered folk come ashore to nest, often forming large communities on the rocky headlands.

The Question of Administration.

This brief sketch suffices to illustrate the nature of Cook's ice-bound continent. The question which now occurs is, of what use is it to be to mankind? What rôle is it to occupy in human affairs?

To begin with, it can be said that this will depend very much upon whether it is merely raped for what it offers at the moment, and then left for ever desolate, or whether it is brought under some system of wise control and development. To secure the latter desideratum it cannot be

left a no-man's-land. It must be secured under authority, competent and able to impose restrictive regulations. This means Government control, and as there are at present no human inhabitants it requires some external Government or Governments to exercise jurisdiction over it. Obviously the fewer Governments the better, in order to more certainly secure the all-necessary desideratum, unanimity of control. Of the adjacent inhabited lands, the British Empire is preponderant, and it is obvious that unified control under a British Inter-Imperial administration would be the most certain to secure ultimate benefaction for the territory. However, rightly or wrongly, it may be that other nations may feel disposed to press claims to a share in the onus of administration of the still unclaimed sectors of Antarctica.

Contiguous British domains have already, in recent years, laid claim to a considerable portion of the land areas, and rightly so, for not only has Greater Britain played a leading part in the discovery of Antarctica, but her proximate lands are geographically in the best position to administer control in development.

Territorial Claims.

France has maintained the claim over Adelle Land made in 1840 by her explorer Dumont d'Urville. d'Urville's claim was for land said to have been sighted by him between latitudes 66° S. and 67° S. and between longitudes 142° E. and 136° E. The area of land thus claimed by France would amount to about 5,500 square miles. In October, 1924, the French Government confirmed its national rights over Adelle Land, and this Antarctic territory has been proclaimed a reservation for the preservation of the native fauna.

In 1908 the Government of the Falkland Islands formally annexed Subantarctic and Antarctic lands lying to the south of them, extending for 60 degrees of longitude, between 20° W. and 80° W. The land area of the portion of the Antarctic Continent falling within this sector is somewhat over 500,000 square miles. This does not include the Subantarctic Islands and Antarctic archipelago.

In 1923 the Ross Sea region, extending between longitudes 150° E. and 160° W., which includes the Balleny Islands, was formally proclaimed British, and appended to the Dominion of New Zealand. The mainland area within these limits is about 175,000 square miles.

In 1911-14 our Australasian Expedition had raised the flag and taken possession of the new territories then discovered, but, on account of the disturbed state of Europe for some years after our return, no Government action was then taken. In 1925, however, the Australian National Research Council appointed an Antarctic Committee, with Sir David Orme Masson as chairman, for the purpose of impressing upon the Commonwealth Government the importance of the Antarctic and the necessity of taking action to establish a claim to the region contiguous to Australia.

The matter was brought before the Inter-Imperial Prime Ministers' Conference in London, in 1926, where the subject was reviewed, and a continuance of Antarctic exploration favoured. Our B.A.N.Z.A.R. Expedition was ultimately launched. Subsequent to our return an Order in Council was issued proclaiming British sovereignty over all the region between 45° E. to 160° E. longitude, with the exception of Adelle Land, already claimed by France. The total area of the ice-clad land involved amounts to about 2,250,000 square miles.

There yet remain two unclaimed sectors. The one is south of the Atlantic Ocean extending between 20° W. and 45° E. longitude. This is a land region of over 1,000,000 square miles in area, in which the

Norwegians have been specially interested, and in the exploration of which they have been principally concerned. The remaining sector is that south of the Pacific Ocean, between 80° W. and 150° W. longitude, where land approaching 600,000 square miles in area is not yet annexed, but in that locality Admiral Byrd has made very important discoveries and has raised the United States flag on a portion of it.

Prospects for Economic Development.

Immediate prospects of commercial development in Antarctica are centred on the fisheries, and whaling is the division ascendant just now. The rise of this Antarctic whaling industry is a very modern event, for it is in recent times, only, that the technique has been evolved for the capture of the very large and powerful Finer Whales and Blue Whales which inhabit those seas. They are hunted by small vessels, referred to as "chasers" or "catchers," which in general appearance very much resemble North Sea trawlers, though capable of a speed of 13 knots. Mounted in the bow is a powerful harpoon gun. When fired, the head of the harpoon explodes several seconds after impact with the whale; thus the animal is promptly despatched. As already noted modern Antarctic whaling developments commenced in a small way in the year 1905. In the earlier stages the operations were usually conducted in conjunction with shore stations for treating the catch. Since then the industry has grown to enormous proportions, and it has been found greatly advantageous to replace the shore factories by floating factories. The modern form of the latter is a vessel of about 22,000 tons, replete below deck with steam digester plant and oil storage tanks. The upper deck is a vast, open working area where whales as many as three at a time, after having been hauled up from the sea through a stern tunnel, are reduced to fragments and fed into the digesters within an hour.

These factory ships, or "mother" ships, as they are termed, each in company with their respective attendant "catchers," to the number of six to ten, dispose themselves throughout the whaling grounds, quickly filling up with blubber oil at the expense of the whales.

By the year 1929 the Antarctic whaling fleet had reached a total of 240 vessels of a total magnitude of 350,000 tons. The value of the products of that year reached the colossal figure of £9,000,000 sterling. The latest type of whaling factory ship has a capacity of about 23,000 tons, requiring 120,000 barrels of oil to fill storage tanks, which necessitates the killing of 1,000 average Antarctic whales.

Since 1905 to the present day over 300,000 whales have been taken in Antarctic waters, producing products valued at over £70,000,000 sterling. Though restrained by the present period of world depression, the boom still continues and rich cargoes are returned each year. This unique and rich industry could be perpetuated for all time, were more adequate international control established.

Australia and New Zealand have been well in the front rank in the exploration of the Antarctic, but they have not up to the present actively participated in the economic development of the Antarctic fisheries. Geographically they are better situated to participate therein than almost any other country in the world. Within 1,320 geographic miles of Hobart lies one of the important whaling grounds of the Antarctic seas. Another extremely rich whaling area lies due south of Albany. In fact, probably the richest whaling region of the world to-day lies adjacent to Australia and New Zealand.

As a winter-sports ground for diversion in summer, Antarctica would be a thrill to Australians, but, by our present modes of travel, it is rather far distant to be likely to be thus useful for a long time to come. But I see no reason to delay the despatch from our ports of modern liners of summer pleasure cruises amongst the pack-ice.

There would be no difficulty in establishing land settlement at a few favoured spots along the coast, provided commercial developments can offer sufficient inducement. Thus, should reasonably rich mineral deposits be located in accessible localities there need be no delay in working them. But so far the only extensive occurrence of useful mineral known is that of coal. Although widely extended in its distribution in Antarctica, coal is not a commodity of sufficient value to be able to meet the extra shipping costs involved in transport from ice-bound shores. Gold, on account of its high value and low bulk for export, would be, par excellence, the element offering best prospect for economic development under Antarctic conditions. But useful deposits of the yellow metal have yet to be found, though the bulk of the known rock formations of Antarctica are quite favorable as matrices for auriferous reefs. We have already located in Antarctica occurrences of all the commoner base metals—but, so far, none in commercial quantities.

The ever present ice itself is a mineral with a definite commercial value were it landed in Sydney or Melbourne. The heat of summer in Australia calls for the consumption of a vast tonnage of ice during the three hottest months; just the period when shipments of ice could be most easily transported from Antarctica. But in these days of low refrigeration costs it is likely that the expense of quarrying, transport and handling charges would preclude export to Australia. Probably few people know that there was a time when shipments of ice were a feature of trade between the New England States of America and Calcutta.

Another feature of some sections of the Antarctic coastline which may in time be turned to account, is the continuity, year in year out, of gales of wind descending from the ice plateau of the hinterland. We found the northward-moving air along the coast of Adelie Land to have an average annual velocity of about 50 miles per hour. To have to live in such a climate is, of course, a most unenviable lot, but those of us who have done so have not failed to be impressed with the vast amount of energy represented by those air currents and available to man. It is, of course, a secondary form of solar energy, but so disposed as to be easily convertible to electricity. Owing to the high velocity of those winds it would be possible, by the erection of only a limited installation of staunchly constructed wind generators, to harness a goodly amount of energy. In the present state of electrical science, such power could not be exported as current; but it might be converted to saleable commodities. Some day, therefore, there may thus be produced for export atmospheric-nitrogen products and like power-consuming manufactures.

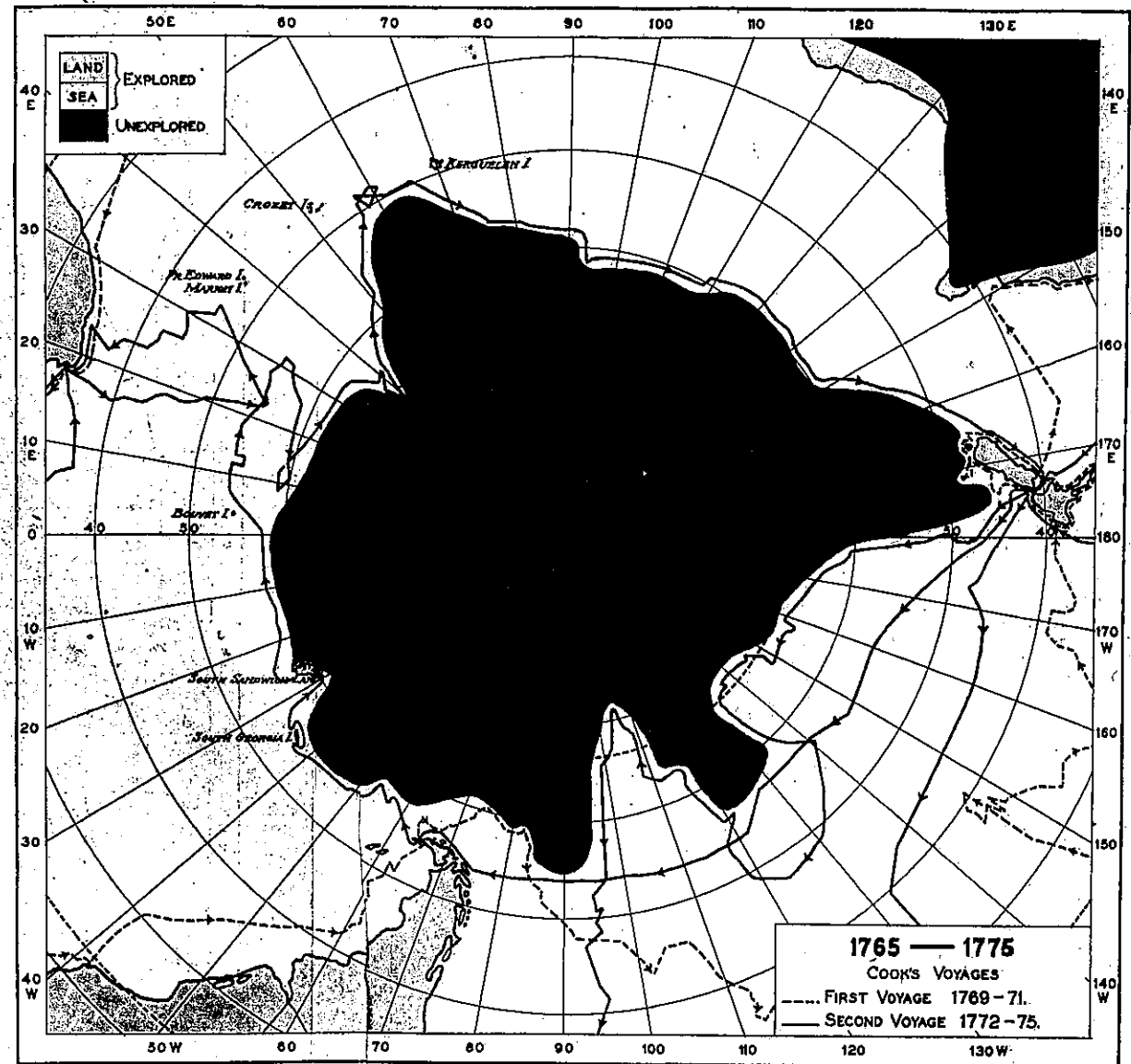
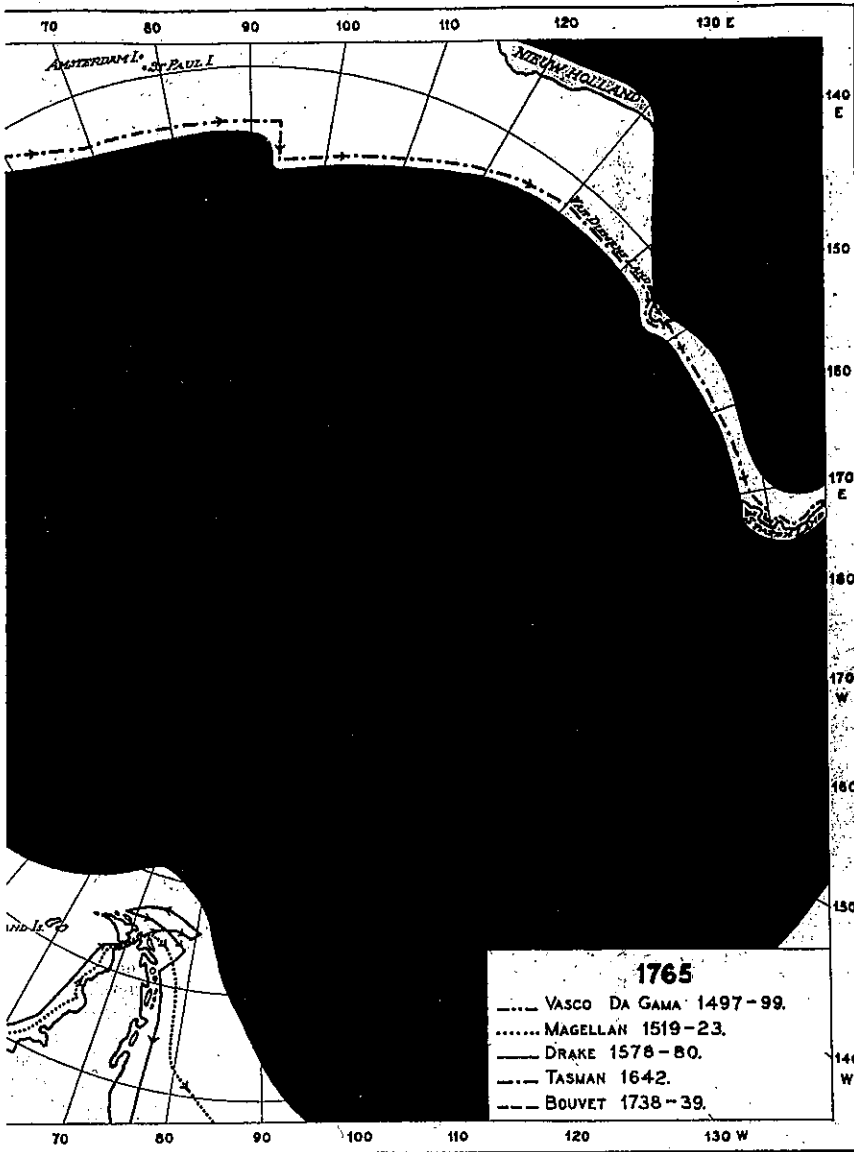
I visualize that, before long, operations will be conducted from Australia and New Zealand into the southern regions much after the plan of the Hudson's Bay Company. There will be isolated shore posts where a few individuals will reside the year round, collecting seal products and penguin eggs, as well as fish products of various kinds. One of their diversions and duties should be to broadcast weather reports each day. They may also take the opportunity to breed Arctic white foxes, for the satisfactory rearing of which the climate should be suitable, and also as a food supply there would be an abundance of meat food available from seal and penguin carcasses. Such fur-farming, both in the Subantarctic islands and on the Antarctic mainland, is sure to develop sooner or later, primarily because of the abundance of suitable food available at no cost whatever.

The shore stations would, of course, be linked with whaling operations. The whaling craft, besides securing cargoes of whale products, would make its business to visit the shore stations annually, bringing stores and transporting the trade to market.

Such a system of exploitation should not be long delayed. These Antarctic territories are important, and our respective Governments should take the necessary steps to preserve and develop this inheritance.

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approximate latitude of 55° S. In its final results, the expedition was no doubt a success for the East India Company, but it did useful work in that it proved that there exists over a large part of the South Pacific Ocean a vast continent.

In the 17th century, both in France and in England, there was a lively interest in the existence of the great continent of the South, which culminated in the despatch of Captain James Cook on his first mission to investigate the fascinating

subject ran high amongst French savants. The first of the French expeditions of note in relation to the continent of the South was that of the *Atalante*. The first, which went forth in 1772 under the command of Louis-Antoine de Bougainville, when bound for the Pacific Ocean via the Cape of Good Hope, had the good fortune to fall in with two small islands. These are known respectively as the Phoenix Islands. The other expedition, under the command of Jean-François de Kerguelen-Trémarec, aimed at reaching the continent of the South to the south of the mid-Indian Ocean. It was successful, for in February, 1772, they discovered the continent, which was named as the Kerguelen Archipelago. This archipelago was found to form part of the sought-for continent of the South. When Captain Kerguelen returned to France he found his compatriots were thoroughly disillusioned when, on a second expedition, he ascertained his "South France" to be merely a group of islands.

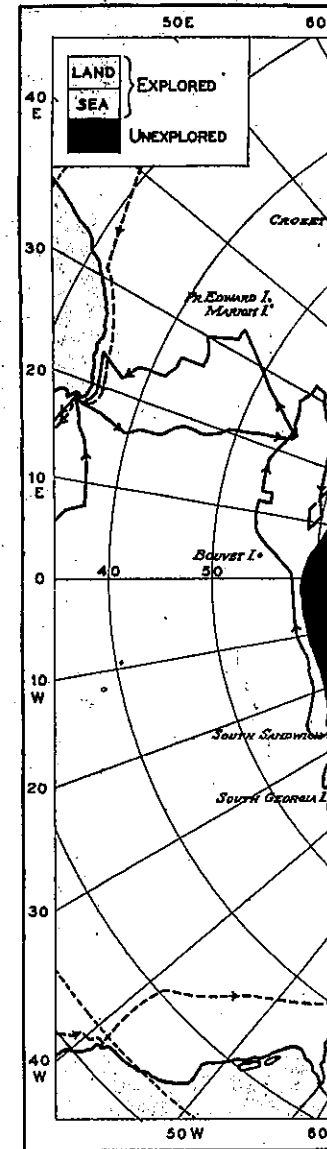
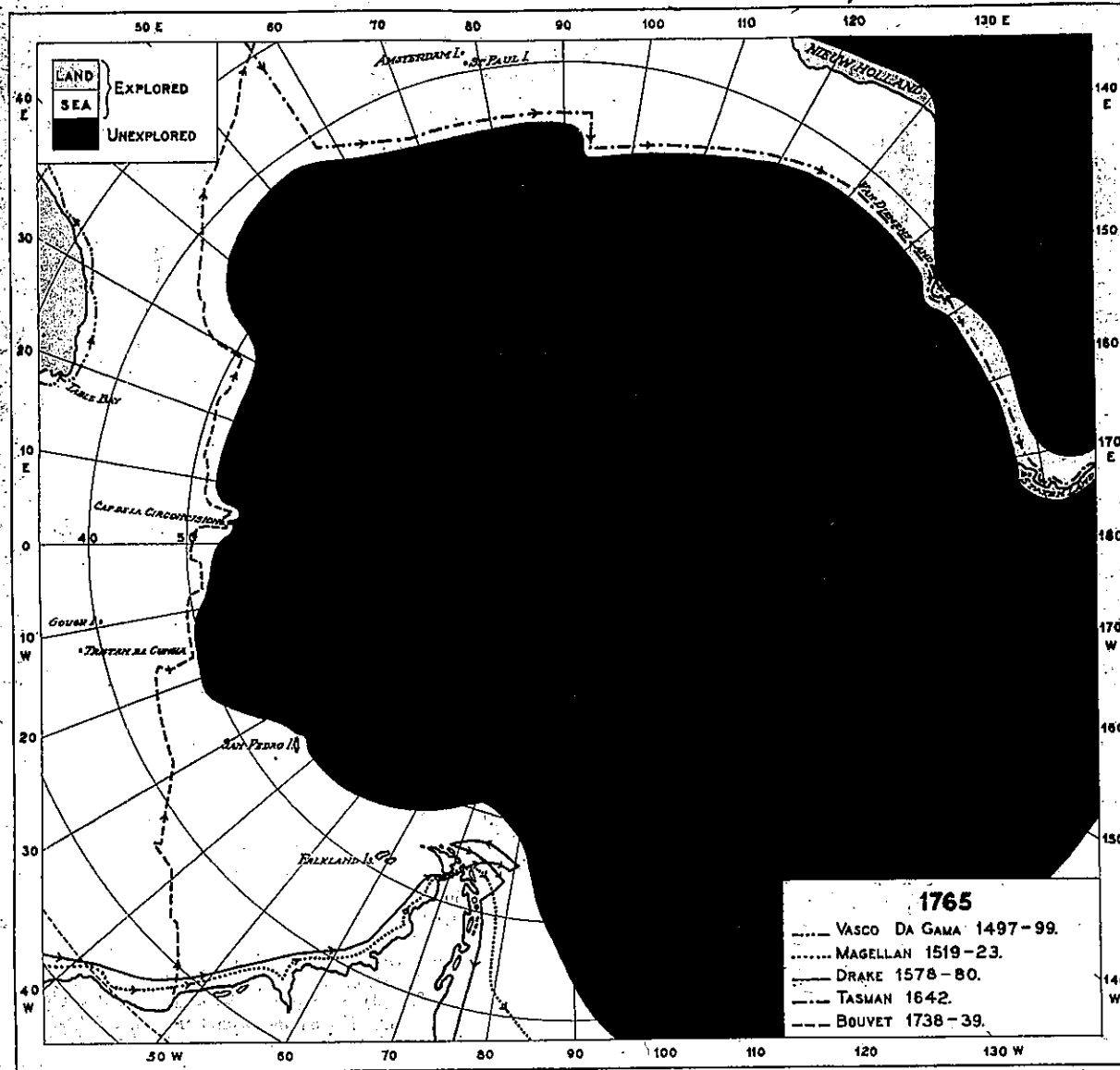
James Cook was originally instructed by the Admiralty to sail across the Pacific Ocean to look for a continent which might be found "meaning the continent of the South." Thus instructed were Captains Cook and James Cook when despatched in 1768 on the command of a scientific expedition with the objective of investigating the continent of the South, as chief objective.

The Discovery of the Spell.

When James Cook, on his first voyage of discovery, sailed south on a voyage of discovery in the Pacific Ocean, he sailed south and west, including a circumnavigation of the east coast of New Zealand.

On his second voyage, Cook accomplished much more, for he had shown New Zealand to be a continent, and had shown only a small part of the continent of the South. He writes as follows (3): "Thus far our discovery is favorable to the notion of a Southern continent, at least three-fourths of the positions of which are now ascertained. He then elaborates "reasons for thinking that the continent lies to the northward of 40° S.; of what can be said of it I can give no opinion."

Eliminated from the South Land by Tasman.

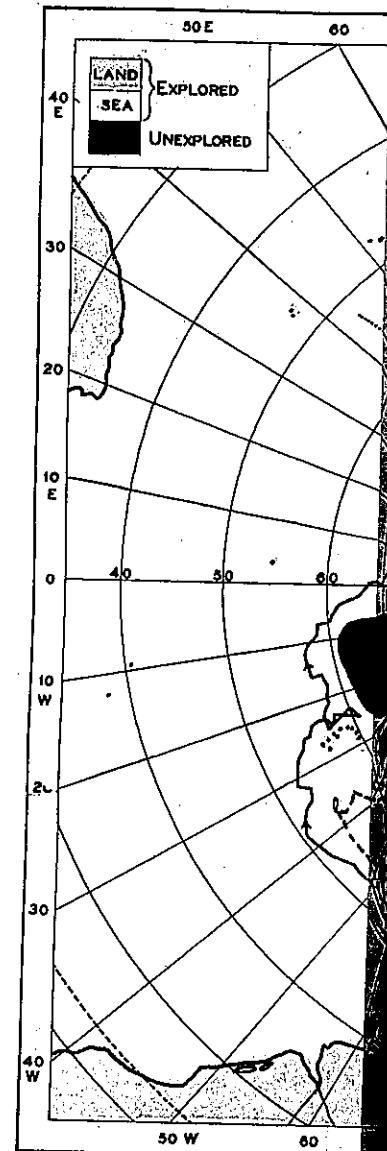
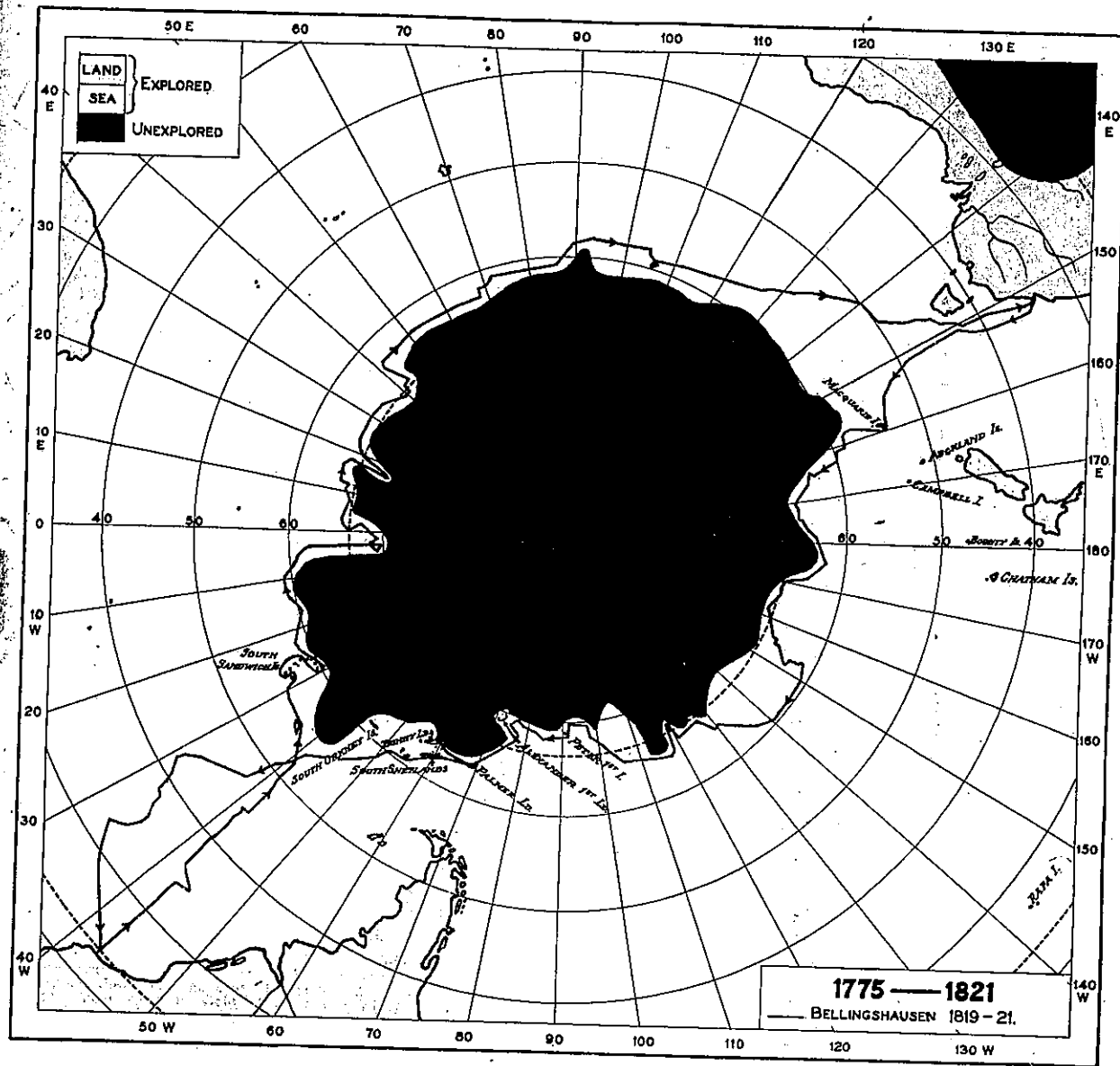


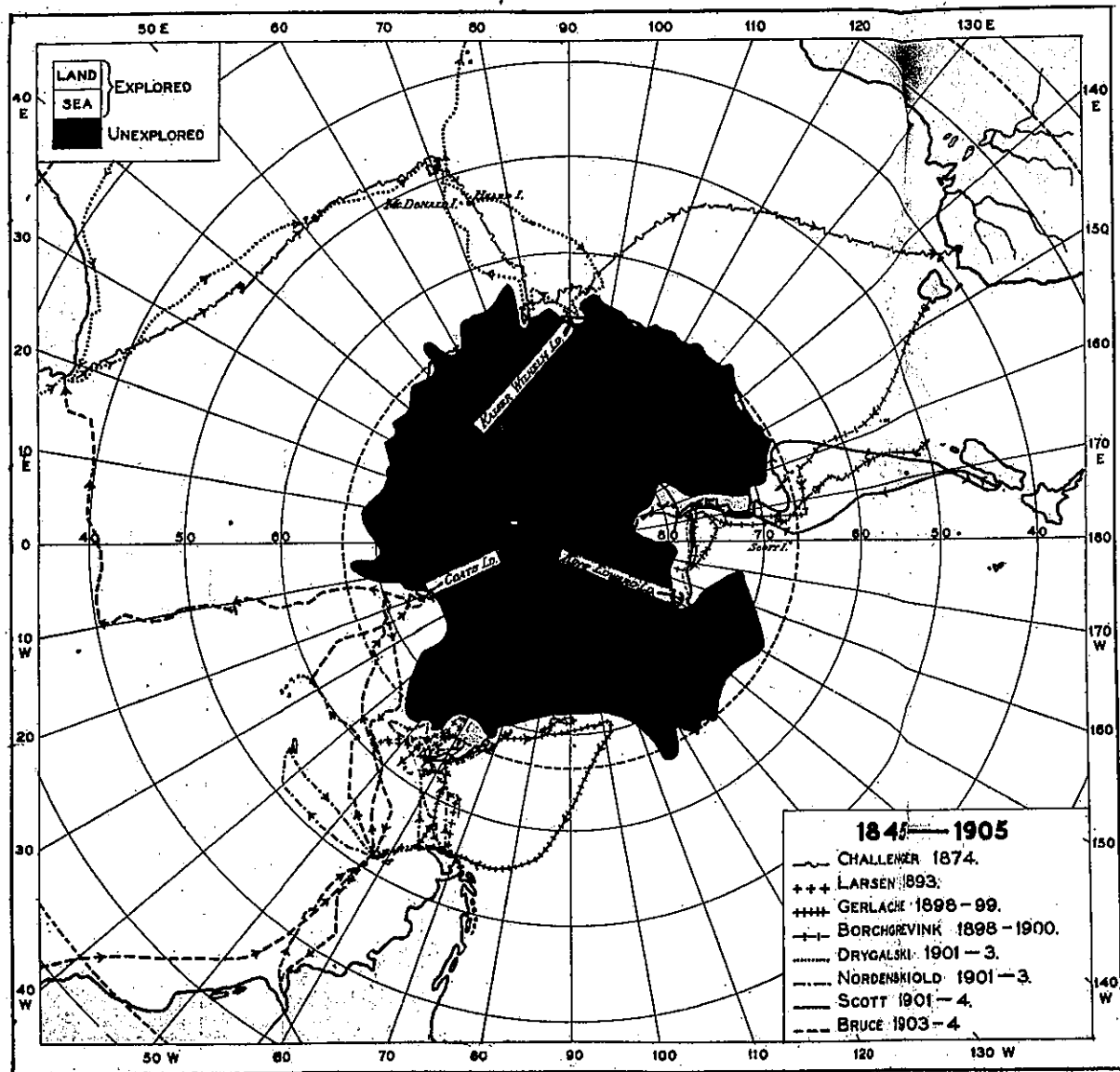
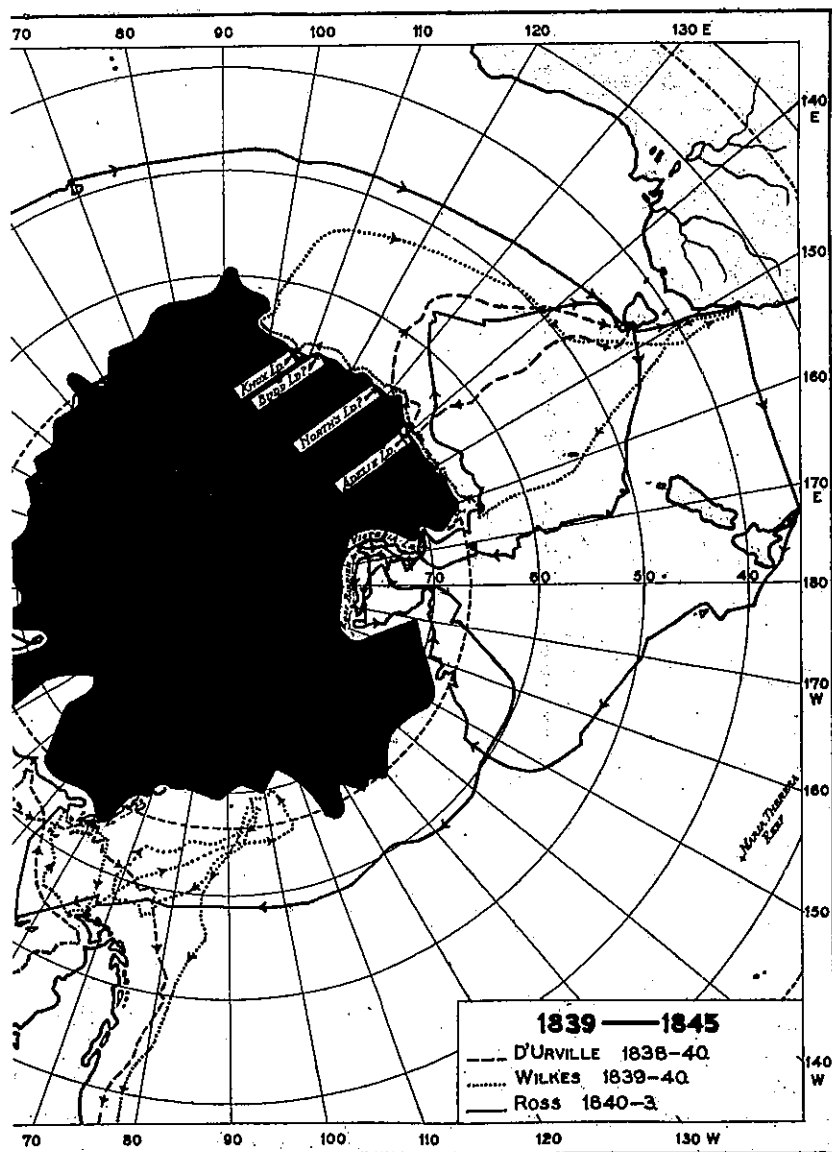
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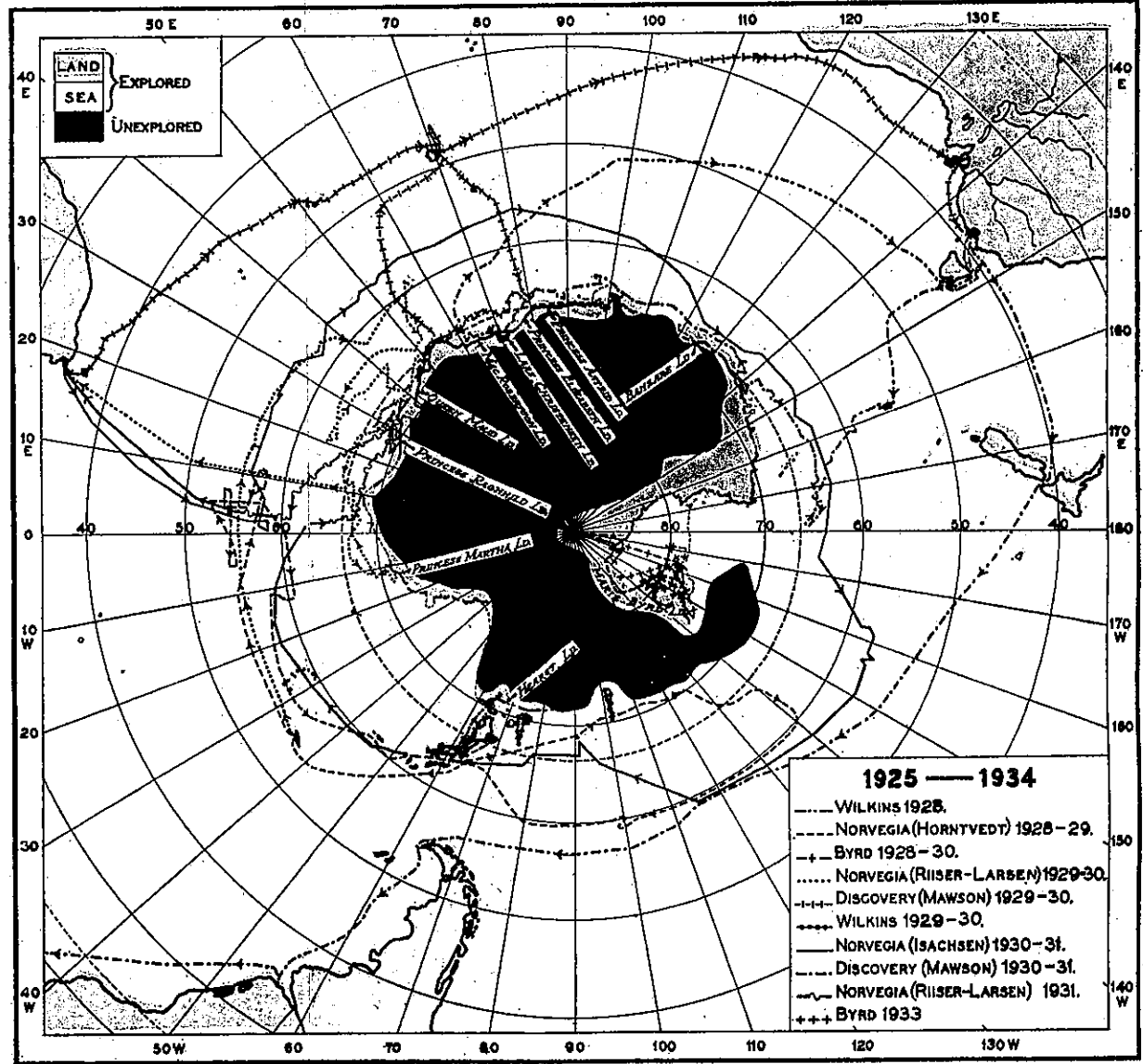
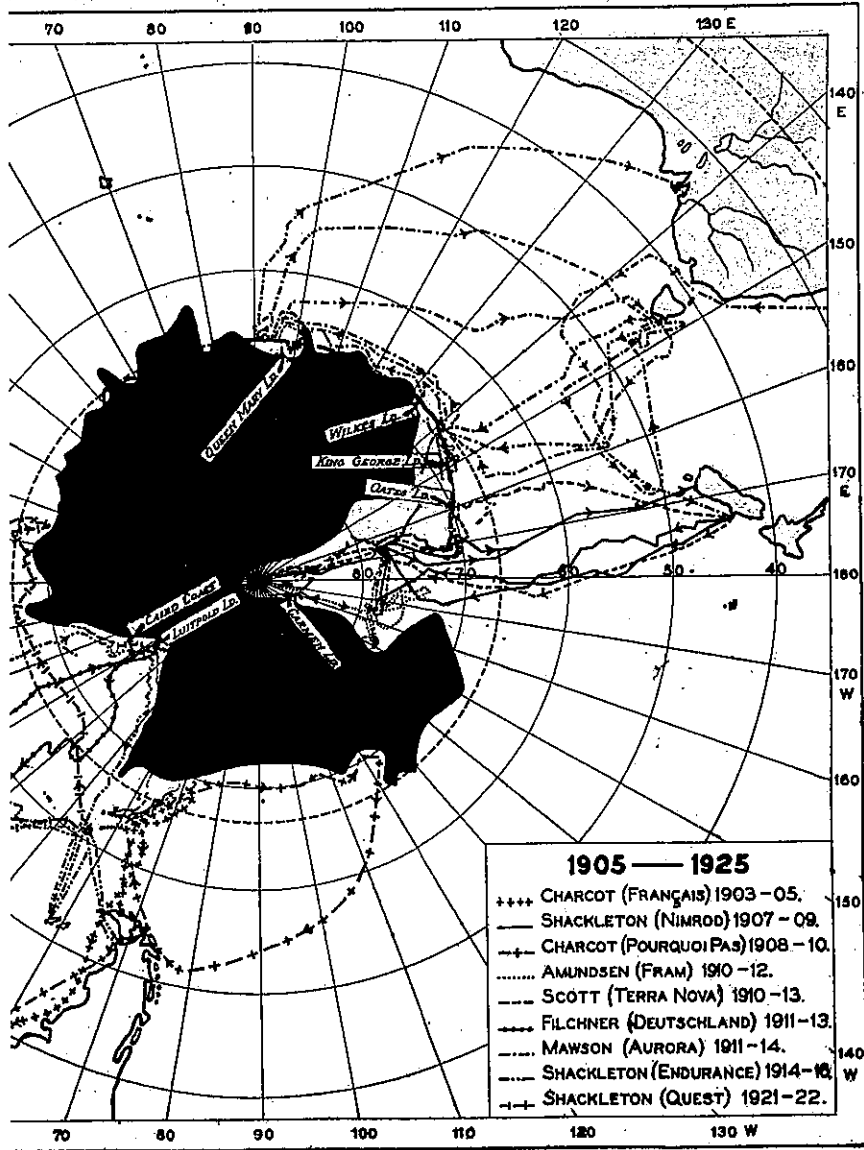
's *Fine Achievement.*

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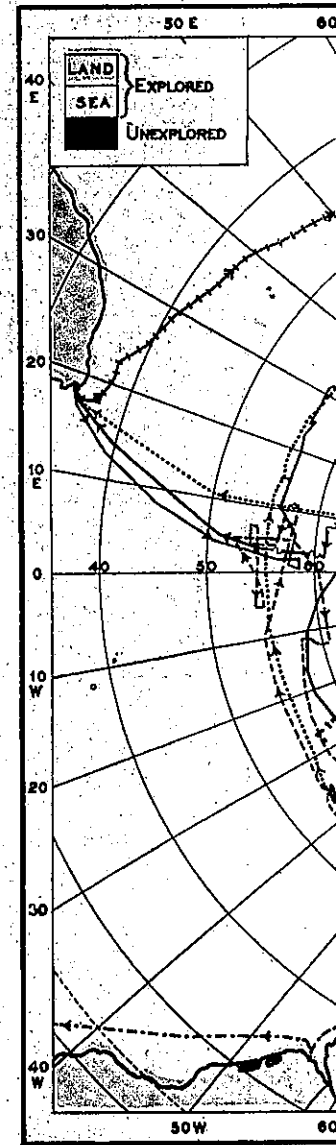
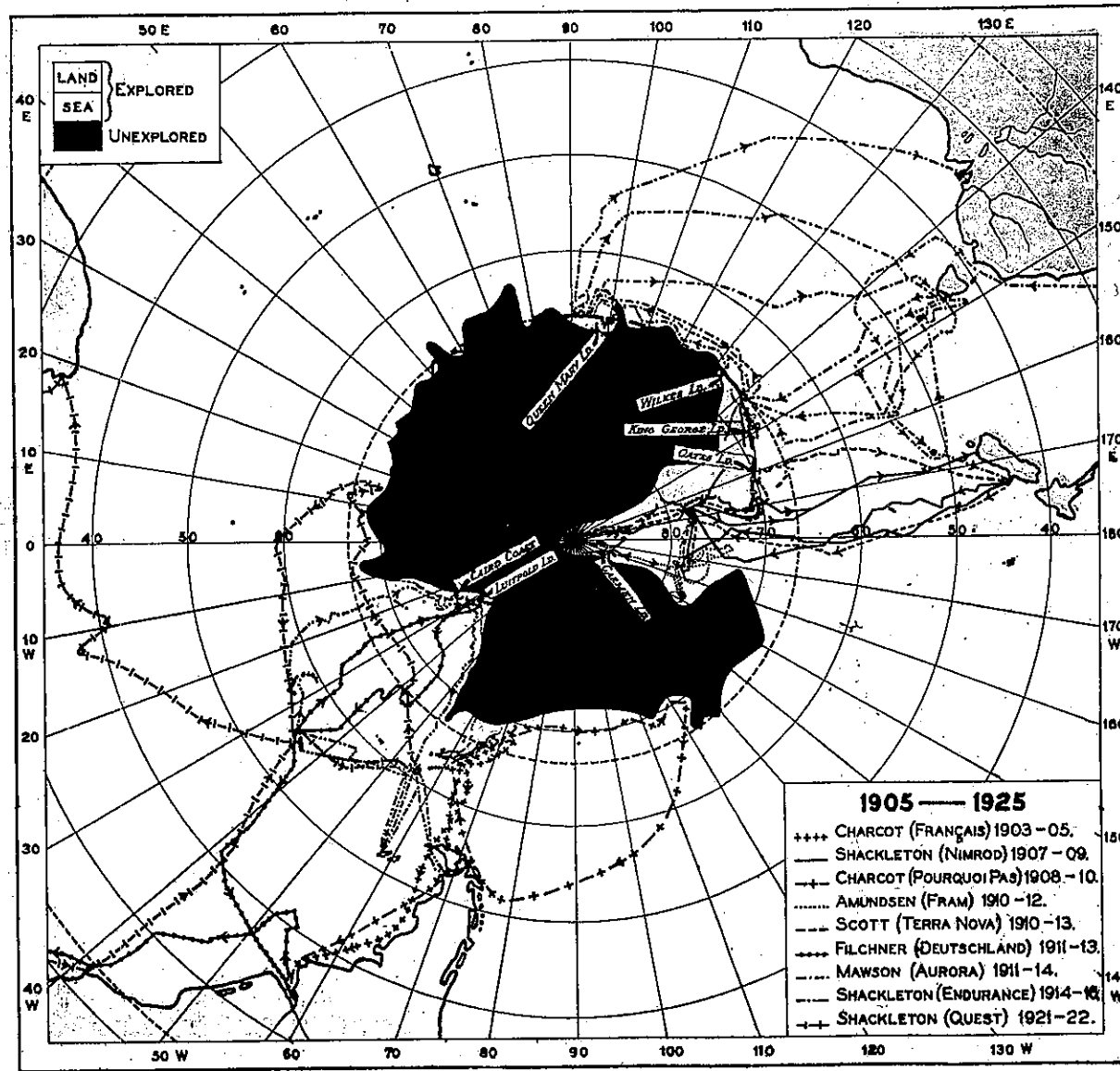
come to what is evidently the head of but probably attainable only in favorable high ice-covered land, promptly named Prince of Wales Land, on the eastern shore of the Weddell Sea. Extending west to the west, as the southern limit of the ice formation like that of the Ross Sea, the expedition was to winter upon and explore this land. However, they were disappointed, for after they had landed and stores upon what appeared to be perfect ice, they were up and drifted away. Then their ship was blown up and drifted helplessly north during the day, fortunately without serious damage. The next day, through the drift, a short sledge journey over the ice, the expedition in search of Morrell's fictitious New South Land, but no trace of land was found.

The Australasian Antarctic Expedition of 1911-14, led by Sir Ernest Shackleton, and the British Antarctic Expedition in 1909, plans for a British expedition immediately south of Australia were also considered. Plans were formally brought forward at the meeting of the Royal Society in January, 1911. The main feature of the expedition was the operation of several shore parties wintering

on the coast of the then President, Sir David Orme, and the suggestion of Sir Edgeworth David, who was then the Secretary of the Association, gave the undertaking its full name. The committee was appointed, and one-third of the expedition was voted, which definitely placed the expedition on a firm basis. The necessary funds were obtained from private and government sources. The vessel was named the *Terra Nova* . In the summer of 1911-12 three parties were sent to the coast, chiefly as a weather station and to explore the coast of the Antarctic, and two others on newly named respectively King George Land and the coast of Amundsen's invasion, the landing party was part of the original plan, had to be occupied by one of Scott's parties. The expedition explored by sledge journeys, one of which crossed the Antarctic plateau 300 miles to the south near the party, under Captain J. K. Davis, also named as Wilkes Land.* The geographical

discovery of coast "Wilkes Land" was solely prompted by the fact that the names of his landfalls after the expedition, none after himself. Having satisfied ourselves that the name certainly was not sighted by Wilkes's Expedition, I have recently been criticized in America for having seen this part of the coast, and, secondly, for having appeared on many maps, for long past, signifying the existence of a land 160 deg. E. and about 160 deg. E. longitude. The use of the name to a section of the whole of that part of the coast, a negative compliment is being paid

to the fact that evidence is conclusive that Wilkes did not discover the land. Secondly, the appearance of the words "Wilkes Land" over the wider areas in the fact that there was the sector through which the expedition exist within the pack-ice. As, however, the expedition had already established the continuity of land through the ice, already had the prior title "Adelie Land," it had no right to the title Wilkes Land as a geographical name. I should still like to honour Wilkes if I may.



-day, alone can be found large regions thus buried. The Arctic, and the Antarctic Continent and the West-Indies, in the south, are now the only great land areas beneath the yoke of ice. The story of the past forces at in time these last strongholds of the frost king will be a long time hence. So we must take it as we now most part a slab of ice. Doubtless a topography of lies below the smooth surface, but no hint of this is in specially favoured regions where mountain ridges or through the ubiquitous shroud. The total area of such capping on the Continent itself can scarcely be less than 10,000 square miles, the bulk of which is certainly the Ross Sea coasts.

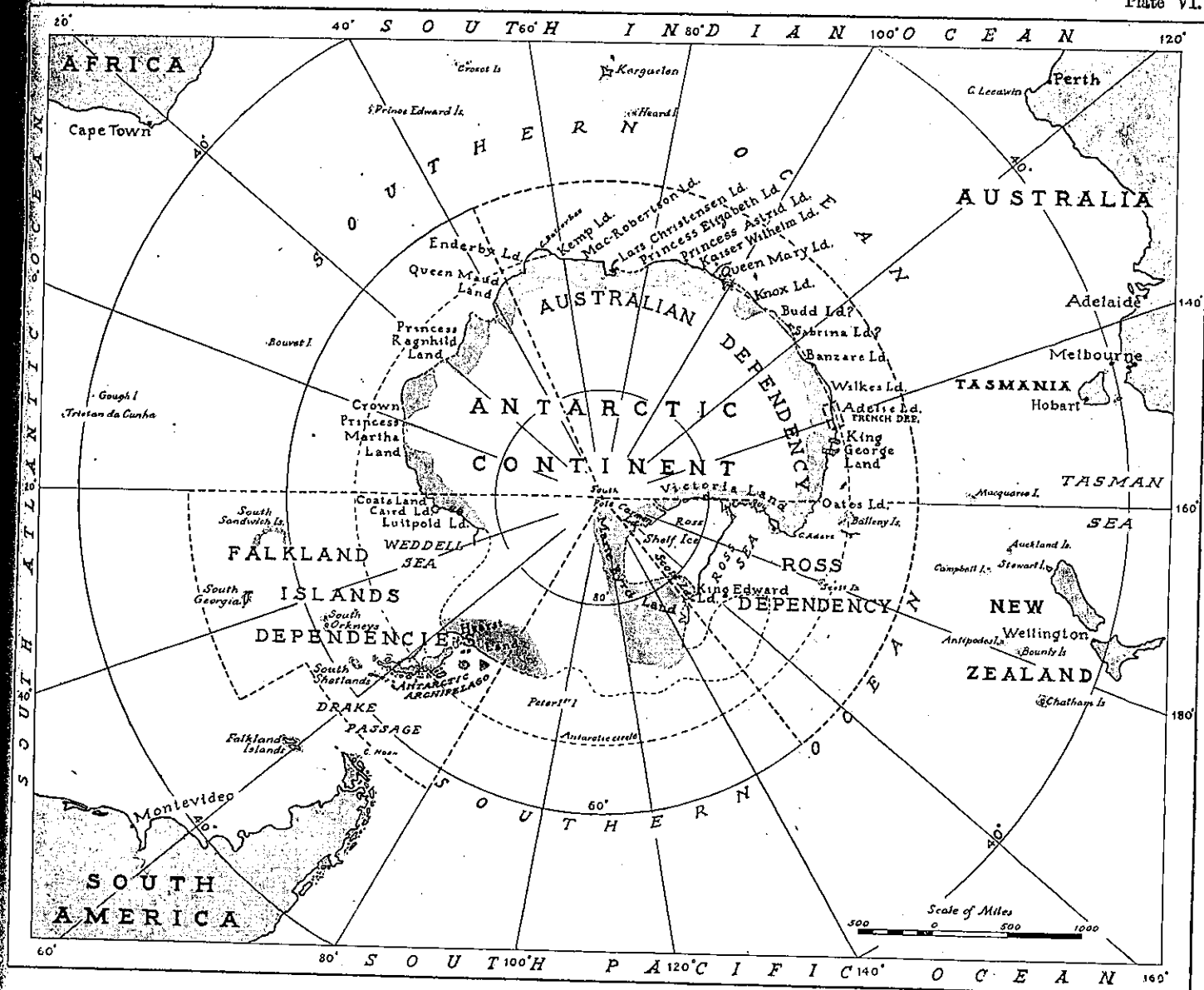
mate of the approximate area of the continent, based on the concerning its limits, gives a figure, in round numbers, are miles. Thus on the basis of these figures the rocky land is accessible to the extent of scarcely more than 1 per cent. of the total area.

reason to believe that beneath the ice cap a diverse lies buried. In some localities near the land margin, ice is able to make its way slowly down to the sea, bold, raise their heads triumphantly to heaven. The highest peak is Mt. Nansen, estimated to exceed 13,000 feet in lands near the Pole in the Ross Sea region. Farther the rising tide of ice has submerged every vestige of rock flat dome which reaches an elevation exceeding 10,000 feet. A very large part of this ice-cap appears to have 8,000 feet, and only quite a narrow coastal zone is 3,000 feet above sea-level. There is no reason to suppose the continent is without its lowland areas, consequently is that, in some places, the thickness of the ice sheet thousands of feet. Colossal though this ice-cap is, it is a remnant of its former self—as developed in the culmination of the ice-age.

the Culminating Phase of the Ice Flood.

has written its own story, indelibly recorded in geological unmistakable import. Undeniable criteria have been found in rocky mountains, which to-day rise high above the margin were formerly submerged. At that time the great ice-cap probably beyond its present boundaries. Everywhere beyond the continent are to be found, beneath the sea, immense ridges which outline the former maximum extension of the built-up mounds on the sea floor are often 50 to 100 or more miles from the real land front, and they are of the order of hundreds of feet. Off the coast of Adelie Land, the height of the main ridge is possibly to be reckoned at something of the order

presence of this submarine terminal-moraine ringing the continent imposes difficulties in approach to many sections of the ice bergs shed from the present ice face become grounded



MAP 10.—The Antarctic Continent, showing present political divisions.