INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

No 20. May 1965

SCAR

SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

BULLETIN

ARGENTINA AUSTRALIA BELGIUM

CHILE FRANCE JAPAN NEW ZEALAND

NORWAY SOUTH AFRICA UNITED KINGDOM

UNION OF SOVIET SOCIALIST REPUBLICS

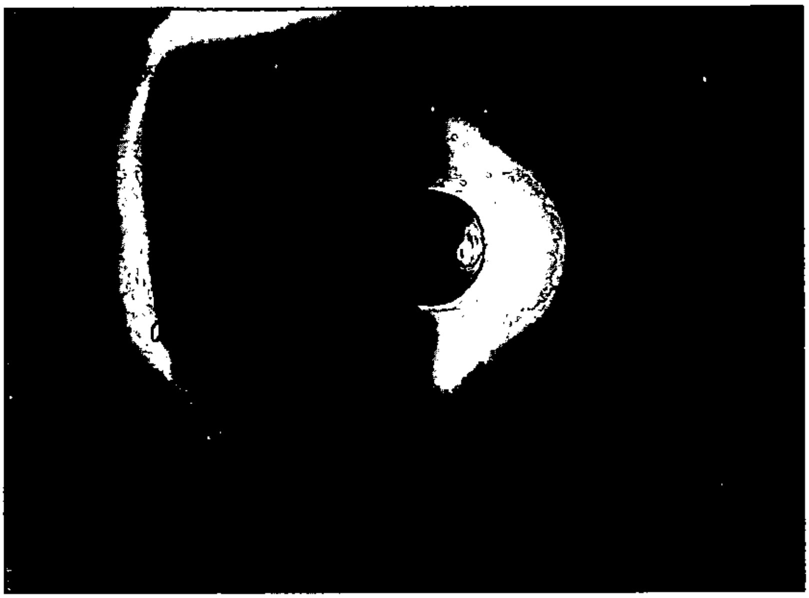
UNITED STATES OF AMERICA

PUBLISHED BY

SCOTT POLAR RESEARCH INSTITUTE, CAMBRIDGE ENGLAND

INSTITUTO ANTARTICO ARGENTINO, BUENOS AIRES, ARGENTINA

Reprinted from *Polar Record*, Vol 12, No 80, 1965, p 611–30.



Photograph in the magnetic meridian plane of a plasma stream incident upon a model earth.

The Polar Record, Vol 12, *No* 80, *p* 611–630
Printed in Great Britain

SCAR BULLETIN

No. 20, May 1965

IQSY IN THE ANTARCTIC

BY TAKESI NAGATA*

CONTENTS

Introduction

During the period of the IGY, 1957–58, and the succeeding period of IGC, 1959, the basic concepts of solar-terrestrial relations were fundamentally altered. Before the IGY, for example, it was believed that the interplanetary space between the Sun and the Earth is almost vacant. It was known that electromagnetic waves of various lengths are continuously radiated from the sun and clouds of ionized corpuscles are occasionally emitted from some parts of the solar surface, resulting in the magnetic storms and auroral displays on the earth, but the quiet interplanetary space was imagined as a space where only the energy of electromagnetic waves exists. Now it is known that the solar corona is extended for a long distance away from the sun, and consequently the interplanetary space is filled up with the cold plasma which is emitted continuously from the sun. "Cold" plasma means plasma in which the non-thermal energy exceeds the thermal energy; in this case the velocity of the plasma as a whole outwards from the sun is greater than the thermal agitation within the plasma. Hence the phenomenon is referred to as the "solar wind".

Fig 1 shows a schematic picture of the solar wind deduced from a number of observed facts. The geomagnetic cavity around the earth is caused by the rejection of the solar wind plasma by the magnetic field of the earth. We can demonstrate the formation of this cavity experimentally in the laboratory and an example of the results obtained is shown in the Plate. The magnetic field of the model earth resists the artificial plasma stream and protects the space around the earth from the plasma. Note, however, that thin streams of the plasma enter the cavity space only towards the north and south polar regions of the model earth. A schematic illustration of the geomagnetic cavity is shown in Fig 2; most of the features shown have been confirmed by direct observations, model experiments and by theoretical examinations. For example, a shock front surface which was predicted theoretically on the sunward side of the boundary of the cavity has been confirmed by direct measurements on space vehicles. Thus, the physical

* Geophysical Institute, University of Tokyo.

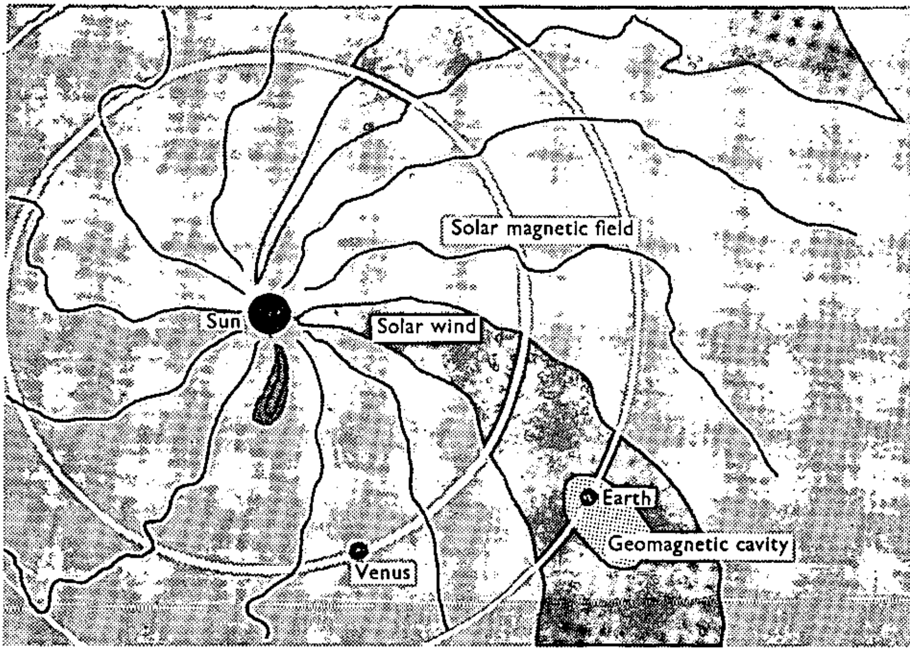


Fig 1. Schematic picture of "solar wind".

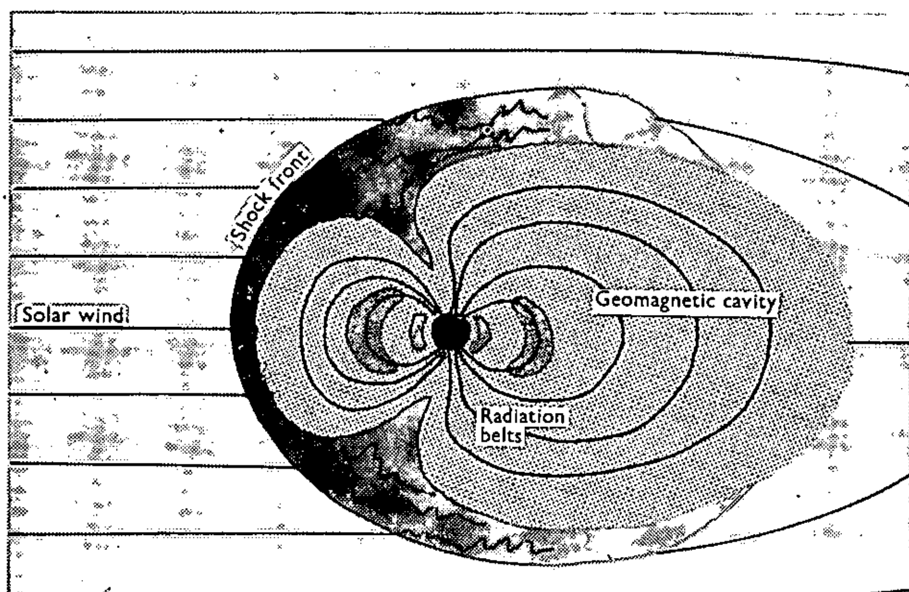


Fig 2. Structure within the geomagnetic cavity.

picture of the electromagnetic characteristics of the earth's environment is almost completely different from that previous to the IGY.

The fundamental discoveries have been made not only from space physics research by means of satellites and space vehicles, but also from extensive observational work carried out over both the north and south polar regions. The chief problem remaining for the IQSY is to observe the solar wind in the quietest condition of the sun, and the effect of the quiet solar wind on the earth.

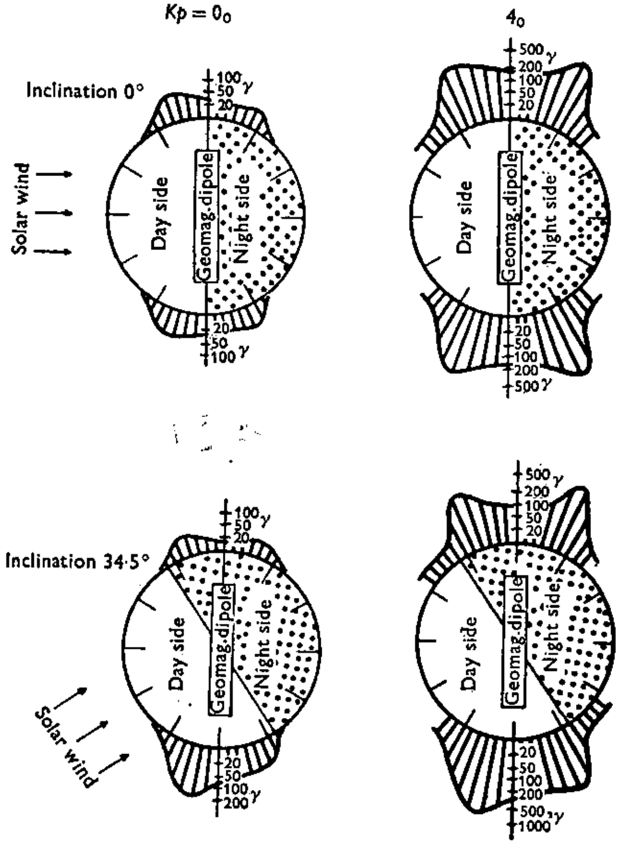


Fig 3. Magnetic agitation in the noon–midnight meridian plane during calm ($K_p = 0_0$) and moderately disturbed ($K_p = 4_0$) conditions during IGY period (after Fukushima).

Antarctic observation networks

Networks of observational stations for the IQSY have been set up in the Antarctic, and a series of maps showing their location was published in the *SCAR Bulletin*, No 17 (*Polar Record*, Vol 12, No 77, 1964, p 222–25). The disciplines represented are cosmic rays, ionosphere, aurora, geomagnetism and meteorology.

In Antarctic and Arctic regions, the incoming streams of plasma are stopped by the earth's atmosphere, generally at the level of the ionosphere, and only the high energy parts of the plasma can be observed as solar cosmic rays at ground evel. The incoming plasma streams and the disturbed ionosphere are believed to cause auroral displays of various types, and polar geomagnetic disturbances, and it is now considered that upper atmosphere disturbances at the ionospheric level may propagate downwards to the ozone layer, or to the upper part of the stratosphere. Therefore, the meteorological network in Antarctica includes ozone measurements as well as the aerological studies with the aid of radio and Rawinsondes. One of the advantages of the Antarctic network is that it covers both the geographic pole and the south magnetic pole and, therefore, the whole polar cap area.

Geomagnetic disturbances in the polar cap in quiet sun conditions

Conclusive results have not yet been obtained on polar magnetic disturbances for the quiet sun period, but Fig 3 illustrates the distribution of geomagnetic agitation along the noon–midnight meridian circle for an extremely quiet period

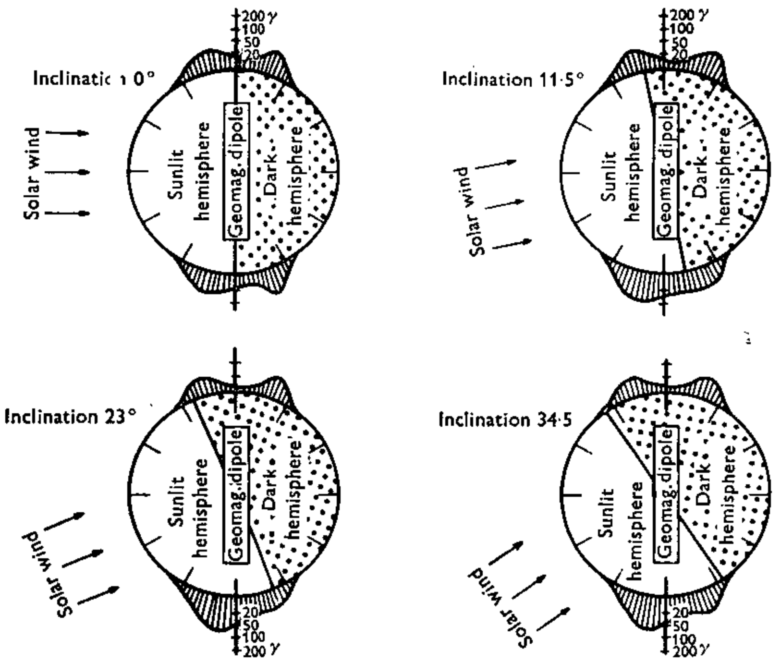


Fig 4. Magnetic agitation in the noon–midnight meridian plane during calm ($K_p = 0_0$) conditions during Second Polar Year (after Fukushima).

($K_p = 0$)* during the IGY. However, geomagnetic agitation of considerable magnitude does exist in both polar regions even on the $K_p = 0$ days. The magnitude of agitation confined to the polar regions is larger on the sunlit side than on the dark side of the earth. In connexion with the general picture of the geomagnetic cavity, we may guess that the earth's polar regions are more or less

* The K index at a single station is a measure of the total range of magnetic variation during each 3-hourly period. K_p is the average K index for the whole earth. *Ed.*

subject to the incoming branch streams of the incoming solar wind, and the result in Fig 3 was derived from data on the quietest days during the IGY period, when the *average* solar activity was around its maximum stage, and not from data for the real quiet sun.

The Second International Polar Year, 1932–33, was in approximate coincidence with a quiet sun period. Fig 4 shows a similar result on polar geomagnetic agitation derived from the Second Polar Year data. The general tendency is in agreement with that of Fig 3 but the magnitude of agitation in the former is smaller than in the latter. Furthermore, the results shown in Fig 4 were derived only from Arctic data, no Antarctic data were available for this study. Simultaneous geomagnetic data from both polar regions will be available during the quiet sun period, providing much more exact knowledge about the effect of the quiet solar breeze and of the solar light on the polar upper atmosphere.

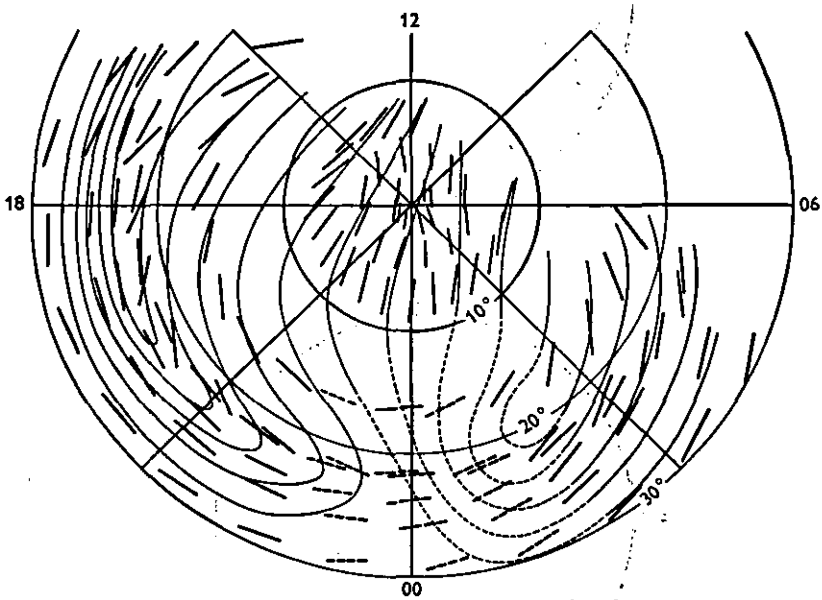


Fig 5. Patterns of auroral forms recorded by all-sky cameras in co-ordinates of geomagnetic co-latitude and approximate geomagnetic time. The pecked lines represent the alignment of aurorae after break-up (after Davis).

Polar cap aurora in quiet sun conditions

Much advantage was obtained from the IGY–IGC data in understanding the auroral zone aurorae. These aurorae are supposed to be caused mainly by electron beams pushed out from the earth's radiation belts by compression of the geomagnetic cavity by an increased strong solar force from the active sun.

For the IQSY period, interest will be focused mainly on the polar cap aurorae which may be linked directly with the incoming plasma streams composed of electrons and protons or other positive ions.

It is almost certain that this type of aurorae did exist in the polar cap area during the IGY–IGC period, but that they were masked and disturbed by the very bright auroral-zone aurorae. For example, based on the IGY data, it was suggested that the alignment of the polar cap auroral forms is likely to be parallel to the midnight–noon meridian line, while the patterns of the auroral

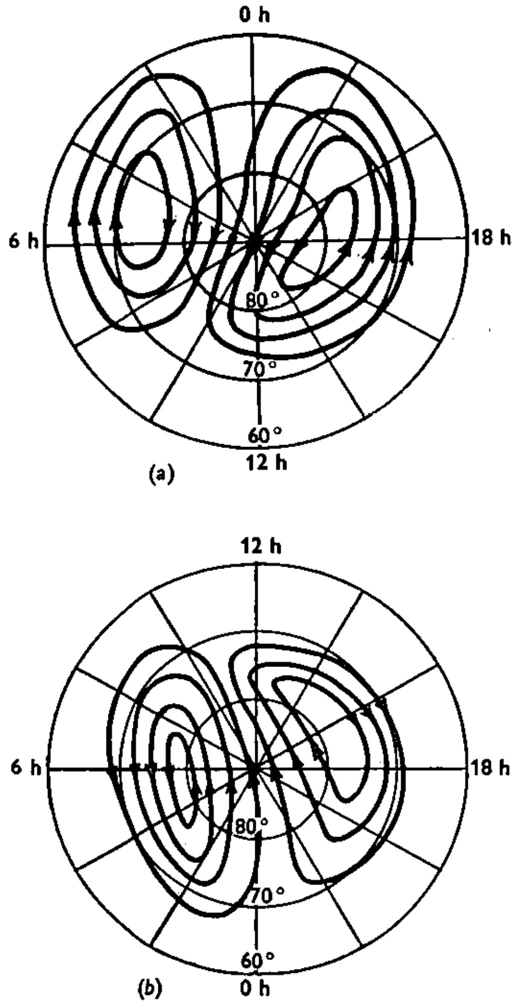


Fig 6. System of electric currents in the sunlit ionosphere calculated to account for the magnetic distrubance component Sq^p (after Nagata and Kokubun). (*a*) North polar cap. (*b*) South polar cap.

zone aurorae are mostly parallel to the auroral zone, as shown in Fig 5. The possibility of disturbances and interferences coming from the bright auroral zone aurorae must be remembered however. Fig 6 illustrates the average pattern of the ionospheric electric current on absolutely quiet days. This figure shows that the polar geomagnetic agitation in quiet sun conditions has a certain regularity, or in other words, the polar cap disturbances in quiet conditions is subject to a certain systematic rule. If this is the case, the polar cap aurorae caused by the quiet sun will also be similarly affected.

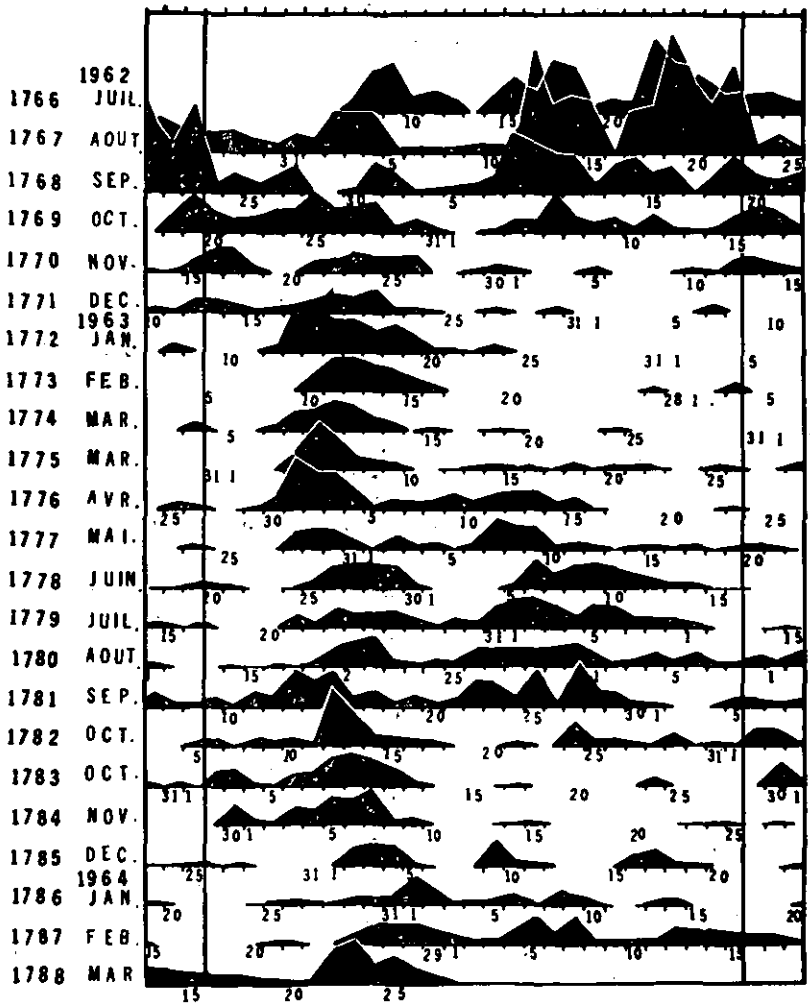


Fig 7. Each horizontal line represents one solar rotation of 27 days. The daily index of geomagnetic micropulsations (PC_3) is plotted vertically on each line and successive solar rotations appear one below the other. July 1962 to March 1964 (after Saito).

The M-region, the solar wind, and geomagnetic pulsations

One of many other subjects which can be clarified only during the quiet sun period is the nature of the "M-regions" on the Sun. The 27-day recurrence tendency of K_p indices is well known and, as the late Professor Bartels pointed out many years ago, this recurrence tendency is clearly observed only during quiet sun periods. The period of 27 days can be attributed only to the rotation period of the sun with respect to the earth. We may suppose that a comparatively narrow stream of solar wind emitted from a limited area of the sun's surface survives during many rotations of the sun and sweeps the earth every 27 days. The unknown area of activity on the sun's surface is called an M-region and the recurrence tendency during recent years can be seen in Fig 7. This diagram illustrates the activity of geomagnetic micropulsations, which are interpreted as the hydromagnetic waves originating near the boundary of the geomagnetic

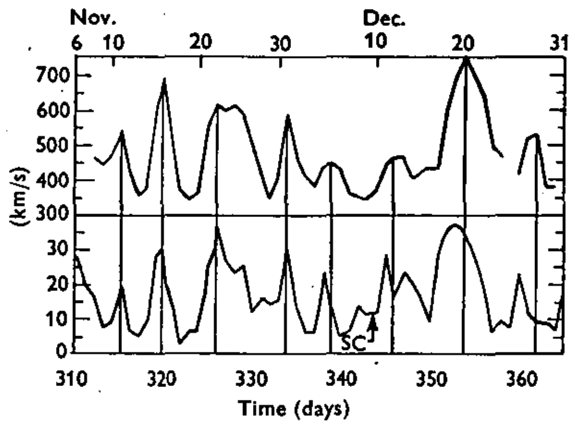


Fig 8. The upper curve represents the daily mean velocity of the solar wind (km/s) measured by the Mariner II spacecraft, while the lower curve shows the sum of the eight K_p indices for each day from 6 November to 31 December 1962 (after Snyder, Neugebauer and Rao).

cavity and the solar wind, and propagating from there to the earth. Therefore, we may suppose that the surface of the geomagnetic cavity has been disturbed every 27 days for the recent quiet sun period. The direct cause of this disturbance was recently illustrated in the results obtained from spacecraft Mariner II. The velocity of the solar wind correlates positively with the geomagnetic K_p indices (Fig 8), and the activity of geomagnetic pulsations is even better correlated with the solar wind velocity, but no other observable geophysical phenomenon is as well correlated with the solar wind. It can therefore be said that the M-region emits a narrow beam of plasma of higher velocity than that emitted from other parts of the solar surface though the cause of this is not yet known. The propagation of hydromagnetic waves, which carry information of the solar wind variation to the earth, has not yet been fully understood. These problems could be solved only during the quiet sun period, and, in particular, by means of satellites or space vehicles in outer space and in the polar regions which are considered to be two windows open to the plasma streams and the hydromagnetic waves coming from the earth's outer space.

Conclusion

Since the Antarctic area is linked to the Arctic area by lines of geomagnetic force, both polar areas are very closely linked by plasma phenomena in the earth's environment. So we must set up a close co-operative system between Antarctic and Arctic observatories, and must undertake the homogeneous and simultaneous observations in both areas. The necessity of this co-ordination between Antarctic and Arctic was not well recognized for the IGY–IGC periods.

References

Davis, T. N. 1962. The morphology of the auroral displays of 1957–1958. *Journal of Geophysical Research*, Vol 67, p 75–110.

Fukushima, M. 1962. Gross character of geomagnetic disturbance during the International Geophysical Year and the Second Polar Year. *Report of Ionosphere and Space Research in Japan*, Vol 16, Pt 1.

Nagata, T. *and* Kokubun, S. 1962. An additional geomagnetic variation field (S_q^p-field) in the polar region on geomagnetically quiet days. *Report of Ionosphere and Space Research in Japan*, Vol 16, p 256–74.

Saito, T. 1964. A new index of geomagnetic pulsation and its relation to solar M-regions. *Report of Ionosphere and Space Research in Japan*, Vol 18, p 260–74.

Snyder, C. W., Neugebauer, M. *and* Rao, U. R. 1963. The solar wind velocity and its correlation with cosmic ray variations and with solar and geomagnetic activity. *Journal of Geophysical Research*, Vol 68, p 6361–70.

SCIENTIFIC INVESTIGATIONS RECOMMENDED BY SCAR: OCEANOGRAPHY

This amends and supersedes for the discipline of Oceanography the list published in *SCAR Bulletin* No 3, 1959, p 601–02 and includes later amendments approved by SCAR.

Oceanography

During recent years it has become evident that scattered observations add little to knowledge of Antarctic oceanography. To facilitate planning, the SCAR programme must be focused on basic problems, the best methods for their solution and the attainment of long term objectives.

Scientific interest

The scientific study of the Antarctic marine expanse is of interest because:

(1) It covers a vast region of the earth's surface latitudinally uninterrupted and is under the direct influence of the extreme conditions of the Antarctic continent and atmosphere.

(2) The physical, chemical and biological phenomena that take place in it influence marine and atmospheric conditions and processes in other parts of the world.

(3) It presents outstanding environmental conditions which support an extremely high rate of productivity.

(4) The formation and melting of ice and the exchange of energy with the atmosphere that takes place at the surface play a vitally important part in the formation of water masses and the general circulation of the oceans.

(5) The structure of high latitude bottom relief and bottom sediments may offer a means of furthering the study of palaeoclimatic and palaeogeographical conditions, and the geological structure of the ocean floor is of world wide interest and importance.

(6) It presents some of the most exciting and clearly formulated problems.

Scientific problems

The main topics for scientific research are:

(1) The distribution of the physical and chemical properties and their variations.

(2) The character of the water masses, their conditions of formation, general circulation, and local currents.

(3) The generation of wind-waves and swell patterns within the ice-fields and in open water.

(4) The character of tides and tidal currents.

(5) The distribution of ice at sea and its variations.

(6) The mechanism and areas of the Antarctic bottom water formation.

(7) The heat budget of the sea, the exchange of energy and interrelations with the atmosphere and the ice.

(8) The bottom topography and sediments.

(9) Primary productivity and ecological balance.

(10) Natural characteristics and processes in the ice-covered regions all the year around.

Specific objectives

It is recommended that the oceanographic efforts of all SCAR nations be concentrated on the following specific objectives as a first step towards furthering the understanding of the processes of Antarctic waters.

(1) *Hydrography*

Aims. To extend knowledge of conditions of the distribution of physical and chemical characteristics in waters close to Antarctica which result in the formation of Antarctic bottom water during winter, and of those factors which determine the position and steepness of the temperature gradient at the Antarctic Convergence and general circulation patterns.

Methods. Observations should be concentrated along a limited number of meridional sections. The three north-south sections recommended at the IV SCAR meeting are confirmed; the first in Drake Passage, the second along the 20° E meridian and the third along 165° E. To these are added two additional standard sections, one in the South Pacific Ocean at long 120° W, one in the South Indian Ocean at long 90° E. Each line should extend from north of the Antarctic Convergence to Antarctica with standard oceanographic stations preferably not more than 60 miles apart, but closer in the convergence and divergence areas. Observations of temperature, salinity and oxygen from the surface to the ocean bottom. Direct current measurements at great depth in the region of the Antarctic Convergence and on the five standard sections, though difficult, would be extremely valuable.

(2) *The nature of the ocean bottom*

Aims. To map the bottom relief and determine the structure, stratification, thickness and distribution of the bottom sediments in the southern oceans, with a view to determining the permanence of the ocean basins and palaeoclimatic changes. To study recent sediment accumulation and its relation to the hydrological peculiarities of water masses.

Methods. All oceanographic ships to be fitted with precision depth recorders. Deep sea cores and records of sub-bottom profiles to be collected whenever possible.

(3) *Tides*

Aims. To extend knowledge of world tides and changes in mean sea level.

Methods. All nations to co-operate in the International Antarctic Tide Gauge programme.

(4) *Marine biology*

Aims. (1) Assessment of productivity in the Antarctic and sub-Antarctic and an elucidation of the factors which determine the intensity and timing of the phytoplankton maxima.

(2) Study of the life histories of typical members of the Antarctic zooplankton community and their vertical distribution in different seasons.

(3) Study of the relation of plankton organisms and pelagic fishes distribution to various water masses and the influence of the hydrological frontal zones upon the distribution of these organisms.

(4) Studies of the structures or species diversities of typical members of the Antarctic zooplankton which are in correlation with primary productivity (from spectrophotometry of the acetonic chlorophyll extract of the phytoplankton).

Methods. (1) Observations to be concentrated on the five meridional sections of hydrological stations specified above.

(2) Mesoplankton nets to be fished vertically and to be provided with closing devices and flow meters so that quantitative data at different depths may be obtained.

(3) Quantitative sampling of macroplankton (e.g. Krill, fishes and squid) by high-speed samplers and comparison of catches with conventional nets to determine reaction of macroplankton to nets under varying light conditions.

(5) *Energy exchange*

Aim. To extend knowledge of energy exchange of ice-covered oceanic areas.

Methods. Radiation measurements from the sea ice and measurements of the heat flow through the ice.

General

All SCAR nations should:

(1) Adhere to accepted standard methods of observation, recording and processing of data.

(2) Consider co-operation between countries likely to work in the same areas to ensure the best possible distribution in space, time and kind of observations.

(3) Consider collaboration between physicists (principally hydrologists), biologists (ecologists of planktonic populations), chemists and geologists. When possible, one water sample should be studied by all four specialists.

(4) Equip ships with, and operate, instruments that will give reliable observations.

(5) Encourage specialized studies using newly-developed instrumentation.

Appendix (from the proposed SCAR programme in Biology)

Marine biology

(1) Surveys of benthic communities in inshore waters, including areas affected by land drainage.

(2) Surveys of plankton in inshore waters, especially during the Spring melt when under-ice diatoms are released.

(3) Measurements of biomass, energy flow at different trophic levels, and primary and secondary productivity in benthos and plankton especially during the winter period of low illumination.

(4) Studies of the flora and fauna under ice shelves. Any opportunity provided by the breakaway of large areas of shelf should be exploited.

(5) The autecology, population dynamics, and physiology of inshore marine species, especially fishes of the family *Chaenichthydae.*

(6) Studies of food chains and the food organisms of birds and mammals.

SCAR EXECUTIVE COMMITTEE

President: Dr L. M. Gould, US Committee on Polar Research, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, USA

Vice-President: Contraalmirante R. N. M. Panzarini, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires, Argentina

Secretary: Dr G. de Q. Robin, Scott Polar Research Institute, Cambridge, England

NATIONAL COMMITTEES OF SCAR

Argentina: Instituto Antártico Argentino, Cerrito 1248, Buenos Aires
Australia: National Committee for Antarctic Research, Australian Academy of Science, Gordon Street, Canberra City, ACT
Belgium: Comité spécial belge de la Recherche scientifique dans l'Antarctique, c/o Dr L. M. Malet, Secrétaire, IRM, 3 Avenue Circulaire, Bruxelles 18
Chile: Comité Nacional de Investigaciones Antárticas, Casilla 13518, Correo 15, Santiago
France: Comité National Français des Recherches Antarctiques, 39ter rue Gay-Lussac, Paris 5e
Japan: National Antarctic Committee, Science Council of Japan, Ueno Park, Tokyo
New Zealand: National Committee on Antarctic Research, Royal Society of New Zealand, P.O. Box 8018, Wellington
Norway: The Norwegian National Committee for SCAR, c/o Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3
South Africa: South African Scientific Committee for Antarctic Research, CSIR, PO Box 395, Pretoria
United Kingdom: Royal Society, Burlington House, Piccadilly, London, W 1
United States: United States Committee on Polar Research, National Academy of Sciences, 2101 Constitution Avenue, Washington 20418, DC
USSR: Sovetskiy Komitet po Issledovaniyu Antarktiki Akademii Nauk SSSR [Soviet Committee on Antarctic Research, Academy of Sciences of the USSR], Ul. Vavilova 30a, Moscow, B-333

PERMANENT DELEGATES TO SCAR

Argentina: Contraalmirante R. N. M. Panzarini, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires
Australia: B. P. Lambert, PO Box 667, Canberra City, ACT
Belgium: Professor J. Van Mieghem, Comité special belge de la Recherche scientifique dans l'Antarctique, IRM, 3 Avenue Circulaire, Bruxelles 18
Chile: Profesor Humberto Fuenzalida, Casilla 787, Santiago
France: Ing. Gén. G. R. Laclavère, 136 bis rue de Grenelle, Paris 7
Japan: Professor T. Nagata, Geophysical Institute, Tokyo University, Tokyo
New Zealand: Dr E. I. Robertson, Geophysics Division, DSIR, 156 The Terrace, Wellington
Norway: Dr T. Gjelsvik, Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3
South Africa: Dr S. M. Naudé, CSIR, PO Box 395, Pretoria
United Kingdom: Dr G. de Q. Robin, Scott Polar Research Institute, Cambridge
USA: Dr L. M. Gould, US Academy of Sciences, 2101 Constitution Avenue, Washington 25

USSR: Dr M. M. Somov, Sovetskiy Komitet po Issledovaniyu Antarktiki Akademii Nauk SSSR [Soviet Committee on Antarctic Research, Academy of Sciences of the USSR], Ul. Vavilova 30a, Moscow, B-333

IGU: Dr V. Schytt, Geografiska Institutionen, Drottninggatan 120, Stockholm VA, Sweden

IUBS: Professor J. G. Baer, Institut de Zoologie, Université de Neuchâtel, Switzerland

IUGG: G. R. Laclavère, 136 bis rue de Grenelle, Paris 7

IUGS: R. W. Willett, Geological Survey DSIR, Box 368, Lower Hutt, New Zealand

IUPAC: No delegate, correspondence to Dr R. Morf, Secretary-General, IUPAC, c/o Hoffman-La Roche Co. Ltd., Grenzacherstrasse 124, Basle, Switzerland

IUPS: Dr L. C. G. E. Pugh, Division of Human Physiology, National Institute for Medical Research, Holly Hill, London, NW 3

URSI: Dr F. J. Hewitt, National Institute of Telecommunication Research, PO Box 10319, Johannesburg, South Africa

WMO: Dr K. Langlo, WMO Secretariat, Geneva, Switzerland

PERMANENT WORKING GROUPS OF SCAR*

Biology

Argentina: A. Corte (temp. Dr H. A. Orlando), Instituto Antártico Argentino, Cerrito 1248, Buenos Aires

Australia: Dr R. Carrick, Division of Wildlife Research, CSIRO, PO Box 109, Canberra City, ACT

Belgium: Dr J. Schell, Laboratorium voor Microbiologie, Rijksuniversitet, Casinoplein 21, Gent

Chile: N. Bahamonde, Museo Nacional de Historia Natural, Casilla 787, Santiago

France: Dr J. Prévost, Laboratoire de Zoologie des Mammifères et des Oiseaux, Museum d'Histoire Naturelle, 55 Rue de Buffon, Paris 5e

Japan: Dr J. Shimoizumi, 16 Myogadani, Bunkyo-ku, Tokyo

New Zealand: Dr R. A. Falla, Dominion Museum, Wellington C. 3

Norway: Professor dr. J. T. Ruud, Universitetet i Oslo, Frederiks Gate 3, Oslo 1

South Africa: Dr E. M. van Zinderen Bakker, Department of Botany, University of the Orange Free State, Bloemfontein

United Kingdom: Dr M. W. Holdgate (Secretary), British Antarctic Survey Biological Unit, Queen Mary College, Mile End Road, London, E 1

USA: Dr W. J. L. Sladen, Department of Pathobiology, Johns Hopkins School of Hygiene, 615 N Wolfe Street, Baltimore, Maryland

USSR: Professor A. P. Andriyashev, Zoologicheskiy Institut Akademii Nauk SSSR [Zoological Institute, Academy of Sciences of the USSR], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow, B-333

* Copies of general correspondence on Working Group matters should be sent to the Secretary of SCAR for information.

Communications

Argentina: Lieut-Cdr Jose Maria Cohen, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires

Australia: W. R. Baird, Overseas Telecommunications Commission, 12 Spring Street, Sydney

Belgium: H. Vandevelde, Société nationale des Chemins de fer belges, Direction de l'Electricité et de la Signalisation, 21 rue de Louvain, Bruxelles 1

Chile: Cdte. de Esc. Alfredo Soto Wengley, Estado Mayor de la Defensa Nacional, Ministerio de Defensa, Santiago

France: R. Bost, Tèrres Australes et Antarctiques Françaises, 27 rue Oudinot, Paris 7e

Japan: Dr T. Kawahara, Nihon, Shortwave Broadcasting Co., Ltd., Tamachi, Akasaka, Minato-ku, Tokyo

New Zealand: R. Cassey, Divisional Engineer (Radio), Engineer-in-Chief's Office, Post Office, Wellington

Norway: Not appointed

South Africa: G. E. Haupt, Department of Transport, Transport Building, Fountain Lane, Pretoria

United Kingdom: A. H. Sheffield (Chairman), Commonwealth Telecommunications Board, 28 Pall Mall, London, SW 1

USA: H. W. Wells, Committee on Polar Research, National Academy of Sciences, 2101 Constitution Avenue, Washington 20418, D.C.

USSR: A. M. Driatsky, Arkticheskiy i Antarkticheskiy Nauchno-Issledovatel'skiy Institut [Arctic and Antarctic Research Institute], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow B-333

Geodesy and cartography

Argentina: L. Picard, Servicio de Hidrografía Naval, Avda. Montes de Oca 2124, Buenos Aires

Australia: B. P. Lambert (Secretary), Director of National Mapping, 22 University Avenue, Canberra City, ACT

Belgium: J. Loodts, Institut Géographique Militaire, Service de Triangulation and Astronomie, 13, Abbaye de la Cambre, Bruxelles 5

Chile: Cap de Fragata Raúl Herrera, Dep de Navegación e Hidrografía, Casilla 324, Valparaíso

France: Ing. Gén. G. R. Laclavère, 140 rue de Grenelle, Paris 7e

Japan: Dr I. Tsubokawa, Geographical Survey Institute, Ministry of Construction, 1000, 7-Chome, Kamimeguro, Meguru-ku, Tokyo

New Zealand: R. P. Gough, Lands and Survey Department, Wellington

Norway: D. Helle, Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3

South Africa: F. W. Marsh, Trigonometrical Survey, Rhodes Avenue, Mowbray, Cape

United Kingdom: W. D. C. Wiggins, Directorate of Overseas Surveys, Kingston Road, Tolworth, Surrey

USA: G. D. Whitmore, US Geological Survey, Department of Interior, Washington 25, DC

USSR: Not appointed

Geology

Argentina: Dr N. H. Foucade, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires

Australia: Dr N. H. Fisher, Bureau of Mineral Resources, PO Box 378, Canberra City, ACT

Belgium: Professor Dr E. Picciotto, Université Libre de Bruxelles, Centre de Physique Nucléaire, 50 Avenue FD Roosevelt, Bruxelles 5

Chile: Ing. C. R. Fuller, Inst. de Investigaciones Geologicas, Casilla 10465, Santiago

France: M. J. P. Bloch, Laboratoire de Géologie de l'ENS, 24 rue Lhomond, Paris 5e

Japan: Dr T. Tatsumi, Department of Geology, University of Tokyo

New Zealand: R. W. Willett (Chairman/Secretary), Geological Survey, PO Box 368, Lower Hutt

Norway: Dr T. Gjelsvik, Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3

South Africa: Dr F. C. Truter, Geological Survey, PO Box 401, Pretoria

United Kingdom: Dr R. J. Adie, Department of Geology, University of Birmingham, Edgbaston, Birmingham 15

USA: Dr L. M. Gould, Department of Geology, University of Arizona, Tucson, Arizona, 85721

USSR: Professor M. G. Ravich, Nauchno-Issledovatel'skiy Institut Geologii Arktiki [Arctic Geological Research Institute], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow, B-333

Geomagnetism

Argentina: R. P. J. Hernández, Servicio Meteorologíco Nacional, Paseó Colon 317, Buenos Aires

Australia: J. M. Rayner, Bureau of Mineral Resources, Box 378, Canberra City, ACT

Belgium:

Chile: P. Perelman, Instituto de Geofísica y Sismología, Casilla 2777, Santiago

France: R. Schlich, Institut de Physique de Globe, 191 rue Saint Jacques, Paris, 5e

Japan: Professor T. Nagata (Chairman/Secretary), Geophysical Institute, University of Tokyo

New Zealand: A. L. Cullington, Magnetic Survey, Botanic Gardens, Christchurch

Norway: Professor L. Harang, Institutt for Teoretisk Astrofysikk, Blindern

South Africa: A. M. van Wijk, Magnetic Observatory, PO Box 32, Hermanus, Cape

United Kingdom: Dr J. M. Stagg, 34 King's Road, Richmond, Surrey
USA: D. K. Bailey, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado
USSR: Mrs V. A. Troitskaya, Institut Fiziki Zemli Akademii Nauk SSSR, [Institute of Physics of Earth, Academy of Sciences of the USSR], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow B-333

Glaciology

Argentina: C. A. Lisignoli, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires
Australia: Dr U. Radok (Secretary), Department of Meteorology, University of Melbourne, Parkville N 2, Victoria
Belgium: Dr W. Debrueck, Rijksuniversiteit-Rozier, 6, Gent
Chile: C. Marangunic, Instituto de Geologia, Casilla 2777, Santiago
France: Professor A. Bauer, EPF, 47 Avenue du Marechal Fayolle, Paris 16
Japan: Professor T. Yoshikawa, Department of Geography, University of Tokyo
New Zealand: I. C. McKellar, Geological Survey, PO Box 79, Dunedin
Norway: O. Liestöl, Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3
South Africa: Vacant. Correspondence to The Secretary, Scientific Committee for Antarctic Research, CSIR, PO Box 395, Pretoria
United Kingdom: Dr G. de Q. Robin, Scott Polar Research Institute, Cambridge,
USA: Dr A. P. Crary, Office of Antarctic Programs, National Science Foundation, Washington, DC 20550
USSR: Dr P. A. Shumskiy, Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow B-333

Logistics

Argentina: Lieut-Cdr E. J. Pierrou, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires
Australia: Dr P. G. Law, Antarctic Division, Department of External Affairs, 568 St Kilda Road, Melbourne, SC 3, Victoria
Belgium: Major F. Aé. F. Bastin V.S. 2, Etat major F.Aé-Section Renseignement et Météorologie, Ministère de la Défense Nationale, Place Dailly Bruxelles 3
Chile: Sección Antártica del Estado Mayor de la Defensa Nacional, Santiago
France: J. Vaugelade, Expéditions Polaires Françaises, 47 Avenue du Marechal Fayolle, Paris 16e
Japan: Dr M. Murayama, Polar Section, National Science Museum, Ueno Park, Tokyo
New Zealand: G. W. Markham, Antarctic Division, DSIR, Box 6022, Wellington
Norway: S. Helle, Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3
South Africa: S. A. Engelbrecht, Weather Bureau, Private Bag 97, Pretoria
United Kingdom: Sir V. E. Fuchs, British Antarctic Survey, 30 Gillingham Street, London, SW 1

USA: Admiral J. R. Reedy, USN, 6th and Independence Avenue, SW, Washington 25, DC

USSR: Ye I. Tolstikov Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow, B-333

New Secretary to be appointed

At the 6th SCAR Meeting P.-E. Victor, Expéditions Polaires Françaises, was elected Chairman

Meteorology

Argentina: Commander L. M. de la Canal, Servicio de Meteorología Maritima, Secretaría de Marina, Cangallo, 55 Buenos Aires

Australia: H. R. Phillpot, IAAC, Commonwealth Bureau of Meteorology, Box 1289 K, Melbourne, Victoria

Belgium: Dr A. Maenhout, Institut Royal Météorologique, 3 avenue Circulaire, Bruxelles 18

Chile: Cdte. de Esc. S. Bravo Flores, Oficina Meteorológica de Chile, Quinta Normal, Santiago

France: J. Alt, Météorologie Nationale, 2 quai Branly, Paris 7e

Japan: Dr M. Yoshitake, Japan Meteorological Agency, Otemachi, Chiyoda-ku, Tokyo

New Zealand: Dr R. G. Simmers, Meteorological Office, Box 722, Wellington

Norway: V. Hisdal, Norsk Polarinstitutt, Postboks 5054, Majorstua, Oslo 3

South Africa: Dr J. J. Taljaard, Weather Bureau, Private Bag 97, Pretoria

United Kingdom: H. H. Lamb, Meteorological Office, London Road, Bracknell, Berks

USA: M. J. Rubin (Chairman/Secretary), US Weather Bureau, Washington, DC 20235

USSR: G. M. Tauber, Glavnoye Upravleniye Oidiometeorologidieskoy Sluzhby [Chief Administration of the Hydrological and Meteorological Service], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow B-333

Oceanography

Argentina: Contraalmirante R. N. M. Panzarini, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires

Australia: Dr G. F. Humphrey, Division of Fisheries and Oceanography, CSIRO, Box 21, Cronulla, Sydney

Belgium: Vacant

Chile: Cap de Fragata Raúl Herrera, Dep. de Navegación e Hidrografía, Casilla 324, Valparaíso

France: P. Tchernia, Laboratoire d' Oceanographie Physique, 43 rue Cuvier, Paris 5e

Japan: Professor Y. Miyake, Faculty of Science, Tokyo University of Education, Otsuka-kubomachi, Bunkyo-ku, Tokyo

New Zealand: J. Brodie, NZ Oceanographic Institute, DSIR, Wellington

Norway: Dr H. Mosby, Universitet i Bergen, Bergen

South Africa: Professor J. H. Day, Department of Zoology, University of Cape Town, Rondebosch, Cape

United Kingdom: Dr G. E. R. Deacon, FRS, National Institute of Oceanography, Wormley, nr. Godalming, Surrey

USA: Dr W. L. Tressler, (Secretary), US Naval Oceanographic Office, Washington 20740, DC

USSR: Dr M. M. Somov (Chairman), Arkticheskiy i Antarkticheskiy Nauchno-Issledovatel'skiy Institut [Arctic and Antarctic Research Institute], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow B-333

Solid earth geophysics

Argentina: S. Gershanik, Observatorio Astronómico de la Plata, Calle 18, No. 1173, La Plata

Australia: R. F. Thyer, Bureau of Mineral Resources, 203 Collins Street, Melbourne

Belgium: Dr A. Devuyst, Centre de Physique du Globe de l'IRM, Dourbes (Nimes), Prov de Namur

Chile: (Seismology) Ing. P. Welkner, Instituto de Geofísica y Sismología, Casilla 2777, Santiago

France: Dr G. Jobert, Institut de Physique du Globe, 191 rue Saint Jacques, Paris 5e

Japan: Professor T. Hagiwara, Earthquake Research Institute, University of Tokyo, Tokyo

New Zealand: Dr E. I. Robertson (Secretary), Head Office, DSIR, PO Box 8018, Wellington

Norway: M. Sellevoll, Universitet i Bergen, Bergen

South Africa: Professor L. O. Nicolaysen, Bernard Price Institute, University of the Witwatersrand, Milner Park, Johannesburg

United Kingdom: Dr R. Stoneley, Department of Geodesy and Geophysics, University of Cambridge, Cambridge

USA: Dr G. P. Woollard, Hawaii Institute of Geophysics, University of Hawaii, Honolulu 14

USSR: Y. D. Bulanzhe, Institut Fiziki Zemli Akademii Nauk SSSR, [Institute of Physics of Earth, Academy of Sciences of the USSR], Soviet Committee on Antarctic Research, Ul. Vavilova 30a, Moscow, B-333

IUGG: Professor K. E. Bullen, Department of Applied Mathematics, University of Sydney

Upper atmosphere physics

Argentina: Dr O. Schneider, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires

Australia: Dr F. Jacka (Chairman/Secretary), Antarctic Division, Department of External Affairs, 568 St Kilda Road, Melbourne, SC 3

Belgium: Professor Dr M. Nicolet, Centre national de Recherche de l'Espace (CNRE), 3 avenue Circulaire, Bruxelles 18

Chile: Dr E. P. Heilmaier, Instituto de Fisica y Astronomia, Pontificia Universidad Catolica de Chile, Santiago de Chile

France: A. Lebeau, Institut de Physique du Globe, 191 rue Saint Jacques, Paris 5e

Japan: Dr H. Ueda, Radio Research Laboratories, Ministry of Postal Services, Kokubunji, PO, Kitatama-gun, Tokyo

New Zealand: W. H. Ward, Dominion Physical Laboratory, Gracefield Road, Lower Hutt

Norway: Dr L. Harang, Institutt for Teoretisk Astrofysikk, Blindern, Oslo

South Africa: R. W. Vice, National Institute for Telecommunications Research, University of the Witwatersrand, Johannesburg

United Kingdom: Dr S. Evans, Scott Polar Research Institute, Cambridge

USA: D. K. Bailey, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado

USSR: Dr S. M. Mansurov, Soviet Committee on Antarctic Research, Academy of Sciences of the USSR, Ul. Vavilova 30a, Moscow B-333

NOTICE

The SCAR Bulletin is published in England in January, May and September each year as part of the *Polar Record*, the journal of the Scott Polar Research Institute.

Contributions are invited, and should consist of factual notes on the membership, equipment and activities of Antarctic parties; articles on matters of particular interest in connection with these activities are also welcome. Contributions should be sent to the Editor, Scott Polar Research Institute, Lensfied Road, Cambridge, England.

THE POLAR RECORD

This is the journal of the Scott Polar Research Institute. It is published in January, May and September each year and may be obtained direct from the Scott Polar Research Institute, Lensfield Road, Cambridge, England, or through any bookseller. The subscription is thirty-one shillings and sixpence a year, or ten shillings and sixpence a copy.

Printed in Great Britain at the University Printing House, Cambridge