Royal Society of Victoria

SYMPOSIUM

At the Society's Hall
Monday 3 December 1956

AUSTRALIA'S PART IN THE INTERNATIONAL GEOPHYSICAL YEAR IN ANTARCTICA

ON Monday 3 December 1956, a Symposium was conducted at the Society's Hall in the presence of His Royal Highness the Duke of Edinburgh, on the subject of "Australia's Part in the International Geophysical Year in Antarctica".

The intention was to mark the participation of Australian explorers and scientists in that part of the programme of the International Geophysical Year (I.G.Y.) which is to be conducted in Antarctica during 1957-58, the Australian contingent being due to depart from Melbourne on the ship *Kista Dan* on December 17.

The opportunity was taken briefly to review past Australian exploration and research in Antarctica and to explain some of the major topics selected for international co-operative research during the I.G.Y.

It was a particularly happy circumstance that His Royal Highness the Duke of Edinburgh had indicated his intention to visit Graham Land *en route* to England after his visit to Melbourne, and also that His Royal Highness's Antarctic Adviser, Sir Raymond Priestley, was present at the Symposium.

The Royal Society of Victoria is deeply grateful to His Royal Highness the Duke of Edinburgh for the honour of his presence in order to make the opening remarks at the Symposium, being aware that his interest and support will be a source of inspiration to all scientists who are actively concerned with the work of the I.G.Y. The Society honours all those explorers, past and present, to whose labours we owe our knowledge of the Sixth Continent.

The Symposium

Speakers

His Royal Highness The Duke of Edinburgh, K.G., K.T., F.R.S.

The President, Australian Academy of Science, Professor Marcus Oliphant, F.R.S., F.A.A.

Professor Sir Douglas Mawson, Kt., F.R.S., F.A.A.

Dr. D. F. Martyn, F.R.S., F.A.A.

The Director, Antarctic Division, Department of External Affairs, Mr. P. G. Law, M.Sc., F.Inst.P.

The President of the Society, Professor E. S. Hills, F.R.S., F.A.A., was in the Chair.

Guests

The Hon. the Premier of Victoria, Mr. H. E. Bolte
The Hon. the Chief Secretary of Victoria, Mr. A. G. Rylah
The Secretary to the Premier, Mr. W. J. Jungwirth
Sir Raymond Priestley
The Chairman of the Executive of C.S.I.R.O., Sir Ian Clunies Ross
The Chairman of the Arthur Wilson Memorial Foundation, Dr. E. R. White
Mrs. E .W. Skeats, Lady Mawson, Mr. J. W. Cudmore.

Recipients of Polar Medals which were presented at an Investiture conducted by His Royal Highness the Duke of Edinburgh in the Society's rooms after the conclusion of the Symposium, were also present as guests of the Society:

R. G. Dovers
Dr. Fritz Loewe
Mr. J. Jelbart*
J. D. Gleadell
W. Harvey
L. E. Macey
J. Russell
B. H. Stinear
W. J. Storer
Dr. R. O. Summers
J. M. Bechervaise
Mrs. H. Crohn†
F. W. Elliott
A. S. Gowlett
R. H. Lacey
E. L. Macklin
R. G. McNair
W. H. Oldham
N. R. Parsons
A. D. Riddell
P. J. R. Shaw
F. A. Van Hulssen
J. L. Ward

* Father of the late J. E. Jelbart, who lost his life in Antarctica.
† Mother of P. W. Crohn, who had not returned from Antarctica.

W. J. R. Dingle, Dr. R. W. Allison, and L. N. E. Jennings-Fox were unable to attend owing to their absence from Victoria.

Seventy-four Members of the Royal Society of Victoria were also present.

For the Members of the Symposium Committee of the Society—

E. S. Hills, *President*
E. D. Gill, *Hon. Secretary*
L. Adams, *Hon. Treasurer*
P. Crosbie Morrison
D. A. Casey.

19 December 1956.

HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH

K.G., K.T., F.R.S.

THREE things have drawn my attention to the Antarctic. First, the Transantarctic Expedition, second, the International Geophysical Year and the Royal Society's station on the Weddell Sea, and third, the Olympic Games in Melbourne.

Before that, all I can say is that I had heard of Scott, Shackleton, Amundsen and Byrd, and that the Antarctic was a continent and a very cold one. It was only when I thought of paying a visit to the Transantarctic Expedition at their Ross Sea or Weddell Sea base that I began to realize a bit more clearly what the place was like. I had to drop the idea in the end because it involved the risk of getting stuck there for 15 months when I felt that my nuisance value would be out of all proportion.

I then turned my attention to Graham Land and which looked much more feasible, and decided to visit some of the Falkland Islands Dependencies survey bases. I hope they will give me some idea of the nature of the continent and the methods of work and manner of life in those fairly high latitudes.

The whole idea come about because of the fact that I was due to open the Olympic Games in Melbourne in the early Antarctic summer.

In the process of making these plans, I had long discussions with the Royal Society, the Falkland Islands Dependencies Survey, and Dr. Fuchs, and as a result the Antarctic is exercising a growing fascination over me.

One of the things I discovered was the enormous amount of scientific work and exploration done by Australians in the Antarctic.

Epic is a mild description of the sledge journey in 1908 when Edgeworth David and Douglas Mawson reached the South Magnetic Pole; hauling the sledges themselves for a thousand miles, they had one biscuit left when they returned to the *Nimrod*. We are all delighted to see Sir Douglas Mawson with us here today. I am particularly delighted because I have just been reading about an even greater adventure of his. To see one's companions die, to stagger along alone for three weeks, to return to base only to find one's ship had sailed the day before, is more than enough to persuade any ordinary man to give up. But Mawson is not an ordinary man; he stayed another year, continued his scientific work and doubled his results.

John Rymill, who served his apprenticeship in Greenland under Gino Watkins, commanded the British Graham Land Expedition in 1934 and laid the foundations of the sledging technique which the men of the Falkland Islands Dependencies Survey have carried on and improved.

These men and many others deserve the admiration and the gratitude of the Australian people.

Exactly, what is the importance of the Antarctic continent? That, I think, is the main question in the minds of laymen when Antarctic enthusiasts get going.

Obviously, I am not going to answer that question because that is what I have come here to find out, but I would like to break the problem down into four parts so that at least the enthusiasts will understand what it is we want to know.

I don't think it is necessary to ask about its scientific importance. To the true scientist anything that is unknown is important.

Even though more than half a century has passed since the first landing on the Antarctic continent, it is still largely an unknown land. I hope to learn today what the modern scientist-explorers have found and what they hope to find.

So far, commercial exploitation has been confined to the Antarctic Ocean with

its whales and elephant seals. I know that traces of minerals of economic importance have been found, but I should like to know what are the prospects of their development.

Has the Antarctic any strategical importance? I know one scientist's answer to that. Let me quote from Sir Raymond Priestley's Presidential Address to the British Association for the Advancement of Science at Sheffield this year: "The strategic value of Antarctica, should world atomic war break out, with the consequent likelihood of the destruction of the Suez and Panama Canals, will stem from the fact that all intercontinental seaborne traffic, and much coastal traffic as well, must then proceed via the Cape of Good Hope and Cape Horn. Under the circumstances and from this cause alone, concern with Antarctica, as a possible air or submarine base, is bound to be a preoccupation of any great power."

Apart from the natural resources of the continent and its strategic importance, has it any other possible advantages to mankind? Various things have been suggested including using it as a gigantic vermin-free cold store for the world's periodic food surpluses, which could be preserved against periods of famine. Somehow I have a feeling that it will not be used to house the world's surplus population for quite a long time yet.

It has also been suggested that it might be developed as an air route. Looking at the map, the only possible routes would be Australia to South America, and New Zealand to South Africa. The distances are roughly equivalent to Wellington to Panama, but I don't know if this is a feasible operation.

In the meantime, exploration goes on at an ever-increasing pace, and I am looking forward to hearing the latest news which I hope the speakers at this Symposium are going to give us.

But before they start, I thought you might be interested to see this. It is the miniature White Ensign which Scott took with him on his sled to the South Pole. It was given to King George V and kept in the old Yacht *Victoria and Albert,* and it now hangs in the *Britannia.*

PROFESSOR MARCUS OLIPHANT, F.R.S., F.A.A.

MY part in this Symposium is purely nominal. As President of the Australian Academy of Science, and on behalf of that body I have to congratulate the Royal Society of Victoria which has arranged this discussion of a region of the world of immense importance to Australia, and express our sincere thanks to His Royal Highness, not only for his participation in this Symposium, but for his deep and abiding interest in all activities in the field of science.

It is significant that the first major national task entrusted to the Academy since its foundation by Her Majesty the Queen, during her visit to Ausralia, should be the organization and co-ordination of Australia's part in the International Geophysical Year, a period of special effort in the Arctic and Antarctic as well as throughout the inhabited regions of the world. At the same time the Academy has established standing committees to encourage the development of hydrology and of oceanography in the areas, including the Antarctic, which are the peculiar responsibility of Australia.

The Academy of Science is a national organization founded to encourage and assist Australian participation in scientific endeavour of all kinds. In its approach to the problems of science in the Antarctic its concern will be for the advancement

of natural knowledge as a human undertaking of great significance for all mankind. Its objective will be co-operation with *all* efforts, national or international, which will increase that knowledge and apply it for the good of all. Its desire will be that Australia's contribution should be honourable and worthy of our responsibilities as a sovereign nation and as a member of the British Commonwealth of Nations. Hence, we are deeply conscious of the value and the significance of the participation of His Royal Highness in our deliberations today. We will bear in mind his words of advice and encouragement. We assure him that men of science in this country will pursue their aims in the spirit of the Charter which, through his understanding, we received from Her Majesty the Queen, in person.

SIR DOUGLAS MAWSON, Kt., F.R.S., F.A.A.

Australian Links with Antarctica

ON account of its relative proximity, the great span of Antarctica facing Australia across the Southern Ocean is geographically linked with our Commonwealth. For long past we have been interested in taking stock of scientific data of that region and establishing in what ways it may have a bearing upon the development of Australia.

Australia and New Zealand have done much towards Antarctic exploration contributing notably, in human effort and achievement, to advance knowledge of the Antarctic regions to its present fullness.

However, it was not until the closing years of the nineteenth century that our limited population, fully occupied in exploring and developing Australia itself, could consider taking an active part in geographical problems further afield.

As early as 1775 Captain James Cook had achieved his famous circumnavigation in high southern latitudes, reducing the unknown to a region wherein the seas were so encumbered with floating ice as to virtually debar the further southward progress of sailing ships of those days.

With regard to the existence of a Great South Land, though he had discovered only several Antarctic islands located in the marginal zone of the ice-packed seas, he nevertheless wrote: "I firmly believe that there is a tract of land near the pole which is the source of most of the ice that is spread over this vast Southern Ocean."

About 45 years later a very notable Russian expedition under Admiral Bellingshausen located more Antarctic islands and further reduced the area of the unknown, ice-encumbered core of the South Polar regions. As opposed to Cook's belief that the existence of a central land mass was indicated, Bellingshausen propounded the ingenious theory that the core of the Antarctic Regions could be no more than a stupendous floating ice mass.

By the year 1820, sealing enterprises, almost exclusively British, began to play a notable part in the exploration of Antarctic seas, discovering many off-lying islands and several sections of coast subsequently proved to be part of the Antarctic Mainland.

Search for the South Magnetic Pole temporarily revived international interest. By the year 1840, France, Britain and America were in the field exploring Antarctic seas to the south of Australia. The French expedition under Admiral Dumont d'Urville, and the American fleet under Lieut. Wilkes sighted ice-capped land in several places to the south of Australia, in latitudes about the Antarctic Circle. The British expedition under Sir James Clark Ross broke through the pack-ice

into a great southward extension of navigable water, to be thereafter known as the Ross Sea. Outstanding geographical features were encountered, including an extensive high land area, South Victoria Land.

Thereafter, until the end of the century, Britain's interest in exploration was diverted elsewhere—to the Arctic and to Darkest Africa.

With the rising tide of science and the growing maturity of Australia during the closing years of last century, the scientific community of Melbourne and Sydney stressed the importance of further investigating Ross's discoveries.

Early in the 1890's an Antarctic Exploration Committee was active in Melbourne, but their efforts were frustrated by the period of severe financial depression which struck Australia at that time.

Among those especially concerned was J. H. Bull, a Melbourne merchant of Norwegian origin. By an appeal to Svend Foyn, a Norwegian whaling magnate of his acquaintance, he was eventually placed in charge of the *Antarctic,* a sailing ship equipped to test whaling prospects in the Ross Sea. C. E. Borchgrevink, a Norwegian national engaged at the time in New South Wales as a surveyor's assistant, begged to be included in the ship's company, and was signed on as "a generally useful hand".

On return from the Antarctic, Borchgrevink visited London and enlisted the co-operation of Sir George Newnes who financed an expedition to the Ross Sea. Borchgrevink's party established a Base Camp at Cape Adare, and were the first human beings to spend a winter on the Antarctic Mainland. This development further fanned the flame of scientific interest and triggered off great international activity in which Sweden, Britain, Germany, France, Belgium and Scotland all participated. Great was the accretion of knowledge resulting therefrom.

Of these expeditions, Australia was most interested in the British National Expedition of 1901-04. Lieut. Robert Falcon Scott was chosen to command the *Discovery*. They wintered for 2 years on the Ross Sea coast at the foot of Mt. Erebus. Great success was achieved. By a wide coverage of sledge journeys important geographical discoveries were made.

We come now to Shackleton's British Antarctic Expedition of 1907-09. Ernest Shackleton had been included as a ship's officer under Scott in the personnel of the *Discovery*. Public interest in the Far South having been whetted by the success of the *Discovery* Expedition, Shackleton's appeal for funds was well received both in Australia and in New Zealand.

Ultimately, Professor T. W. E. David of Sydney University and I were included in the scientific staff, joining with Raymond Priestley and John Murray, thereby increasing the scope of the scientific programme of the expedition. Bertram Armytage of Melbourne was also included in the wintering party to assist with the care of the Manchurian ponies.

Shackleton's sledge party reached to within 97 geographic miles of the South Geographic Pole. There the spectre of starvation turned them back. Our Australian party sledged in quite a different direction proceeding towards and eventually arriving at the area of the South Magnetic Pole.

The *Terra Nova* Expedition organized and led by Captain Scott followed in 1910. Scott's personal goal was to reach the South Geographic Pole, but his appreciation of the value of scientific research led him to include in the expedition personnel a number of young men of well-proved scientific attainment, including several Australians. The scientific results achieved were great. It will always remain a deep national regret that Scott's party did not survive the return journey from the Pole.

Roald Amundsen's dash to the South Pole added new knowledge concerning the eastern limits of the Ross Iceshelf, and of that approach to the Pole.

The attainment of the South Pole had proved too great a magnet, diverting resources and human effort from more rewarding fields for science in unknown Antarctica.

Thus when, in 1909, Scott had asked me to be a member of his prospective sledge party to the Pole, I explained to him that, in Australia, scientific interest was calling for the exploration of that wide and virtually unknown arc of the Antarctic lying directly south of Australia, rather than for continuance in, what was by then, the better known Ross Sea Region.

Thus it was that I planned and organized the Australasian Antarctic Expedition of 1911-14 which sailed south in the *Aurora*. The Australasian Association for the Advancement of Science threw its weight behind the project. Many leading Australians subscribed generously. Further help was forthcoming in London. Eventually, considerable financial assistance was extended from Australian Government sources. We were fortunate in securing as Ship's Captain and Second in Command of the Expedition, Captain J. K. Davis, who had already won his spurs on Shackleton's *Nimrod*.

The programme was extensive, planned solely to search for new knowledge within a wide range of scientific enquiry. To help trace the movement of air masses between Antarctica and Australia, a sub-Antarctic station was established and maintained on Macquarie Island.

Dumont d'Urville and Wilkes had both recorded sighting land in that great sweep of ice-encumbered ocean but, except in the case of Terre Adélie, the reports were extremely vague. One thing appeared certain—that almost all land we might discover would be smothered beneath an over-riding ice-cap. To do everything possible to obtain samples of the rock formations beneath the flood of ice, I arranged for the expedition's vessel *Aurora* to be equipped with a powerful dredge for scooping up erratics from the off-shore sea-floor. By this means some idea of the general nature of the rock terrain underlying the ice-cap was obtained throughout the whole sector investigated.

On what proved to be the Antarctic mainland, two base-stations were established. These were located 1100 miles apart, each set up on the shore of land areas discovered by the expedition, named respectively King George Land and Queen Mary Land.

The plans of Lieut. Filchner's German expedition to the Weddell Sea were cut short by the *Deutschland* being irrevocably caught in the pack ice.

Shackleton's second and third expeditions which followed were curtailed by disasters. In 1916 the Australian and New Zealand Governments relieved his Ross Sea party from their plight.

In the early 1920's, the Falkland Islands Government, through the Colonial Office, initiated an important organization for land exploration and marine biological research. In its earlier years their programme was mainly confined within the area of the Falkland Islands Antarctic Dependency. In later years marine operations were extended throughout the waters of the Southern Ocean. Land occupation has continued to the present day.

The Australian explorer Sir Hubert Wilkins, partly in co-operation with the *Discovery* Committee's programme during the summer of 1928 and 1929, made long flights exploring the Graham Land chain and the impenetrable pack-ice region to the south-west thereof.

The Australian National Research Council, in the year 1925, drew the Com-

monwealth Government's attention to the increasing concern to Australia of adjacent Antarctic lands. Prime Minister, Stanley M. Bruce, at the conference in London in 1926, indicated Australia's interest in Antarctic territory in the regions to the south.

As a result, our British-Australian-New Zealand Antarctic Research Expedition set forth in the *Discovery* in 1929, and continued through two summer cruises, to explore Antarctic seas to the south of Australia and around to the west, as far as the meridian of 45° east of Greenwich. The scientific results forthcoming included oceanographic investigations, the discovery of new coast-line, namely Banzare Land, Princess Elizabeth Land and MacRobertson Land, as well as checking and delineating Enderby Land, Kemp Land and Sabrina Land, the existence of which had been reported by sealers about 100 years earlier, but never confirmed.

The recovery of erratics from the off-shore sea-floor by systematic dredging was extended to the west from the region dealt with by our expedition of 1911-14. The evidence of sialic rocks secured everywhere by these dredgings, when taken in conjunction with the existence of a submerged continental shelf proved, by our soundings, to exist throughout an arc of 125° of longitude to the west of the Ross Sea, left no doubt that a continental platform exists beneath the ice throughout that area. These observations, extending the findings of other expeditions working in the Ross Sea region, demonstrated the existence, beneath the Antarctic ice-cap, of a bulge in the crustal-lithosphere, continental in size and composed of continental type rocks—obviously a continent beneath the ice-cap.

Even if, in places, the underlying rocky crust is depressed below sea-level by isostatic response to the immense ice-cap load, the Antarctic Mainland still remains an ice-welded continent.

In the year 1933, following upon our extended explorations, the Antarctic arc lying to the south of Australia, where not already under foreign suzerainty, was proclaimed by an Order in Council of His Majesty's Government, as British Territory. Then followed the Australian Antarctic Territory Acceptance Act, placing it under the authority of the Commonwealth.

The entry of the United States of America into Antarctic land exploration was undertaken by Admiral Byrd in 1928. Having previously flown to the North Pole he set out to reach the South Pole. The expedition operated from a base "Little America" located near the eastern limits of the Ross Ice-shelf. Important geographical and other results were obtained. Byrd flew over the Pole as planned.

During the next 10 years Byrd led other very large-scale expeditions, which, as in the case of his first, were all concentrated on the exploration of the previously unknown sector of Antarctica lying to the south of the Pacific Ocean.

In 1935, Lincoln Ellsworth, another American, completed a very notable flight across a great lobe of unknown Antarctica from the Graham Land area to Little America on the Ross Sea. Even prior to the Second World War the combined United States operations, in the region south of the Pacific, gave to the world a very good picture of an immense area previously unexplored.

The Norwegian whaling magnate, Lars Christensen, in association with whaling operations, pursued a programme of geographical exploration between the years 1928-36. Norwegian aviators participating in these investigations discovered much new land and greatly contributed to knowledge of the location and nature of the coastal margin of Antarctica.

The South Australian, John Rymill, organized and led with great success an expedition to western Graham Land. Important geographical features were encountered. New land was discovered and mapped.

At the conclusion of the Second World War eyes were again turned towards the Antarctic. In the summer of 1947-48, under the planning and advice of Admiral Byrd, the U.S.A. Navy staged operation "High Jump" which set out to photograph from the air, the major part of the coastline of Antarctica. A great fleet of ships, aircraft and men participated. It was about this time also that an American, Finn Ronne, led an expedition to Graham Land which, partly in co-operation with members of a Falkland Islands Government expedition, also operating there, achieved a great advance in knowledge concerning the western margin of the Weddell Sea.

Paul Emile Victor's Explorations Polaire established a base on Terre Adélie in 1940 and continued operations for several years, thereby completing the detailed mapping of that French Territory.

During the years 1949-52 an important Norwegian-Swedish-British Expedition operated from Crown Princess Martha coast south of the mid-Atlantic. Australians Robin and Jelbart were members of staff. A long line of ice soundings was run from the coast inland across the ice-cap with most interesting and valuable results.

Reverting to the year 1939, plans were then afoot in Australia for continuing with scientific investigations in the Territory claimed by Australia. These proposals had to be abandoned when war broke out, but were revived again later in another form.

In 1946, the Australian National Research Council drew the attention of the Commonwealth Government to the desirability of continuing with the exploration of Australian territory in the Antarctic. The Chifley Government of the time was responsive; Dr. Herbert Evatt, then Minister for External Affairs, undertook to support a programme of research. To cope with this activity there was developed the Antarctic Division of the Department of External Affairs. Operations commenced early in 1947 and have continued ever since. Now under the stimulus of the Rt. Hon. R. G. Casey, the present Minister, it is engaged on a big job as part of the programme of the International Polar Year. Mr. P. G. Law is the Director of activities. He, being present today, will, I believe, briefly indicate the operations in hand.

DR. D. F. MARTYN, F.R.S., F.A.A.

Australia and the International Geophysical Year

THE International Geophysical Year, colloquially known as I.G.Y., is the successor of two former great co-operative efforts by world scientists—the International Polar Years of 1882-83 and of 1932-33. These earlier "Polar Years" were organized mainly to study magnetism, meteorology, and the aurora, earth sciences which show marked peculiarities in polar regions. However, as a result of knowledge gained from these and subsequent studies, it has become apparent that the striking phenomena of these regions have their counterparts in moderate and even equatorial latitudes. The marked perturbations of the earth's magnetic field which frequently occur at latitudes near 67° are paralleled by strong perturbations in a narrow belt only a few hundred miles wide near the magnetic equator. The aurora borealis has been seen at Bombay.

Because we now realize that almost all the earth's sciences are global in scope, that polar phenomena are closely linked with happenings in other parts of the world, the forthcoming international effort has been given a world-wide scope, and is called a geophysical rather than a "polar" year.

One of the first men of science to realize the global character of the daily geomagnetic variations was Balfour Stewart, who set out his views in the *Encyclopedia Britannica* (9th edition). In a famous article he forecasted the existence of the ionosphere, an electrically conducting region high in the earth's atmosphere, and showed how electric currents flowing there were the probable cause of the daily movements of the compass needle in all parts of the earth. He further showed how such electric currents could be generated by tidal winds, the upper atmosphere becoming a giant dynamo as the conducting air was driven across the magnetic field of the earth itself.

As we shall see later this remarkable hypothesis of Balfour Stewart, after many vicissitudes, has come into its own. It is a fitting tribute to a remarkable man, to his work on geomagnetism, the aurora, on solar radiation, on atmospheric electricity, and on meteorology, that the first satellite to be launched from the earth during the I.G.Y. will be called "Balfour Stewart".

It is a happy coincidence for us here today that the name of Balfour Stewart will always be closely associated with that of Edinburgh. Stewart was born in Edinburgh in 1828 and later did much of his work in the Natural Philosophy Department of its University. What may not be so well-known is the further happy coincidence that he began his career at sea, and that he developed a lasting interest in science in the course of a voyage to Australia. In fact, his first scientific paper was published here in Melbourne by this Society, of which he was a foundation member, just a century ago.

It is unlikely that Stewart's audience here a hundred years ago realized how important a role Edinburgh would soon assume in science. In this respect we are better informed; we are well aware already of the keen and knowledgeable interest of our distinguished visitor in all aspects of science, of his membership and informed patronage of the Royal Society of London, and of his personal interest in the presentation of a Royal Charter to our youthful Australian Academy of Science. It requires no electronic brain to predict that the name of Edinburgh will for long continue to be associated with science and its adaptation to human welfare. That is certainly the sincere hope and wish of all of us.

Stewart's atmospheric dynamo was conceived long before wireless had emerged from the laboratory. At the turn of the century when it became clear that some invisible mirror in the atmosphere was helping radio waves bend round the globe beyond the horizon, two engineers, Kennelly in America, and Heaviside in England, independently suggested that this mirror was a conducting region high in the atmosphere. It was not until 1925, however, that Sir Edward Appleton, now the distinguished Vice-Chancellor of the University of (yes!) Edinburgh, proved by direct experiment the existence of conducting regions at heights of 60 miles and more above the ground. This confirmed the ideas of Kennelly and Heaviside about the mechanism of long distance radio propagation, but a doubt still remained about Stewart's dynamo. It appeared that the ionosphere, as the newly-discovered regions were named, was a good enough conductor of electricity to act as a radio "mirror", but was not a good enough conductor to circulate the world-wide dynamo currents which Stewart believed to be the cause of the daily variations of the compass needle. This difficulty remained until a year or two ago when Australian scientists showed that the ionosphere has the peculiar property of giving electric currents which flow, not parallel to the electric field, but nearly perpendicular to it. When account was taken of this peculiarity it was at last possible to say definitely that Stewart was right, that his atmospheric dynamo does indeed account for the daily magnetic variations. In fact, the modern form of Stewart's theory predicts that there should

be a peculiar narrow region near the magnetic equator in which the variations of the compass would be unusually large. Such a region, the so-called "electrojet", has indeed been found to run round the earth, passing through Peru, Brazil, Abyssinia and the southern tip of India. It is the existence of such peculiar equatorial phenomena in the ionosphere that is largely responsible for the extension of the I.G.Y. to include non-polar as well as polar regions.

The concept of holding an International Geophysical Year in 1957-58 developed in discussions between Professor Sydney Chapman of Oxford and Dr. Lloyd Berkner, President of Associated Universities (America) in 1950. There were two reasons for the date suggested. It was realized that 1957-58 would coincide with a peak of activity of the eleven-year sunspot cycle, which would profoundly enhance nearly all the phenomena to be studied, and that it would require six or seven years to complete all the manifold preparations for so big an international effort. The plan was enthusiastically endorsed by the International Council of Scientific Unions, which speedily set up a central planning organization under the chairmanship of Professor Chapman. By 1952 it had become possible to get down to detailed planning. In that year, Australia was host country to the General Assembly of the International Union of Radio Science, the first occasion on which an International Union had met south of the equator. As guests of the Commonwealth Government, the Commission on the Ionosphere, a Commission composed of representatives of several scientific Unions, met in Canberra under the Presidency of Sir Edward Appleton. At this meeting, plans presented by Professor Chapman were considered in detail by a distinguished international group of scientists. The resulting manuscript, which may truly be called the "master plan" for I.G.Y., and which now rests in the archieves of the Australian Academy of Science, was subsequently substantially endorsed by the relevant specialist Unions.

The subjects to be studied intensively during I.G.Y. are meterorology, geomagnetism, the aurora (both polar and non-polar—the latter being now called just "air-glow"), the ionosphere, the sun (especially sunspots, eruptions and coronal "hot spots"), cosmic rays, glaciers, earthquakes and earth tremors, the shape of the earth, and the variations of the force of gravity over its surface. On certain predetermined days or groups of days, so called "world intervals" or "world days", the rate of observation will be stepped up in all fields of activity. Other "special days" will be determined at short notice, when unusual solar activity suggests the imminence of a world-wide electrical and magnetic "storm" in the earth's high atmosphere. Notice of these "special days" will be flashed to all observers by an elaborate world-wide communications network.

The observers will be located at all latitudes over the earth, but there will be special concentrations near three meridians, one through the Americas, one through Europe and Africa, and one through Australia and Japan.

This vast effort has required provision of men and money. Some idea of the scale of the effort involved will be given if I mention that the United States alone will spend more than $30 millions on I.G.Y. The finding of scientists and technicians has been more difficult in all countries except Russia, in fact, the extent of Australian participation will be determined largely by the number of available scientists in the appropriate fields who are able to turn their attention to the appropriate geophysical tasks during I.G.Y. The Commonwealth Government, through the Academy of Science, has made available £67,000 for the purpose of enabling the Universities and other non-departmental bodies and persons to take an active role. In addition, various Government bodies such as the Commonwealth Scientific and Industrial Research Organization, the Department of External Affairs (Antarctic Research

Division), the Department of National Development, of Supply and of the Interior will each step up its normal activities to a higher level during I.G.Y.

The most exciting and potentially most fruitful event in I.G.Y. will be the launching of the first man-made satellites of the earth from Florida in the United States. During the planning stages the code letters sometimes used to denote such satellites were M.O.U.S.E.—minimum orbital unmanned satellite of earth—mouse. They will be large mice, weighing about 20 lb., and about 20 inches in diameter, large enough to be seen at sunrise and sunset when the sky is still dark and the satellite illuminated by the sun's rays. Certainly the effort at present being expended in preparation for their launching is mountainous. Next year, the 2,000-year-old words of Phaedrus should come true:

> "The mountain groaned in pangs of birth;
> Great expectation filled the earth;
> And lo! a mouse was born!"

The first satellite will be launched into its orbit about 300 miles above the earth with a speed of 18,000 miles per hour. It will go round the world in about an hour and a half and will be in the sky for a few minutes once a week in moderate to low latitudes. It will not be seen at high latitudes. One of the first puzzles it will settle is the density of the atmosphere at great heights. According to American calculations, which are based mainly on some observations made by rocket-borne instruments, the first satellite would stay in its orbit for about a year before being slowed down by impact with air molecules. According to Australian calculations, which are based on a long series of measurements of radar echoes from the ionosphere, it is unlikely that the satellite will stay in the sky for more than a few weeks.

There are many perplexing discrepancies like this that we may expect to see resolved during the forthcoming year.

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IN 1947 the Australian Government established the Australian National Antarctic Research Expeditions.

The ANARE, as it is called, is organized on a national basis. Its funds are wholly provided by the Government, it is backed and assisted by a number of Government departments and Australian universities, and the Department of External Affairs is responsible for its administration.

There are two main reasons for the activities of the ANARE:

1. Australian Antarctic Territory embraces 2½ million square miles of the Antarctic Continent. The ANARE aims to explore this area and to build up techniques of living and working in this region so that ultimately the Territory can be developed and its resources exploited.

2. Antarctica and the Southern Ocean together comprise somewhat more than one eighth of the surface of the earth, yet in this area scientific observations are few and our knowledge of the region is scanty. Data from Antarctica is urgently needed in a number of scientific fields—in geophysics, biology and geology—and Australia is geographically better situated than any other country to carry out such research in the Indian Ocean Sector. The results obtained will be of great value to scientists throughout the world.

For ten years now this work has been proceeding. In 1948 the first expeditions established stations on Heard Island and on Macquarie Island and attempted, although unsuccessfully, to push through to Antarctica itself in the small ship *Wyatt Earp*.

During the period 1948-1953 inclusive, the ANARE devoted its efforts to developing and manning geophysical observatories on Heard and Macquarie Islands. Landing operations under the most difficult of conditions, together with the energetic and determined efforts of successive parties of men, gradually built up these establishments and produced unbroken series of important geophysical observations. Meanwhile, in Melbourne, the headquarters organization of the Antarctic Division of the Department of External Affairs gained experience and consolidated its techniques.

Always before it was the objective of setting up a research station on the Antarctic Continent, but world-wide investigations failed to discover a suitable ship.

Finally, in 1953, a new Danish ice ship, the *Kista Dan,* was chartered and, early in 1954, the ANARE established a research station on an unknown stretch of the MacRobertson Land coast.

This was the first Australian research station in Antarctica since Sir Douglas Mawson returned to Australia from his base at Commonwealth Bay in 1913. The new station was called, most appropriately, after this famous explorer.

However, the material and manpower resources of the ANARE and the passenger accommodation on the *Kista Dan* were not adequate to maintain three stations at full strength, so in order to permit the full development of the Mawson Station, the Heard Island Station was reluctantly closed down early in 1955.

Plans for the International Geophysical Year which began to develop in 1955 underlined the importance of the Mawson and Macquarie Island stations, conveniently situated at widely separated points on the southern auroral zone. In 1956 and 1957, therefore, additional instruments and equipment are being added to the already elaborate installations.

In 1957 Macquarie Island will have 48 huts and Mawson 30. At each station the geophysical studies will be much the same: meteorology—including radiosonde and rawind upper air observations; geomagnetism—magnetographs and absolute instruments; cosmic rays—automatic counter telescopes and neutron recorders; ionosphere—vertical sounding equipment and radar meteor wind apparatus; aurorae—all sky cameras, auroral height cameras, spectographs and visual theodolites; seismology—seismographs for teleseismic observations; other studies—gravity measurements and tide gauge records.

At Mawson, in addition, there are glaciological studies, ice-depth measurements and geological and topographical surveys, while from the *Kista Dan* depth soundings are regularly carried out. At both Mawson and Macquarie Island advanced studies in biology are being pushed forward.

In 1957 the ANARE will set up a new Antarctic base at Vestfold Hills, where studies in meteorology, geology and aurora will be carried on. Also, an automatic weather station will be installed on the Wilkes Land coast.

In addition to scientific research the ANARE has carried out much valuable exploration. In 1954 Robert Dovers and his men traversed for the first time the MacRobertson, Kemp and Enderby Land coasts from the Scullin Monolith to King Edward VIII Gulf. They also penetrated inland 160 miles to see ahead of them a vast series of ranges which Dovers named the Prince Charles Mountains.

The following year John Bechervaise and his men succeeded in reaching the Prince Charles Mountains 220 miles inland, but the breakdown of their vehicles

prevented them from carrying out their ambitious plans to explore these mountains for a further 200 miles. They also surveyed and climbed for the first time the coastal ranges south-west of Mawson and carried out geological and glaciological studies along the coast and immediate hinterland.

This year Bill Bewsher and his men have already achieved much and the main part of their working period is still ahead. With the aid of two aircraft, operated by a R.A.A.F. Flight led by Squadron Leader Douglas Leckie, they have surveyed and photographed from the air everything within a radius of more than 300 miles from Mawson. They have opened up vast interesting regions in Enderby Land never before seen and have plotted new and unexpected coastal features, glaciers and mountain ranges. Using aircraft as ferries they have landed scientists in remote areas hundreds of miles from Mawson to make their observations. Later this summer they plan long surface journeys over the Antarctic Plateau using snow vehicles.

Meanwhile, each year, the *Kista Dan* pushes in through pack-ice to permit ANARE men to make landings and carry out research and exploration along coasts never before visited. Such work has now covered 1500 miles of coast, from Adelie Land to Enderby Land, most of which has been photographically surveyed by the Expedition's Beaver aircraft.

With its administrative and field techniques well established, and its scientific stations already operating at almost their full strength, the ANARE looks forward confidently to the results of its efforts during the International Geophysical Year.