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No. 11 May 1962

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SCAR BULLETIN

No. 11, May 1962

Recording sea ice distribution from meteorological satellites

BY D. Q. WARK*

Pictures of the Gulf of St Lawrence obtained by the meteorological satellite TIROS I on 1 and 2 April 1960 gave evidence of sea ice. When compared with Canadian Meteorological Service aerial ice reconnaissance charts for the same period, it was evident that many features of the sea ice could be evaluated from the satellite photographs.[1] The next opportunity to observe ice from satellites came in January 1961, when TIROS II could view the Gulf of St Lawrence; in March 1961 this satellite was again favourably oriented for viewing the same area.

In order to evaluate the ice photographs planned for TIROS II during January and March 1961, a limited number of air reconnaissance flights were programmed to obtain visual and photographic observations of ice in the gulf and in the Atlantic off Newfoundland coincident with the scheduled TIROS II passes over the area. This programme was carried out during a period when many excellent satellite photographs were obtained. Comparison of some of them with the aerial reconnaissance information obtained by the United States Navy and by the Canadian Meteorological Service has led to a better appreciation of the potentials and the limitations of this revolutionary method for observing sea ice.[2]

The Gulf of St Lawrence has been selected for TIROS ice studies mainly because it is one of the few areas of the world where abundant sea ice can be found at so low a latitude. The great polar ice areas lie beyond the scope of TIROS satellites, whose orbits carry them only to 48° north and south. In addition, the poor quality of the wide-angle camera on TIROS II necessitated the exclusive use of the narrow-angle camera (12·7° in the diagonal) on that satellite; photographs can be taken by TIROS satellites at intervals of less than 30 sec. only when in direct communication with the readout stations, and a picture-taking interval of 10 sec. was required to give overlap of successive photographs. The gulf lay within range of the readout station in New Jersey.

Because the Gulf of St Lawrence is at the "top" of the orbit, there is a good chance that even a narrow-angle camera can view the same area repeatedly during a favourable observation period, limited to about 10 days by the orbit and spin precessions of these spin-stabilized satellites. This is illustrated in the accompanying photograph, which shows two mosaics of the same area assembled from photographs taken by the satellite on 23 and

* Meteorological Satellite Laboratory, U.S. Weather Bureau, Washington, D.C.

29 March 1961. The foreshortening of Anticosti Island, seen to the left of the centre of the mosaic of 29 March, gives an indication of the rate at which the precessions were acting to shift the favourable view away from the gulf.

The best overall sequence of pictures was obtained during orbit 1763 on 23 March, when the entire area from the St Lawrence River to the east coast of Newfoundland was free of clouds. A portion of this sequence is shown in the upper part of the photograph. At the far left is the eastern tip of the Gaspé Peninsula, Gaspé Bay is uniformly white and presumably covered with fast ice. The eastern half of Anticosti Island is seen in the left centre; broken ice and floes lie between the Gaspé Peninsula and the island, but it is concentrated along the peninsula, with a passage of open water along the coast of the island; to the south is a large area of open water, normal for this time of year; on the northern side is nearly solid ice, although some large cracks near the eastern tip of the island stand out clearly. At the extreme right is fast ice attached to the Newfoundland shore in the vicinity of the Bay of Islands; an area of open water lies between the Newfoundland coast and the field of broken ice and floes extending westward to Anticosti Island. Individual pictures are about 70 miles square.

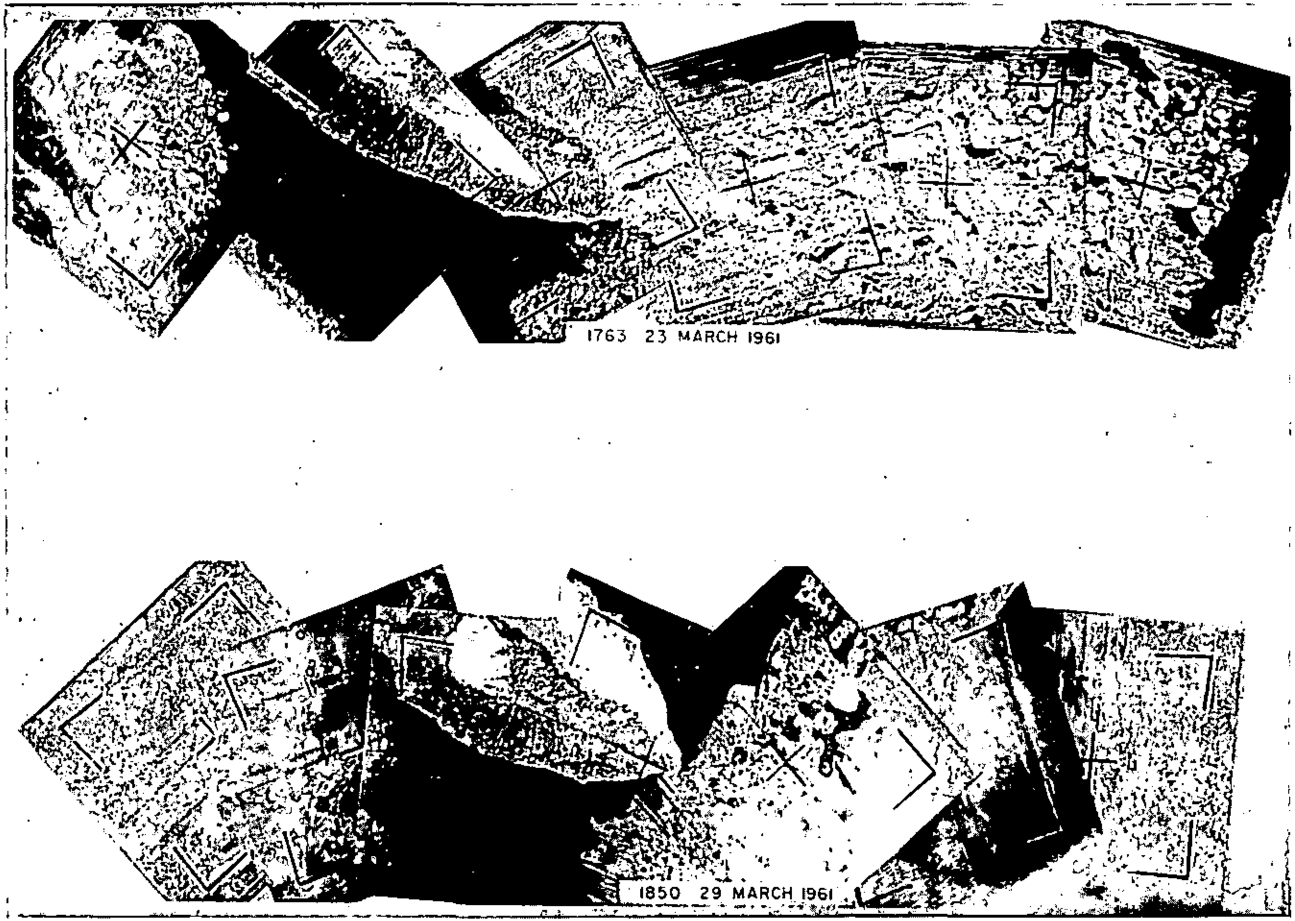
The same area, photographed during orbit 1850 on 29 March, is shown in the lower part of the figure. Weather conditions were less favourable than on 23 March and clouds obscure the Gaspé Peninsula on the left and Newfoundland on the right. Anticosti Island is free of clouds, however, and marked changes can be seen to have occurred in the intervening 6 days. A wedge of open water has appeared to the north of the eastern tip of the island, an area which had a dense concentration of ice on 23 March. The ice is still rather solid along the north shore of the island, while the concentration to the east of the open water has decreased somewhat. The open water south of the island remains about the same, but the ice off the Gaspé Peninsula, visible at the edge of the clouded area, has thinned and no longer contains a great number of giant floes. On the right, some features can be seen through the clouds, and it appears that the shore lead along Newfoundland has broadened considerably.

These photographs indicate many of the capabilities and shortcomings of satellites in recording ice. Much detail can be seen and continuity maintained in the absence of clouds, but when clouds are present the ice conditions may be partially hidden or even obliterated. The detail seen in orbit 1763 is much to be prized, but the coverage is inadequate; with greater coverage, one will have to sacrifice detail. However, it is expected that eventually both of these attributes can be maintained by more advanced instruments, and that reliable and detailed polar sea ice information will be available daily through the medium of satellite photographs.

References

[1] WARK, D. Q. *and* POPHAM, R. W. TIROS I observations of ice in the Gulf of St Lawrence, *Monthly Weather Review*, Vol. 88, 1960, p. 182–86.

[2] WARK, D. Q., POPHAM, R. W., DOTSON, W. A. *and* COLAW, K. S. Ice observations by the TIROS II satellite and by aircraft, *Arctic*, 1962 (in the Press).



Mosaics of narrow angle photographs taken from satellite TIROS II, showing 6 day change in sea ice conditions near Anticosti Island, Gulf of St Lawrence, March 1961

Photograph: National Aeronautics and Space Administration; United States Weather Bureau

ANTARCTIC GLACIOLOGICAL REPORT, 1960†

BY A. P. CRARY*

Inland traverse operations over 5,000 km. of the Antarctic ice sheet were made during the 1960 season to determine elevations, ice thicknesses and snow and névé characteristics. On the high polar plateau area, a Soviet party journeyed from Mirny to lat. 72° 30′ S., long. 90° E. and thence to "Komsomolskaya" and "Vostok". A United States unit from McMurdo travelled via Skelton Glacier to lat. 78° S., long. 159° E., thence south-west to lat. 83° S., long. 121° E., south-east to 88° S., long. 140° W., and to the South Pole. From preliminary information of these traverses, the rock surface underneath the ice was usually found close to sea level. A second United States traverse covered the general area between "Byrd" and the Eights Coast of the Amundsen Sea, obtaining further outline of the deep sub-ice channel running east and north-east from the Ross Sea. An inland traverse for ice thickness and glaciological measurements was also made from "Syowa". An airlifted United States seismic crew obtained some ice thickness values in the coastal regions north of "Byrd".

At "Base Roi Baudouin" ice cores were obtained during a drilling operation to a depth of 117 m. Temperatures, ice densities and radioactive studies were among the investigations made in this programme. From stratigraphic studies the average annual water equivalent was shown to be approximately 39 cm. per year at this site.

A study of the outflow of glacier ice on to Ross Ice Shelf was initiated in 1960 by United States parties at four glaciers on the west and south-west side of the ice shelf. On the Filchner Ice Shelf an Argentine glaciological party made extensive re-surveys of a triangulation network running from a fixed position on Luitpold Coast to "General Belgrano" and "Ellsworth". Measurements of ice movement and accumulation were also made by a South African party at "Norway station", by New Zealanders on Ross Ice Shelf south of "Scott base", and by the British on several glaciers on the east coast of Trinity Peninsula, and some small ice-covered islands in the Argentine Islands. Movement studies were also continued by the Australians near Mawson and "Wilkes".

Accumulation records and studies of general surface snow characteristics were continued at all stations, and periodic sea ice observations made where-ever possible.

Most glaciological studies are progressing satisfactorily. At the present rate, the traverse operations on the inland ice sheet will complete in a few years a broad survey of elevations and ice thicknesses over the main areas of the continent. However, much work remains to be done on detailed surface movement studies and investigations of ice at depth in the interior of the continent.

† Presented to the Fifth Meeting of SCAR, 1961.
* National Science Foundation, Washington, D.C.

Provisional list of antarctic meteorological observations, 1960

(Subject to corrections)

	Surface	Radiosonde	Radar/radiowind	Pilot balloon	Direct solar radiation	All sky radiation	Diffuse radiation	Terrestrial radiation	Nett radiation	Illumination	Duration of sunshine	Total ozone	Ozone (Umkehr)	Surface ozone	Ozonesonde	Snow accumulation	Blowing snow	Snow surface temperature	Sub-surface temperature profile	Snow crystals	Radioactivity of atmosphere	Radioactivity of precipitation	CO_2 content of atmosphere	Chemical analysis of precipitation	Atmospherics	Sea ice observations
Argentina																										
"Almirante Brown"	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
"Decepçion"	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	×
"Melchior"	×	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	×
"Orcadas"	×	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×
"Teniente Camara"	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
"Esperanza"	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	×	.	.	.
"Ellsworth"	×	.	.	.	×	×	.	×	.	.	×	.	.	.	.	×	.	×	×	.	.	.	×	.	.	×
"General Belgrano"	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
"Teniente Matienzo"	Not known																									
"General San Martin"	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Australia																										
Davis	×	×	×	×	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Macquarie Island	×	×	×	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mawson	×	.	.	×	.	×	×	.	×	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
"Wilkes"	×	×	×	×	×	.	.	×	.	.	×	.	.	.	.	×	.	.	.	.	.	.	.	.	×	×
Lewis Island (automatic weather station)	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Belgium																										
"Base Roi Baudouin"	×	×	×	.	.	×	×	.	.	.	×	.	.	.	×	.	.	.	.	.	.	.	.	.	×	.
Chile	Not known																									
France																										
"Camp Heurtin"	×	×	×	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
"Dumont d'Urville"	×	×	×	.	.	×	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Port-aux-Français	×	.	×	.	.	.	.	.	.	.	×	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Japan																										
"Syowa"	×	×	×	.	.	×	.	×	.	.	×	×	.	.	.	×	.	.	×	.	.	.	.	.	.	.
New Zealand																										

	Surface	Radiosonde	Radar/radiowind	Pilot balloon	Direct solar radiation	All sky radiation	Diffuse radiation	Terrestrial radiation	Nett radiation	Illumination	Duration of sunshine	Total ozone	Ozone (Umkehr)	Surface ozone	Ozonesonde	Snow accumulation	Blowing snow	Snow surface temperature	Sub-surface temperature profile	Snow crystals	Radioactivity of atmosphere	Radioactivity of precipitation	CO_2 content of atmosphere	Chemical analysis of precipitation	Atmospherics	Sea ice observations
South Africa																										
Marion Island	×	×	×	×	·	×	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Gough Island	×	×	·	×	·	×	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tristan da Cunha	×	·	·	×	·	×	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
"Norway station"	×	×	×	×	·	×	·	·	·	·	×	·	·	·	·	×	·	×	×	·	·	·	·	·	·	·
United Kingdom																										
Port Lockroy	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Deception Island	×	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hope Bay	×	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Stonington Island	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Argentine Islands	×	×	·	×	·	×	×	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Signy Island	×	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Horseshoe Island	×	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Halley Bay	×	×	×	·	·	×	×	·	×	·	·	×	×	×	·	×	·	×	×	·	·	·	·	·	·	×
Grytviken	×	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Admiralty Bay	×	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
United States																										
South Pole	×	×	×	×	×	×	·	×	×	×	×	×	·	×	·	×	·	×	×	·	×	·	×	×	·	·
"Byrd"	×	×	×	×	×	×	·	×	×	×	×	·	·	·	·	×	·	×	×	·	·	·	·	·	·	·
"McMurdo"	×	×	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
"Hallett"	×	×	×	×	×	×	·	×	×	×	×	×	·	×	·	×	·	×	×	·	·	·	·	×	·	×
"NAF Beardmore"	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
"NAF Rockford"	×	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
USSR																										
Mirny	×	×	×	·	×	×	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·
"Lazarev"	×	×	·	×	×	×	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·
"Vostok"	×	×	×	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
"Komsomolskaya"	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

* January and February only.

Notes on isotope glaciology†

BY E. PICCIOTTO*

Definition and application of isotope glaciology

Isotope glaciology is a new field of study and a meeting ground of several disciplines. Here it is considered to be concerned with the application of nuclear physics and chemistry to glaciology. The introduction of these methods of research has already led to outstanding successes in various branches of geophysics and geology, but their application to glaciology is a new departure.

The importance of isotope studies in connexion with glaciology is shown in two groups of problems: the first concerning age determinations by means of radioactive isotopes; the second being involved with variations in the composition of stable isotopes of hydrogen and oxygen.

These methods can only be applied if the precipitations are preserved in their original order of deposition, and have not been mixed by melting and percolation. Consequently the polar regions, and especially the Antarctic, are the best areas for the study and application of these methods.

Radioactive isotopes

A group of radioactive isotopes may assist age determinations provided that they disintegrate at a constant and known rate. In practice, a radioactive isotope of half-life T can be used to determine ages between $0{\cdot}1T$ and $6T$.

Snow contains a certain number of radioactive isotopes which are present in the atmosphere, and of which three offer immediate possibilities in the measurement of the age of ice:

(*a*) ^{14}C ($T = 5{,}500$ years), associated with CO_{2+} which requires some tons of ice for each determination, has been used on icebergs in Greenland waters.

(*b*) Tritium ($T = 12$ years). The use of this isotope is complicated by uncertainty of the rate of natural and artificial production (from thermo-nuclear explosions). Since the first measurements made in Antarctica, several lines of research have been followed, without definite result.

(*c*) Radium D ($T = 22$ years) is formed in the atmosphere by the disintegration of radon and is deposited in the soil by precipitation. It could be used to measure ages between 5 and 60 years.

A few kilos of snow is a sufficient sample for estimation of the last two isotopes and such measurements might contribute to knowledge of the rate of accumulation in recent years.

Artificial radioactive isotopes produced by nuclear explosions have been dispersed throughout the world since the first thermo-nuclear explosions in

† Presented to the Fifth Meeting of SCAR, 1961.
* Université Libre de Bruxelles.

1954. They are of glaciological significance because they mark precipitations of 1954 wherever these are preserved.

Stable isotopes

Elements display in nature the variations of their isotopic composition, variations particularly recognizable in lighter elements such as hydrogen and oxygen. These variations are caused by natural processes of physico-chemical decay, and provide information on the origin and history of the systems studied.

Variations of the isotopic composition of precipitation are of great glaciological interest. These variations, known for a long time, have been systematically studied and interpreted by Epstein and his associates and by Dansgaard. The isotopic composition of precipitation depends, among other factors, on the temperature of the air in the clouds at the time of precipitation. This dependence produces a seasonal effect, mainly noticeable in high latitudes, which facilitates distinction between summer and winter precipitation. In cases where accumulated snow has not been subjected to fusion, this seasonal effect also permits distinction between summer and winter layers, even in compact ice where layering can no longer be distinguished. Information can also be collected from the isotopic composition of precipitation about the latitude and altitude at which they were formed. This method, combined with that of ageing by ^{14}C, has been used to estimate the average rate of flow of glaciers in Greenland.

Finally, the mean average variations of the isotopic composition in ice from deep soundings can throw light on recent climatic variations.

Great care, nevertheless, must be taken over the interpretation of results as the isotopic composition of precipitation depends only in an indirect way on temperature at time of formation; various other factors play a part also.

One must not overlook the relevance of nuclear methods in glacial geology in the important problems of dating the retreat of ice in a given place.

In the Antarctic, the opportunities of using ^{14}C dating are reduced by the scarcity of organic remains. Methods based on ^{36}Cl (T = 500,000 years) or the study of thermo-luminescence of certain minerals may perhaps prove successful.

Activities during 1960 *and the summer of* 1960–61

American expeditions carried out continuous measurements of atmospheric radioactivity during 1960. Samples of ice were collected on the South Polar Plateau in the vicinity of lat. 85° S., long. 140° W., for the measurement of annual accumulation by the amount of tritium content.

The French Antarctic expeditions in 1961 collected samples to be used for the measurement of stable isotopes of oxygen and hydrogen.

Measurements of heavy hydrogen have been made by the United States Atomic Energy Commission, at Saclay, on samples of precipitation collected in Victoria Land, and from névé from Terre Adélie.

The Belgian Antarctic expeditions have carried out a series of measurements of radioactivity in the air at "Base Roi Baudouin". Samples of precipitation, from snow at the surface and at deep levels, were collected at the station and in the eastern part of Dronning Maud Land in connexion with the measurement of stable and radioactive isotopes. During the summer of 1960–61, a core sample from a depth of 115 m. was collected from the ice shelf close to the station for the study of the variations in the isotopic composition of ice in relation to the stratigraphy.

It may be seen from the preceding paragraph that activity in this field has been little increased since 1957. It is regrettable that so many opportunities to collect samples of snow during long journeys on the polar plateau have been lost. It would be useful to direct the attention of expeditions still active to the importance of systematic collection of samples from snow drifts and from surface and deep-layer snow, both at stations and during the journeys.

Stations operating in the Antarctic, summer 1961–62, winter 1962

(Stations marked * are north of lat. 60° S.)

Argentina

"Decepcion", lat. 62° 59′ S., long. 60° 43′ W.	Summer and winter
"General Belgrano", lat. 77° 58′ S., long. 38° 48′ W.	Summer and winter
"Esperanza", lat. 63° 23′ S., long. 56° 59′ W.	Summer and winter
"Orcadas", lat. 60° 45′ S., long. 44° 43′ W.	Summer and winter
"Teniente Matienzo", lat. 64° 58′ S., long. 60° 03′ W.	Summer and winter
"Ellsworth", lat. 77° 43′ S., long. 41° 07′ W.	Summer and winter

Australia

Macquarie Island,* lat. 54° 30′ S., long. 158° 57′ E.	Summer and winter
Mawson, lat. 67° 36′ S., long. 62° 52′ E.	Summer and winter
Davis, lat. 68° 35′ S., long. 77° 58′ E.	Summer and winter
"Wilkes", lat. 66° 15′ S., long. 110° 32′ E.	Summer and winter

Chile

"Capitán Arturo Prat", lat. 62° 29′ S., long. 59° 38′ W.
"Presidente Pedro Aguirre Cerda", lat. 62° 56′ S., long. 60° 36′ W.
"Presidente Gabriel Gonzalez Videla", lat. 64° 49′ S., long. 62° 51′ W.
"General Bernado O'Higgins", lat. 63° 19′ S., long. 59° 38′ W.

France

"Camp Heurtin",* lat. 37° 50′ S., long. 77° 34′ E.	Summer and winter
Port aux Français,* lat 49° 21′ S., long. 70° 12′ E.	Summer and winter
"Dumont d'Urville", lat. 66° 40′ S., long. 140° 01′ E.	Summer and winter

Japan

"Syowa", lat. 69° S., long. 39° 35′ E.	Summer only

New Zealand

"Scott base", lat. 77° 51′ S., long. 166° 46′ E.	Summer and winter

New Zealand/United States

"Hallett", lat. 72° 19′ S., long. 170° 13′ E.	Summer and winter

South Africa

Marion Island,* lat. 46° 53′ S., long. 37° 52′ E.	Summer and winter
Gough Island,* lat. 40° 19′ S., long. 9° 51′ W.	Summer and winter
"Norway station", lat. 70° 30′ S., long. 2° 32′ W.	Summer and winter

United Kingdom

Adelaide Island, lat. 67° 46′ S., long. 68° 54′ W.	Summer and winter
Argentine Islands, lat. 65° 15′ S., long. 64° 15′ W.	Summer and winter
Deception Island, lat. 62° 59′ S., long. 60° 34′ W.	Summer and winter
Fossil Bluff, lat. 70° 20′ S., long. 68° 17′ W.	Summer and winter
Grytviken,* lat. 54° 17′ S., long. 36° 30′ W.	Summer and winter
Halley Bay, lat. 75° 31′ S., long. 26° 36′ W.	Summer and winter
Hope Bay, lat. 63° 24′ S., long. 56° 59′ W.	Summer and winter
Port Lockray, lat. 64° 50′ S., long. 63° 31′ W.	Summer only
Signy Island, lat. 60° 43′ S., long. 45° 36′ W.	Summer and winter
Stonington Island, lat. 68° 11′ S., long. 67° W.	Summer and winter
Bird Island, lat. 54° S., long. 38° 05′ W.	Summer only

United States

"Amundsen–Scott", South Geographical Pole	Summer and winter
"Byrd", Old: lat. 79° 59′ S., long. 120° W. New: lat. 80° 01′ S., long. 119° 31′ W.	Summer and winter
"McMurdo", lat. 77° 51′ S., long. 166° 40′ E.	Summer and winter
NAAF "Beardmore", lat. 83° 17′ S., long. 175° 45′ E.	Summer only
NAAF "Little Rockford", lat. 79° 16′ S., long. 147° 30′ W.	Summer only
"Sky-Hi", lat. 75° 14′ S., long. 77° 10′ W.	Summer only

Union of Soviet Socialist Republics

Mirny, lat. 66° 33′ S., long. 93° 01′ E.	Summer and winter
"Vostok", lat. 78° 27′ S., long. 106° 52′ E.	Summer only
"Novolazarevskaya", lat. 70° 46′ S., long. 11° 49′ E.	Summer and winter
"Molodyozhnaya", lat. 67° 48′ S., long. 46° E.	Summer only

SCAR BULLETIN, INDEX

An index to Nos. 1 to 9, January 1959 to December 1961 will be published during 1962.

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, Lensfield Road, Cambridge, England.

THE POLAR RECORD

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