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SCAR BULLETIN

No. 23, May 1966

UNITED STATES GEOLOGICAL SURVEY MAPPING FOR THE US ANTARCTIC RESEARCH PROGRAM

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CONTENTS

Air photography

Air photography for mapping in Antarctica was, until 1965, obtained by the trimetrogon method. Prior to 1959–60 this coverage totalled over 65000 square miles, but, as it consisted mostly of exploratory and reconnaissance coverage, it was unsuitable for topographical mapping.

The responsibility of the Navy to provide logistic support for the scientific work in Antarctica includes the air photography requirements specified by the Geological Survey. During the past four seasons, Navy Air Development Squadron 6 (VX 6) has obtained nearly 325000 square miles of mapping-quality trimetrogon coverage, flown at altitudes of 20000 to 25000 feet above sea level. During the first three years, the flying was accomplished with two photoconfigured, ski-equipped LP-2J Neptunes. After these aircraft were phased out of use in 1963, a small amount of photography was obtained with a C-121J Super Constellation personnel-carrying aircraft equipped with three cartographic cameras, with 6-inch metrogon lenses and 9-inch-square formats.

A Geological Survey photogrammetric specialist is stationed in New Zealand and Antarctica during the photographic season to expedite inspection and final acceptance of photography. He inspects all film as missions are accomplished and advises the Navy on necessary reflights; when feasible, he also acts as in-flight adviser and visual navigator.

Air photographs have been used in preparing sixty-two 1:250000-scale sheets, covering approximately 248500 square miles. Nineteen sheets, covering 55350 square miles, have been published, while the remainder are in various stages of completion (Fig 1). Air photography requirements listed in the revised National Science Foundation–US Geological Survey Plan for Topographic Mapping of

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Antarctica provide for over 1118000 square miles of coverage during the next five seasons, covering approximately two hundred 1:250000-scale sheets (Fig 2).

The 1964–65 air photography season was the most successful on record, due largely to the use of a specially adapted LC-130F Hercules, in addition to the C-121J Super Constellation aircraft previously used. The LC-130F is ski-equipped, and carries a removable 3600-gallon internal fuel tank which increases its flight time by approximately five hours. A total of about 182500 square miles was photographed acceptably compared to 244500 square miles obtained between 1959 and 1964.

Material can be inspected at the Washington Office of the Geological Survey, and contact prints can be purchased. A preliminary 1:6000000-scale index is kept, available on request, and the location and extent of photographic coverage is shown in more detail on 1:250000-scale line indexes. Thus far, 1:1000000-scale photo indexes have been distributed for the Sentinel Range and Executive Committee Range.

Ground control surveys

For the past eight years, the Geological Survey has sent engineers to Antarctica to establish field survey control for mapping. At first they served as navigators on expeditions organized for scientific purposes, where they measured elevations by altimeter, made astronomical observations for the determination of geographical positions, and made triangulation intersections from base lines to visible photoidentifiable features. Base-line measurements were usually made by steel tape, although, during the 1960–61 season, tellurometers were used.

In 1961–62, however, the first helicopter-supported electronic distance traverses, "Topo North" and "Topo South", were undertaken.

Engineers, equipped with Wild T-2 theodolites and MRA-1 tellurometers, were airlifted from peak to peak by two Bell UH-1B gas-turbine helicopters of the US Army Transportation Board. Distances between stations, usually on peaks, were measured by tellurometer, and traverse angles by theodolite; angles were read and recorded to previously selected photoidentifiable features, thus greatly increasing the area being controlled. "Topo North" traverse extended from McMurdo north to Cape Hallett, and "Topo South" from McMurdo south to Beardmore Glacier. The total for the two traverses, carried out in about two months, was 1570 miles, and they furnished control for mapping an area of approximately 100000 square miles.

Two more traverses, "Topo East" and "Topo West", were made in 1962–63. "Topo East" extended from the limit of "Topo South", at Beardmore Glacier, eastward to the Thiel Mountains, and "Topo West" extended from the Cape Hallett end of "Topo North" in a westerly direction into northern Victoria Land. The UH-1B helicopters were improved by substituting more powerful engines, greatly facilitating operations especially on the higher peaks. Tellurometers were replaced by Model DM-20 Electrotapes (see plate) which proved to be very effective.

The combined length of "Topo East" and "Topo West" was 1608 miles and furnished control for 1:250000-scale mapping of an area of about 80000 square

Model DM-20 Electrotape being used for measuring distances between stations (p 274)

(*Facing p* 414)

miles. The four traverses thus furnished over 3155 linear miles of control traverse down the Transantarctic Mountains.

During the 1963–64 season, engineers carried out 250 linear miles of electronic-distance traverse for mapping control in the Neptune Range of the Pensacola Mountains. They also established a geodetic tie between control nets in the Patuxent Mountains (lat 85° 15′ S, long 60° W) and the Neptune Range, with a 45-mile electronic tie across an intervening glacier. In addition, fifteen stellar and five solar observations were completed at the previously established "Patuxent Camp" astronomic station.

Mapping control in the Ellsworth Mountains included the extension of a previously completed electronic control net through the Heritage Range and re-observation (18-star programme) of the "Camp Gould" astronomical station established during the 1962–63 field season.

Other activities included the initiation of the "Byrd" Geological Strain Net (precise ice-strain net) from "Byrd" east for approximately 60 miles.

A large-scale topographical map of a portion of the Cape Hallett penguin rookery was also completed. Existing control was extended by electronic distance traverse and 2 ft contours were sketched by plane table methods.

During the 1964–65 field season, engineers carried out two helicopter-supported electronic-distance traverses to control regions in David Glacier and north Victoria Land areas for topographical mapping and to establish geodetic ties between previously established control nets. They also completed the precise "Byrd" Glaciological Strain Net initiated in 1963–64, which now extends east from new "Byrd" to between the Filchner Ice Shelf and the Ross Ice Shelf. The total traverse is a 106-mile-long chain of 52 quadrilaterals. This party also established glaciological strain nets at mile posts 60 and 120 of Army–Navy Drive and determined new geographical positions for these two mile posts.

Control was established by electronic-distance traverse from McMurdo around the perimeter of Ross Island. An electronic-distance traverse was also carried near "Byrd" to determine the position of the University of Washington's VLF (Very Low Frequency) long-wire antenna facility.

Five stellar observations and eight sets of solar observations were observed at "Byrd'. Also at "Byrd", the geographical position of Stanford University's readout centre for the POGO (Polar Orbiting Geophysical Observatory) satellite was determined.

The results of the several traverses indicate that the methods used are successful in mountainous terrain.

The method is, however, not yet satisfactory over flat snow surfaces because of optical refraction close to the ground and accompanying difficulties in communication. Considerable improvement in these conditions is noted when one, or preferably both, electronic instruments are elevated above the snow surface. The elevation of instruments to a height of 15 ft above the snow, say on the roofs of vehicles, and the use of portable aluminium survey towers overcame these difficulties.

Another technique that was tested during the 1965–66 field season was the Airborne Control (ABC) system. In this, a tellurometer-type instrument is

elevated in a helicopter, which hovers over a point on the ground. The helicopter-borne electronic instrument can then be observed by two ground stations equipped with compatible electronic equipment and theodolites. The method has been used successfully to establish photopoint control in Alaska and other parts of the United States.

Cartography

The Geological Survey's mapping activities in Antarctica began prior to 1957 with compilations based on photography and control obtained during operations "High Jump", 1946–47, and "Windmill", 1947–48. Planimetry and topography were compiled along the coast between long. 94° W and 126 °W and planimetric compilation was made along the coast of Mac. Robertson Land between longs 60° E and 67° 30′ E. In addition, photomosaics of coastal areas between longs 120° and 60° W were prepared, and eleven 1:500000-scale topographical reconnaissance maps were compiled covering coastal areas of Enderby Land, Kemp Land and Wilkes Land.

During the second meeting of SCAR, Moscow, 1958, a temporary Working Group on Cartography was authorized, and at a later SCAR meeting it was converted to a permanent Working Group on Geodesy and Cartography. As a result of the activities of the Working Group, SCAR has made a series of formal recommendations to member governments pertaining to standards, technical specifications, and symbols for Antarctic surveys and maps.

Since 1960, using photography obtained specifically for mapping, nineteen 1:250000-scale shaded relief reconnaissance maps have been produced and 43 more are in various stages of compilation. These are the regularly scheduled and maintained maps or map series produced by the Geological Survey, (Fig 1). A useful by-product of this programme is the production of 1:50000-scale planimetric maps which are made available to Antarctic scientists prior to the formal publications.

In addition, the Geological Survey has compiled two 1:100000-scale maps covering all the dry valleys, a 1:20000-scale map of the Labyrinth area of Wright Valley, and large-scale (1:2400 and 1:4800) maps of the penguin rookeries at Cape Crozier.

An interesting product of the Geological Survey activity in Antarctic mapping is a two-piece plastic relief model of the continent. The model is unique in that it is really two models in one. The lower model shows the subglacial and ocean-bottom features. The upper model is transparent, fits over the lower one and shows the Antarctic ice surface and ice-free features and the ocean surface. The model was originally an experimental project but plans are well advanced to make it available for general distribution.

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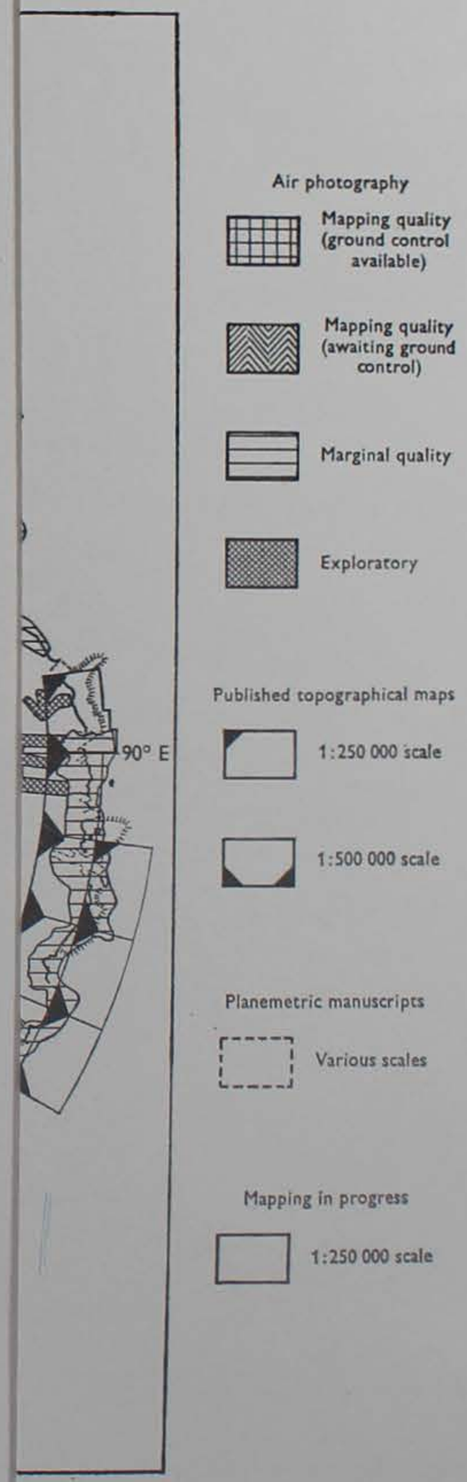

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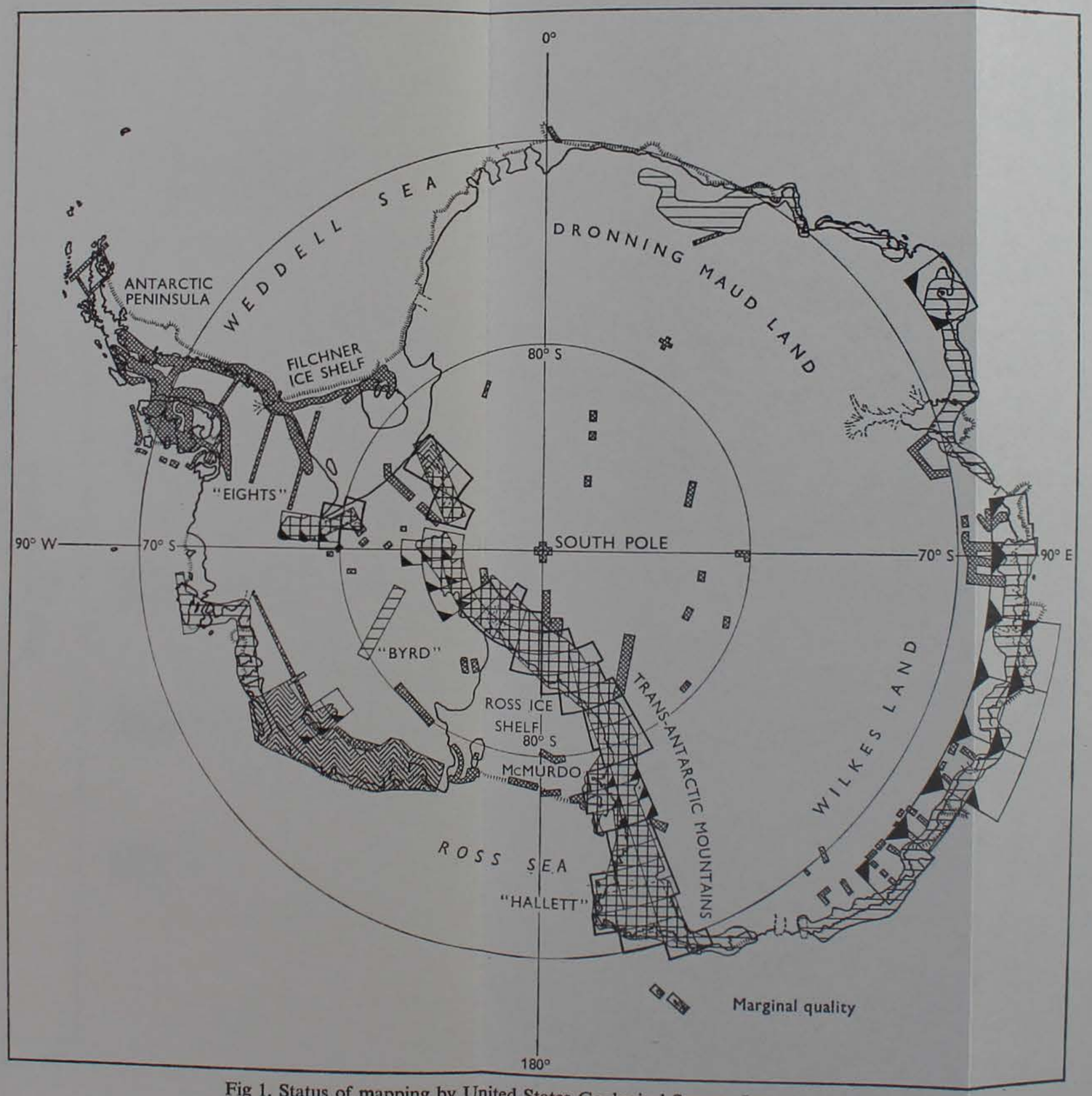

Air photography

- Mapping quality (ground control available)
- Mapping quality (awaiting ground control)
- Marginal quality
- Exploratory

Published topographical maps

- 1:250 000 scale
- 1:500 000 scale

Planemetric manuscripts

- Various scales

Mapping in progress

- 1:250 000 scale

Fig 1. Status of mapping by United States Geological Survey, January 1966

(*Facing p* 416)

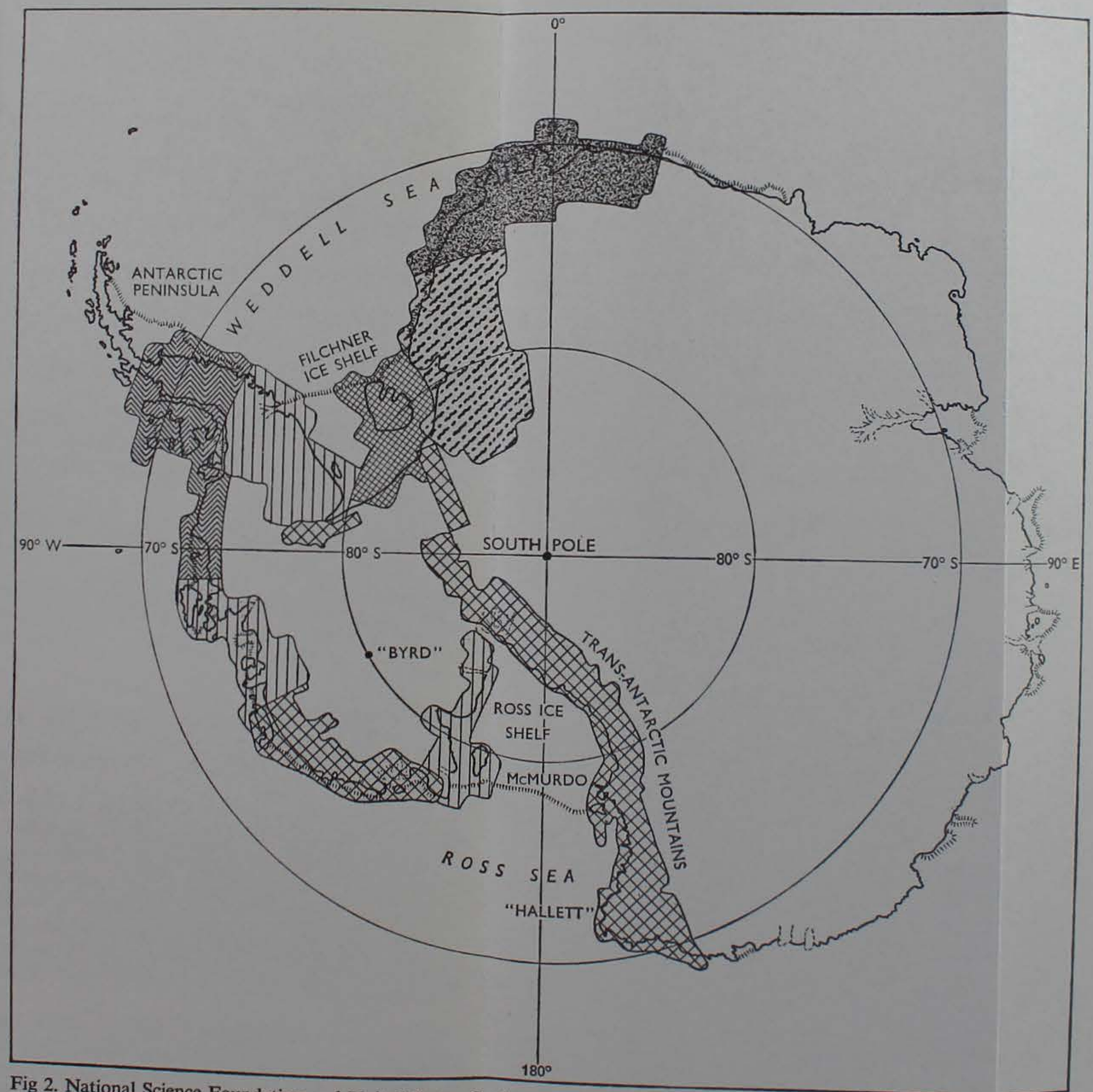

Fig 2. National Science Foundation and United States Geological Survey plan for optical air mapping photography, May 1965

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EXCHANGE SCIENTISTS IN THE ANTARCTIC, 1964–65

Summer 1964–65

Country of origin	Name	Subject	Host country
Australia	D. E. Anderson	Geology	United States (McMurdo)
	B. E. Hobbs	Geology	United States (McMurdo)
	C. T. McElroy	Geology	United States (McMurdo)
	P. D. Tilley	Geology	United States (McMurdo)
	P. F. Williams	Geology	United States (McMurdo)
	Z. Soucek	Biology	United States (*Glacier*)
Belgium	E. E. Picciotto	Glaciology	United States (South Pole—Dronning Maud Land traverse)
Chile	H. Durán	Meteorology	United States (McMurdo)
France	R. Delépine	Biology	Argentina ("Melchior")
German Democratic Republic	K. Lindner	Gravimetry	USSR
	G. Mellinger	Geodesy	USSR
	T. Schmidt	Geodesy	USSR
German Federal Republic	D. Müller	Biology	United States ("Hallett")
Japan	T. Cho	Biology	United States (McMurdo)
	Z. Hirayama	Biology	United States (McMurdo)
	K. Kizaki	Geology	USSR
	J. Sugiyama		United States (McMurdo)
	T. Tatsuda		USSR
	T. Torii	Biology	United States (McMurdo)
	N. Yamagato		United States (McMurdo)
	Y. Yoshida		United States (McMurdo)
New Zealand	J. F. McCahon	Radiation	United States (McMurdo)
Norway	O. Dybvadskog	Glaciology	United States (South Pole—Dronning Maud Land traverse)
South Africa	T. W. Gevers	Geology	United States (McMurdo)
	D. C. Neethling	Geology	United States (McMurdo)
USA	A. R. Fralick	Biology	Argentina ("Melchior")
	I. M. Lamb	Biology	Argentina ("Melchior")
	R. E. Waterhouse	Biology	Argentina ("Melchior")
	M. H. Zimmerman	Biology	Argentina ("Melchior")

Winter 1965

Czechoslovakia	S. Pinter	Magnetism	USSR ("Novolazarev'skaya")
	J. Skok	Cosmic rays	USSR ("Vostok")
German Democratic Republic	H. Wirth	Gravimetry	USSR ("Molodezhnaya")
	K. Elsner	Gravimetry	USSR ("Molodezhnaya")
Hungary	G. Kirling	Aerology	USSR (Mirny)
Poland	V. Chelchowski	Actinometry	USSR (Mirny)
USA	G. H. Meyer	Microbiology	USSR (Mirny)
USSR	I. A. Zotikov	Glaciology	United States (McMurdo)

STATIONS OPERATING IN THE ANTARCTIC AND SUB-ANTARCTIC, WINTER 1966

(Those marked with an asterisk are north of lat 60° S.)

Argentina

"Decepción", lat 62° 59′ S, long 60° 43′ W
"General Belgrano", lat 77° 58′ S, long 38° 48′ W
"Esperanza", lat 63° 24′ S, long 56° 59′ W
"Orcades", lat 60° 45′ S, long 44° 43′ W
"Teniente Matienzo", lat 64° 58′ S, long 60° 03′ W
"Almirante Brown", lat 64° 53′ S, long 62° 53′ W

Australia

*Macquarie Island, lat 54° 30′ S, long 158° 57′ E
Mawson, lat 67° 36′ S, long 62° 52′ E
"Wilkes", lat 66° 15′ S, long 110° 32′ E

Belgium/Netherlands

"Roi Baudouin", lat 70° 26′ S, long 24° 19′ E

Chile

"Capitán Arturo Prat", lat 62° 29′ S, long 59° 39′ W
"Presidente Pedro Aguirre Cerda", lat 62° 56′ S, long 60° 36′ W
"General Bernardo O'Higgins", lat 63° 19′ S, long 57° 55′ W

France

*Port Alfred, Ile de la Possession, Iles Crozet, lat 46° 25′ S, long 51° 52′ E
*Ile Amsterdam, Archipel de Kerguelen, lat 37° 50′ S, long 77° 34′ E
*Port aux Français, lat 49° 21′ S, long 70° 12′ E
"Dumont d'Urville", lat 66° 40′ S, long 140° 01′ E

Japan

"Syowa", lat 69° S, long 39° 35′ E

New Zealand

"Scott Base", lat 77° 50′ S, long 166° 44′ E

South Africa

*Marion Island, lat 46° 53′ S, long 37° 52′ E
*Gough Island, lat 40° 9′ S, long 9° 51′ W
"Sanae", lat 70° 20′ S, long 2° 25′ W

United Kingdom

Deception Island, lat 62° 59′ S, long 60° 34′ W
Stonington Island, lat 68° 11′ S, long 67° 00′ W
Argentine Islands, lat 65° 15′ S, long 64° 15′ W
Signy Island, lat 60° 43′ S, long 45° 36′ W
Adelaide, lat 67° 46′ S, long 68° 54′ W
Halley Bay, lat 75° 31′ S, long 26° 38′ W
*Grytviken, South Georgia, lat 54° 17′ S, long 36° 30′ W

USA

"Amundsen-Scott", South Geographical Pole
"New Byrd", lat 80° 01′ S, long 119° 32′ W
"McMurdo", lat 77° 51′ S, long 166° 40′ E
"Palmer Station", lat 64° 46′ S, long 64° 04′ W
"Plateau", lat 79° 30′ S, long 40° 00′ E

USSR

Mirny, lat 66° 33′ S, long 93° 00′ E
"Novolazarevskaya", lat 70° 46′ S, long 11° 49′ E
"Molodezhnaya", lat 67° 40′ S, long 45° 51′ E
"Vostok", lat 78° 27′ S, long 106° 52′ E

JAPANESE ANTARCTIC STATION REOPENED

The Japanese station, "Syowa", in lat 69° S, long 39° 35′ E, was re-opened on 15 January 1966 and began to operate on 1 February, manned by a wintering party of eighteen. It had been closed since February 1962.

NEW UNITED STATES STATION IN ANTARCTICA

A new United States station "Plateau" has been established by air in lat 79° 30′ S, long 40° E and opened on 30 January 1966. It will be operated during the winter of 1966 by a party of eight, including four scientists.

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.

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