

GERMAN CONTRIBUTIONS TO THE CARTOGRAPHY OF ANTARCTICA  
BY MEANS OF PHOTOGRAMMETRY AND REMOTE SENSING

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Contribuciones Alemanas a la Cartografía de la Antártida  
por medio de la Fotogrametría y Exploración Remota

Primeramente el autor da una vista general sobre la exploración de la Antártida y sobre las actividades cartográficas realizadas de Alemania antes de 1945. En consideración de la grande importancia de la expedición Antártida de 1938/39 y la primera aplicación de cámaras para aerofotogrametría automática de parte de una expedición alemana, atención especial está llamada sobre esta expedición. En seguida, el autor informe sobre las actividades ejecutadas despues de 1945, en particular sobre las contribuciones de la República Federal de Alemania a la cartografía topográfica-coroográfica de la Antártida y sobre el establecimiento y puesta al día de un "Archivo Digital de Nombres de la Antártida" para las nombres en lengua alemana. Finalmente siguen informaciones sobre actividades en los campos de fotogrametría y exploración remota planeadas por la República Federal de Alemania en la Antártida.

Contributions allemandes à la cartographie de l'Antarctique  
à l'aide de la photogrammétrie et de la télédétection:

L'auteur présente d'abord une vue d'ensemble de l'exploration de l'Antarctique et des activités cartographiques exécutées par l'Allemagne avant 1945. En considération de la grande importance de l'expédition dans l'Antarctique entreprise dans les années 1938/39, où l'on a utilisé pour la première fois des chambres automatiques métriques photogrammétriques dans une expédition allemande, cette expédition est traitée en particulier. Ensuite est donné un rapport sur les activités postérieures à 1945, en premier lieu sur les contributions apportées par la République fédérale d'Allemagne à la cartographie topographique-chorographique de l'Antarctique, ainsi que sur l'établissement et la mise à jour d'un "fichier numérique Noms de l'Antarctique" pour les noms en langue allemande. L'exposé se termine par des informations relatives aux diverses activités photogrammétriques et de télédétection dans l'Antarctique dont l'exécution est projetée par la République fédérale d'Allemagne.

Deutsche Beiträge zur Kartographie der Antarktis  
mittels Photogrammetrie und Fernerkundung

Der Autor gibt zunächst eine Übersicht über die Erkundung der Antarktis und die kartographischen Aktivitäten Deutschlands vor 1945. Wegen der großen Bedeutung der Antarktis-Expedition 1938/39 und des erstmaligen Einsatzes von photogrammetrischen Reihenmeßkamern bei einer deutschen Expedition, sind dieser Expedition besondere Ausführungen gewidmet. Anschließend wird über die Aktivitäten nach 1945 berichtet, insbesondere über die Beiträge der Bundesrepublik Deutschland zur topographisch-chorographischen Kartographie der Antarktis sowie über die Einrichtung und Laufendhaltung einer "Digitalen Namen-Datei Antarktis" für das deutschsprachige Namengut. Abschließend folgen Hinweise über geplante photogrammetrische und fernerkundliche Aktivitäten der Bundesrepublik Deutschland in der Antarktis.

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
## 1. General Review of the Exploration of Antarctica and of Cartographic Activities before 1945

It was JOHANNES SCHÖNER (1477-1547), professor of mathematics and cartographer at Nürnberg [1], who at the beginning of modern times again represented in a cartographic form of expression, an Earth globe of 1515, that continent which, according to a hypothesis of the ancient Greek philosophers (ARISTOTELES 384-322 B.C. and others), was supposed to exist in the south polar region (Figure 1).

As a consequence of this, the "terra australis (incognita)" is indicated on later maps of the Earth produced by GERHARD MERCATOR (1538), RUMOLD MERCATOR (1595), JOHANNES KEPLER/PHILIPP ECHEBRECHT (1630) and others although reconnaissance voyages to that hypothetic continent had been more or less unsuccessful. Meanwhile the imagination of man had turned it into a vast and fertile continent. But this old idea of the existence of the "terra australis" had to be abandoned at the latest after the reconnaissance voyage of the Englishman JAMES COOK to the southern seas from 1772 to 1775. With the sailing ships "Resolution" (commanded by JAMES COOK) and "Adventure" (commanded by TOBIAS FOURNEAUX) and assisted by the German naturalists JOHANN REINHOLD FORSTER and his son GEORG FORSTER (Figure 2) Cook explored the regions around 60° latitude south and for the first time advanced beyond the antarctic circle (latitude 66°30' south) (see enclosed map 1). If a continent existed in the south pole area at all, then it had to be smaller and lie south of the explored pack ice. In memory of the almost 2000 year old idea of a "terra australis", in 1814 MATTHEW FLINDERS, the British explorer of Australia, suggested calling the continent named "New Holland" in future "Australia". [4]. His proposal became generally accepted.

At the time, Cook's aforementioned voyage gave rise to little increase in south polar research activities. Merely some whalers and sealers, made curious by Cook's reports, advanced further and further south in search of rich fishing grounds. It is very likely that they were the first ones to see the coasts of the Antarctic "terra firma" (land above mean sea level) but kept it secret for a long time for fear of competition. Today, the year 1820 is considered to be the date of an "established discovery" of the so-called "terra firma", the question being whether this honour is due to the American NATHANIEL PALMER, the Briton WILLIAM SMITH, GOTTLIEB v. BELLINGSHAUSEN in the service of Russia or to the Briton EDWARD BRANSFIELD. During a clarification of territorial claims between Great Britain, Argentine and Chile in 1955 the International Court of Justice in The Hague bestowed this honour on BRANSFIELD, stating that he had first "discovered" (first laid eyes on) the Antarctic

"terra firma" on 30 January 1820. The honour of having been the first to set foot on the Antarctic "terra firma" is in general conferred on the Norwegian CARSTEN BORCHGREVINK (on 24 January 1895 / South Victoria Land) although in 1894 his fellow countryman CARL ANTON LARSEN had visited already the supposed Seal Islands close to King Oskar Land; these, at a later date, were recognised to be ice-free nunataks of the terra firma. Accordingly, the honour of having been the first to set foot on Antarctic "terra firma" is due to him. [5].

There are differing opinions as far as the extent of Antarctica is concerned. The mathematic boundary is considered to be the southern polar circle (66°30' south latitude). The Antarctic oceanic convergence, i.e. that zone where the cold Antarctic surface waters coming from the south meet the moderately warm waters of more northerly areas and sink into the depths, is considered to be a limit of great constancy. From the biological and geographical point of view the outer sea ice limit is of special significance [6]. A definite delimitation is nearly impossible in this case. On the enclosed maps 1 and 2 the symbol  indicates this limit which is the mean value of the extent of sea ice with an ice coverage of 1/8 or more for the period from 1971 to 1976 [7]. The Antarctic Treaty (see par. 4) includes all land and ice shelves below 60° south latitude.

German activities in the south polar region began with the expedition by EDUARD DALLMANN (1873-74). Table 1 provides a review of the most important German expeditions before 1945. The enclosed map 2 shows the routes of the research vessels; the most important regions hereby discovered/explored are indicated by their names. With the Antarctic expedition of 1938/39 led by ALFRED RITSCHER German Antarctic research came to a temporary halt. Because of its great significance and the first use of aerial survey cameras by a German expedition, it will be dealt with more thoroughly in the following chapter.

The enclosed map 1 gives a general impression of the Unveiling of Antarctica up to the end of the Second World War. At this time the outline of the continent of Antarctica can be considered as being "known in its principal features". (On the unveiling of the Earth see [8]).

## 2. The German Antarctic Expedition of 1938/39 and its Cartographic Results

The main task of the "German Antarctic Expedition of 1938/39" sponsored by the DEUTSCHE FORSCHUNGSGEMEINSCHAFT (German Research Society) was the aerophotogrammetric exploration and survey of the continent of Antarctica between the longitudes 20° west and 20° east in the direction of the pole [9] p. 80. In addition to this task involving photogrammetry, topography, geography and cartography, further tasks had been envisaged for Meteorology: meteorological advice for photoflights and investigation of the upper layers of the atmosphere by radiosondes. Oceanography: survey of underwater terrain by echo soundings, sea surface observations and measurements, temperature measurements, investigation of ice conditions.

Nautical science: testing of instruments, measurements of the depression of the horizon, revision of German nautical charts, drawing of coast views for nautical manuals.

Geophysics: dust countings, radiation measurements, measurements of declination, inclination and horizon intensity on ice and land.

Biology: observations on the presence of whales, seals and birds, plankton catches and gathering of data on food selection and food ingestion of the euphausia superba.

All these branches of science were represented by at least one scientist each.

The logistic prerequisites for the expedition had been provided by the German Government of the Reich under the responsibility of Staatsrat Ministerialdirektor HELMUT WOHLTHAT, the initiator of the expedition. For the main task, the following, and other, equipment had been made available and was put to use:

- the catapult vessel of the Deutsche Lufthansa "Schwabenland" with 2 seaplanes of the Dornier 10 t whale type (converted into survey aircrafts and equipped with skis for landing on snow). They had a range of 2500 - 2800 km. and a speed of 150 - 170 km/hour (Figure 3).
- 2 metric cameras RMK 21/18 with 4 film cartridges (for 55 m film each) made by Zeiss-Aerotopograph, provided by the then Hansa Luftbild GmbH (director WILHELM GESSNER).
- 60 rolls of Agfa Aeropan B-aerial film, each 50 m in length with paper leader and trailer (for insertion of film in daylight).

The "Schwabenland" (navigator Captain ALFRED KOTTAS; ice pilot Captain OTTO KRAUL) left Hamburg on 17 December 1938 and reached the field of operation (ice shelf) on 19 January 1939. She left again on 6 February 1939 and arrived in Hamburg on 11 April 1939. The expedition was commanded by Captain ALFRED RITSCHER (Figure 4). His experience gathered in the Arctic, his qualification as captain and the fact that he had proved himself to be a good aviator during World War I were the decisive factors for making him the leader of the expedition [10], [11]. Since an appreciation of his accomplishments would go beyond the scope of this contribution, it can only be pointed out here that special merit is due to ALFRED RITSCHER for his efforts regarding German Antarctic research.

For the accomplishment of the aforementioned main task using the two seaplanes

Name:	"Boreas"	"Passat"
Captain of the aircraft: (Deutsche Lufthansa)	RICHARDHEINRICH SCHIRMACHER	RUDOLF MAYR

Aerial photographer/operator: SIEGFRIED SAUTER MAX BUNDERMANN  
(Hansa Luftbild GmbH)

a total of 11,600 oblique aerial photographs were taken, the overall distance flown amounted to 7,706 km, the overall flight time to 57<sup>h</sup>14' and the area covered to approximately 600,000 km<sup>2</sup>. The positioning of the metric cameras in the aircraft is shown

in Figure 5. In the lateral tilt direction they had a nadir distance of  $70^{\circ}$ . From the paper contact prints seen so far it may be deduced that the original aerial films must have been of first class quality. Unfortunately they have not been located up to now. It is to be feared that they were lost at the end of World War II (in Berlin/Zoo airraid shelter?). Nevertheless it may be stated here that the two aerial photographers/operators of Hansa Luftbild GmbH, SIEGFRIED SAUTER and MAX BUNDERMANN, have done an excellent job (Figure 6).

Apart from the aforementioned oblique aerial photographs 434 photographs in black and white and 90 photographs in colour were taken with a hand-held camera (7 cm x 9 cm), as well as one 16 mm cinema negative film 1800 m in length and one cinema colour film 485 m in length. All reconnaissance and survey flights were carried out from 19 January to 5 February 1939. Mrs. ILSE RITSCHER handed over the original reversal copies of the cinema negative film and the cinema colour film (3 rolls) found in the effects of her husband who died on 30 March 1963 to the FEDERAL ARCHIVES at Koblenz on 17 November 1977 (Ref. Nr. 5262). A cordial thank-you to her, which is most surely spoken on behalf of many Antarctic researchers. The Federal Archives also hold in their custody the Ufa-Tonwoche (newsreel) Nr. 450/1939 showing the arrival of the "Schwabenland" in Hamburg in April 1939.

The cartographic goals of the expedition consisted in the production of a topographic map series 1 : 250,000 covering all of Neuschwabenland and in the production of single topographic maps 1 : 50,000 covering regions of particular interest [9] p. 121. Because of the Second World War, this ambitious aim could be realised only in part, merely the following being produced:

- a provisional general map of the field of operation of the German Antarctic Expedition of 1938/39 "Neu-Schwabenland" 1 : 1,500,000 (compiled by HANSA LUFTBILD GmbH Berlin; Direction: HANS RICHTER, cooperation RUDOLF FÖRSTNER and FRIEDRICH, THIERBACH. Published in 1939, with changes 1942 [9])
- a topographic map "Neu-Schwabenland, Wohlthat-Massiv" 1 : 500,000 based on aerial photographs taken on 3/4 February 1939 with 250 m contour line representation. 5 colours. (Compiled by OTTO v. GRUBER. Published 1942 [9])
- a topographic map "Am Westrand des Alexander v. Humboldt-Gebirges" 1 : 50,000 based on aerial photographs taken on 3 February 1939 with 100 m and, in part, 50 m contour line representation. 5 colours. (Compiled by OTTO v. GRUBER. Published 1942).
- a topographic map "Wohlthat Massiv" 1 : 50,000 based on aerial photographs taken on 3 February 1939 with 100 m and, in part, 50 m contour line representation. 5 colours. (Compiled by OTTO v. GRUBER, Published 1942 )

Considering the given conditions (oblique aerial photographs, no control points etc), the geodesist O. v. GRUBER achieved a considerable increase in value of the expedition results with the production of the three lastmentioned topographic maps and by this means entered his name in the annals of German Antarctic research. Unfortunately nothing as yet is known about the where-

abouts of the map originals.

In connection with the aforementioned map making, v. GRUBER also examined flight lines which, according to the aircraft catapulting sites, the estimated speed above ground, the assumed magnetic declination and the estimated wind drift had already been determined and represented on a map by Hansa Luftbild GmbH in 1939 (Figure 7). Above all he corrected flight line VII and thereby increased the absolute positional accuracy of his maps. By making use of numerous paper prints of the expedition's aerial photographs and the Norwegian topographic maps 1:250,000 meanwhile published, the INSTITUT FÜR ANGEWANDTE GEODASIE (IfAG) examined the flight lines once again. According to this, major corrections are to be applied to flight lines I to VI while only a very small correction is needed for flight line VII already corrected by v. Gruber. The results obtained will be made subject of a special report. The new examination is connected with the coverage of German names for Antarctica.

### 3. German Names for Antarctica

The satellite maps, aerial maps and line maps to be prepared within the scope of Antarctic research must be provided with names and designations for single topographic/geographical features, whereby the names and designations assigned by Germany before 1945 and by the Federal Republic of Germany after 1945 are to be retained.

The names and designations so far assigned to Antarctic features are at present being traced with the support of the DEUTSCHE FORSCHUNGSGEMEINSCHAFT. The expedition reports of the expeditions listed in Table 1 and the reports published by the BUNDESANSTALT FÜR GEOWISSENSCHAFTEN UND ROHSTOFFE (Federal Institute for Geosciences and Natural Resources) in Hannover on the names and designations assigned during the German Antarctic North Victoria Land (GANOVEX) expeditions serve as a source of information. Moreover, the previously assigned names (Table 1) must be re-examined. With respect to point-shaped features, an unambiguous assignment of name and feature must either be available or must be made by means of satellite images/satellite image maps/more recent line maps. In the case of areal features it is for the most part very difficult to find out exactly which area the bestower of a name intended to cover with this name (e.g. a landscape name). It is equally difficult and very time-consuming as well to establish the limits of such an area since a regional division is to a large extent still missing in Antarctica.

Special merit is due to HANS-PETER KOSACK for his efforts in retaining and cartographically processing German names in Antarctica. On his map of Antarctica 1 : 4,000,000 (4 sheets, date of compilation 1 October 1953) [12], on his map of Antarctica 1 : 7,500,000 (1 sheet, date of compilation May 1956 [13], and on hand-drawn records he has tried above all to refer those names assigned during the German Antarctic expedition of 1938/39 to the topographic/geographic survey results which have become available in the meantime with a higher positional accuracy.

(thanks are due to Mrs. L. KOSACK for making available all relevant documents). Another name/feature correction is at present being made at IfAG (Dipl.-Geograph K. BRUNK) by means of about 650 aerial photograph paper contact prints dating from 1938/39. This correction leads, as a rule, to a change in the geographical coordinates (including sea level data) assigned to the feature name. The results obtained will be made subject of a special report.

The goal of this work is the establishment and revision of a "Digital Name File Antarctica" for the German names in Antarctica. The INSTITUT FÜR ANGEWANDTE GEODÄSIE undertook to perform this task in compliance with a request of the German National Committee of the SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH (LA-SCAR) presented at its 11th meeting and in agreement with the ALFRED WEGENER INSTITUT FÜR POLARFORSCHUNG (AWI) (Alfred Wegener Institute for Polar Research) at Bremerhaven (19 August 1982). Profiting from the experiences gained in the compilation of the Gazetteer Federal Republic of Germany, IfAG will establish the digital name file in such a manner that the latest status can be output at any time in the form of alphabetical name lists and name cards (name transparencies).

The newly assigned names and designations will be published as required in the current "National Antarctic Research Report to SCAR" of the Federal Republic of Germany. In this connection it should be pointed out that the names assigned during the German Antarctic expedition of 1938/39 were published in 1952 in the Federal Gazette Nr. 149 (4th year) of the Federal Republic of Germany.

For the assignment of names and designations in the German language to topographic/geographic features and regions in Antarctica a procedure has been worked out which comprises the following steps:

- (1) Assignment of "working names" (provisional assignment) by the expedition in situ, by competent map editing agency or others. Preparation of a supporting document in the form of lists and maps (preliminary drawing).
- (2) Data preparation at IfAG and calling in of the STÄNDIGER AUSSCHUSS FÜR GEOGRAPHISCHE NAMEN (STAGN), (Permanent Committee on Geographical Names) which examines the planned name assignment from its point of view and, if necessary, expresses wishes for changes.  
(The office of STAGN is run by IfAG).
- (3) After coordination with those concerned (in particular with AWI) IfAG submits the "corrected data" to LA-SCAR which decides (by resolution) whether the provisional assignment is to become a final one. If this is the case, IfAG incorporates the final data into the "Digital Name File Antarctica".
- (4) Publication: National Antarctic Research Report to SCAR.

In the Digital Name File Antarctica among others there are stored: name/designation, feature code, key-number, geographical coordinates (latitude, longitude), height above zero, date of source of information, limiting geographical coordinate lines

with areal features, source number, reason for name assignment, date of coordinate determination, date of levelling, date of discovery, date of LA-SCAR confirmation, azimuth of the name field, Antarctic partial map, synonym.

As to the present status of the establishment and revision of the Digital Name File, the following should be pointed out:

- Of the names assigned to features and areas in Antarctica before 1945, 207 have been covered so far. According to Table 1 they are subdivided as follows:

1873-1874	Dallmann	14 names
1884	v. Reibnitz	2 names
1882-1883	Schrader	33 names
1893-1894	Larsen	14 names
1901-1903	v. Drygalski	19 names
1911-1912	Filchner	29 names
1938-1939	Ritscher	96 names

Approximately another 100 names will probably be added from the area of the Kerguelen Islands.

- The name data as obtained from the expedition report or other sources of information are regarded as a "source version" which is marked by the numbers .00 (written behind the name numbers). All subsequent changes of the source or .00 version are marked as version .01, .02, .03 etc. So far 398 versions have been handled this way. The overall list of all versions shows the historic development of the data of the names.
- According to step 2 of the aforementioned procedure of assignment, a first alphabetical list of the 201 names (including an overall list containing the 398 versions) was sent to STAGN on 28 November 1983.
- After 1945, the Bundesanstalt für Geowissenschaften und Rohstoffe assigned in connection with the Antarctic expedition GANOVEX I (1919/80) and forwarded 55 working names for acquisition to IfAG. A list of the working names from GANOVEX III (1982/83) with the appertaining data is presently being drawn up.

#### 4. Contributions of the Federal Republic of Germany to the Topographic-Chorographic Cartography of Antarctica

There is no question that the INTERNATIONAL GEOPHYSICAL YEAR 1957/58 gave a strong impetus to international cooperation in Antarctic research. 66 countries participated in these international efforts, 12 of them concentrating in particular on Antarctica. On 1 December 1959 these 12 countries signed the ANTARCTIC TREATY [14]. After the DEUTSCHE FORSCHUNGSGEMEINSCHAFT had become a member of the SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH (SCAR) in May 1978 and had founded a GERMAN NATIONAL COMMITTEE (LA-SCAR), the Federal Republic of Germany acceded to the Antarctic Treaty on 5 February 1979 which by this time counted 26 member states. Because of the substantial scientific research activity in Antarctica and the permanently occupied research station "GEORG v. NEUMAYER", erected in 1981, the Federal Republic of Germany was admitted on 3 March 1981 as the 14<sup>th</sup> member in the "Consultative Party" which attends to essen-



tial tasks within the scope of the Antarctic Treaty.

Both these facts and the activity of LA-SCAR led to the "Antarctic Research Programme of the Federal Republic of Germany" [15] comprising at present about 70 projects. Two of these are "Remote sensing with satellites" and "Geodetic-cartographic survey of ice-free regions" the activities of which are described here.

Within the scope of the project "Eiswarte" of the Antarctic expedition of 1981/82, Prof. Dr. HELL (university, now polytechnic of Karlsruhe) carried out some preliminary photogrammetric investigations [16] resulting in aerial photographs of the Georg v. Neumayer station and its surroundings, taken from a helicopter with a Hasselblad camera 500 C/M (format 6 cm x 6 cm). A map of the station is at present being compiled at 1 : 2000 scale.

The contribution of the INSTITUT FÜR ANGEWANDTE GEODÄSIE to the topographic-chorographic cartography of Antarctica has consisted up to the present primarily in the production of satellite image mosaics and satellite image maps.

The satellite image mosaic "Atka-Bucht, Ritscher-Hochland, Mühlig-Hofmann-Gebirge" prepared manually in November 1981 at approximately 1 : 1,000,000 scale is composed of 20 LANDSAT 01 and 02 imagery (band 7).

For the production of satellite image maps control points are needed, i.e. points which can be identified on the satellite image and the (geographical) coordinates of which are known. For this reason a topographic control point file has been established for the Antarctic region 90°W - 0° - 50°E, comprising at present 234 points available in map and photograph form. For the establishment of such a file it was necessary to first locate and procure suitable, i.e. sufficiently accurate maps. Then suitable points, identical on both map and photograph, had to be selected and their geographical coordinates determined cartometrically.

Further preliminary work in connection with this was the examination of the data processing programmes for satellite image rectification available at IfAG with respect to their usability for image map production. Problems to be solved during data processing included data reformatting, contrast enhancement for mostly snow and ice-covered regions as well as geometric and radiometric adjustments of adjacent imagery. The research activities (Dr. W. GÖPFERT and co-workers) were in particular based on imagery data from the satellites NOAA 06-08 and LANDSAT 01-03.

To prove the effectiveness of the optimized (and now operational) procedure, the digital image processing system available at IfAG was used for the production of the satellite image maps "West-Neuschwabenland 1981" and "Neu-Schwabenland 1982", both at 1 : 3,000,000 scale in stereographic projection. A portion of the last mentioned map is enclosed. A satellite image map, also in stereographic projection, for the Antarctic region of about

90°W - 0° - 60° E (with South Pole) at the scale of 1:6,000,000 will be completed in the near future.

Part of these activities has been funded by the Deutsche Forschungsgemeinschaft.

Another contribution of the INSTITUT FÜR ANGEWANDTE GEODÄSIE aims at the preparation of photomaps by means of orthophoto procedures at 1 : 50,000 scale (or larger) of selected areas of Antarctica. It is planned that German photogrameters carry out for the first time since 1938/39 (see par. 2) aerial photography in Antarctica in the austral summer of 1983/84, the Federal Minister of Research and Technology (BMFT) having provided the logistic prerequisites for this project by the procurement of a survey aircraft DO 228-100 (Figure 8) and aerial photography equipment. IfAG assisted in the procurement by defining the photogrammetric equipment (including a photographic laboratory for the Georg v. Neumayer station) and by further measures. Moreover, it has tested the functioning of the purchased equipment, a metric camera from the firm of CARL ZEISS/Oberkochen RMK 8,5/23 with accessories, in the laboratory and during flight conditions, the tests in the aircraft having taken place in cooperation with the firms of DORNIER/Friedrichshafen and HANSA LUFTBILD/Münster. At the same time the aerial films Agfa Avipot Pan 200 and Kodak Aerochrome Infrared 2443 were tested with respect to their use in Antarctica.

Regarding the connection between the Doppler Navigation System Decca Type 72 of the DO 228-100 and the data display recording system DAS of the RMK system, IfAG cooperated closely with the firms of CARL ZEISS/Oberkochen and PRAKLA SEISMOS/Hannover.

There was always close contact with the geophysicists, with Prof. Dr. F. THYSSEN from the Geophysical Institute of the university of Münster, who will also make use of the DO 228-100 for geophysical measurements. Prof. Thyssen was and still is responsible for coordinating the different activities in connection with aeronautic logistics.

The Antarctic photoflight programme 1983/84 was developed and coordinated during two technical discussions held at IfAG on 24 January and 12 July 1983 with representatives from different geosciences (geophysics, geology, geography etc.) and from extraterrestrial physics/cosmo-chemistry. The programme comprises, among others, areal coverages (at 1 : 80,000 image scale) of parts of the mountains in western Neuschwabenland and land route explorations from the Georg v. Neumayer station and from a defined point at the ice-shelf edge south of Cape Norwegia to these mountains. The logistic preparations and photoflight planning have meanwhile been concluded. Part of the equipment is already being shipped to the Georg v. Neumayer station on board the German polar research vessel "Polarstern" (Figure 9). The remainder will be shipped with the chartered South African vessel "Agulhas". The survey aircraft DO 228-100 (equipped with skis for landing and take-off on snow) and a (rescue) plane DO 128-6 are scheduled to fly to the Georg v. Neumayer station via South America. It must be expected that due to lack of time

desirable reconnaissance flights over parts of the seaward edge of the Filchner ice shelf and areal coverages around the FILCHNER STATION (summer station on the Filchner ice shelf) cannot be carried out during this mission. Since besides the available flight time the realisation of the photoflight programme depends essentially on the weather conditions in the different geographical regions, decisions on the course of the programme can only be taken on the spot. With the approval of the Federal Minister of the Interior, the IfAG members Dr. J. SIEVERS and Dipl.-Ing. H. WALTER will carry out the photoflight programme according to the conditions encountered there. During photoflight planning they were actively supported by Dipl.-Geographer K. BRUNK.+)

Part of these activities was again funded by the Deutsche Forschungsgemeinschaft.

By including Antarctic research projects of the Federal Republic of Germany in the working programme of the Institut für Angewandte Geodäsie, which is Division II of the Deutsches Geodätisches Forschungsinstitut (German Geodetic Research Institute) and by providing the necessary funds, the FEDERAL MINISTER OF THE INTERIOR is also making a valuable contribution to research in Antarctica and to its topographic-cartographic coverage.

Owing to the fact that a synoptic representation of the German survey activities hitherto carried out in Antarctica does not yet exist, this topic was made a diploma thesis at the UNIVERSITY of KARLSRUHE at the instigation and under the guidance of the author [17]. In connection with this it was of particular interest whether and to what extent geodetically determined landmarks can be used as control points for future mapmaking. With great zeal cand. geod. ROBERT FORSTER compiled, selected and evaluated the geodetic and photogrammetric work carried out during German Antarctic expeditions from 1900 to 1982.

#### 5. Planned Photogrammetric and Remote Sensing Activities in Antarctica

Since according to present planning the survey aircraft DO 228-100 will be used by the Bundesanstalt für Geowissenschaften in Hannover for geographical measurements during the austral summer of 1984/85 most likely it will not be available for photogrammetric purposes until the austral summer of 1985/86.

As a result of coordinating discussions held with representatives of different geosciences, IfAG is planning the realisation of three projects which are best described by the following keywords:

- (a) Coverage of the topography of West-Neuschwabenland (information about topography, geomorphology and geology of West Neuschwabenland including parts of the Mühlig-Hofmann mountains, possibly in cooperation with Norway and South Africa).

+ ) According to a telex report from the Georg v. Neumayer station (Dr. Sievers/Walter) dated 25 January 1984, essential parts of the photogrammetric programme have in the meantime been carried out successfully.

- (b) Ice edge survey  
 (Information about kinematics, change in form, ice break-off etc. of the seaward edge of the Filchner ice shelf approximately 500 km in length, carried out not just with some single points but nearly continuously over the whole length. Testing of a new aerial photography procedure for covering nearly structureless and "drifting" zones. Realisation within the scope of the "2<sup>nd</sup> Filchner Ice Shelf Project").
- (c) Topographic coverage of the Transantarctic Mountains in the eastern and southern boundary zone of the Filchner iceshelf. (Information about the topographic and geologic structure of parts of the Transantarctic Mountains).

Project realisation is scheduled for the austral summer of 1985/86. In the meantime a corresponding research programme has been set down in writing.

According to a report of the Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt (DFVLR) (Aero Space Research Institute) [19] it may be expected that NASA will conduct a shuttle flight in 1986. The instrumentation for radar imagery recording will be a joint contribution of the USA and the Federal Republic of Germany (BMFT/DFVLR), consisting of American SAR instruments (Synthetic Aperture Radar) (L band and, possibly, C band) and the German MRSE instrument (Microwave Remote Sensing Equipment). The project is called SIR-C (Shuttle Imaging Radar C).

MRSE was first used in SPACELAB-01 together with the metric aerial camera RMK 30/23 (Space Transport System 09 from 28 November to 8 December 1983). For the use of MRSE in SIR-C some modifications have been planned. It will then be called X-SAR.

The shuttle flight is scheduled to take place early in 1986 (launch in Vandenberg), a polar orbit at 250 km altitude being envisaged. This means that for the first time Antarctica could be covered by radar imagery data in the L-, X- and, possibly, also in the C band with a X-SAR picture element size of about 25 m. The X-SAR strip width will amount to approximately 8 km and be within the 40 to 60 km strip width of the USA-SARs. The planned (almost) polar orbit will facilitate a comparison with the corresponding MSS (Multi Spectral Scanner) and TM (Thematic Mapper) data from LANDSAT-04.

In view of the properties of the microwaves (all-weather suitability, penetration of heavy cloud coverage, day and night operation, terrain penetration capability etc.), the SIR-C programme could in the author's opinion represent a considerable contribution to Antarctic research. It is to be expected that the radar data in the L, X and perhaps C band combined with the corresponding MSS and TM data from LANDSAT-04 will provide the various geosciences with information which can hardly be obtained otherwise in this quantity and time. This applies to topography certainly (including cartography). Since X-SAR and TM data have about the same picture element size (about 30 m) interesting possibilities of comparison and combination present themselves which in all likelihood will lead to increased information acquisition.

Beyond this, the start of ERS-01 (ESA Remote Sensing Satellite System) is planned for 1987/88. This system, too, can contribute considerably to Antarctic research.

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Table 1 German Antarctic Expeditions before 1945

Year	Command "Vessel" and others	Activities/Results (Support)
1873-1874	Eduard Dallmann, Captain, Sealer and whaler "Grönland". First operation of a (sailing) steamship in the South Polar region.	Exploration of the "Bismarck strait", the "Kaiser Wilhelm Archipelago" and others. (by order of the Polar Fishing Company in Hamburg)
1874	v. Reibnitz, Captain "Arkona"	Exploration and determination of a suitable position for the observation of a Venus transit on 9 December 1874; the observation proper was carried out by Dr. Ladislaus Weineck on the Kerguelen Islands.
1874-1876	Georg Emil Gustav Freiherr von Schleinitz, Captain (later Admiral) "Gazelle"	Oceanographic explorations and surveys in the Kerguelen area. Map 1 : 175,000: "Kerguelen Island, from Howe Island to Accessible Bay".
1882-1883	Dr. Karl Schrader "Moltke" and "Marie"	Participation in the 1 <sup>st</sup> International Polar Year. Geographical and meteorological measurements. Wintering on South Georgia.
1893-1894	Carl Anton Larsen, Captain, Norwegian sealer "Jason" in company with "Hertha" Captain Evensen	Explorations along the east coast of the Antarctic Peninsula. Map 1 : 7,500,000: "Dirck Gherritz Archipelago" (1895) (by order of the Steam Ship Company "Oceana" in Hamburg).
1898-1899	Prof. Dr. Carl Chun Zoologist "Valdivia" Captain Sachse Captain Krech	Oceanographical and biological explorations between the Kerguelen Islands and Enderby Land. Bouvet-Is- land rediscovered; crater edge height measurement/ Kaiser Wilhelm peak highest point. (Government of the Reich)
1901-1903	Prof. Dr. Erich v. Drygalski Geographer, geophysicist "Gauss I" Captain Hans Ruser	Exploration of the "Kaiser Wilhelm II Land" and survey of the "Gaussberg" including first applica- tion of <u>terrestrial photogrammetry</u> on the part of a German expedition. First time production of <u>aerial photographs</u> of Antarctica from a captive balloon at 500 m altitude on 29 March 1903. Map 1 : 7,500 "Der Gaussberg" Map 1 : 15,000 "Das Inlandeis am Gaussberg" Map 1 : 250,000 "Das Schelfeis der Posadowsky-Bai" Sketch map: "Posadowsky-Bai mit dem Winterlager des Gauss" (Kaiser Wilhelm II, Government of the Reich, Graf Baudissin, Graf Posadowsky).
1911-1912	Dr. Wilhelm Filchner "Deutschland" Captains Richard Vahsel and Alfred Kling	Exploration of the "Prinzregent Luitpold Land" and the "Filchner Schelfeis". The vessel was surrounded by ice and drifted for 9 months through the Weddell Sea. Map 1 : 450,000 "Prinzregent Luitpold Land" (Govern- ment of the Reich, Prinzregent Luitpold von Bayern and others)
1925-1927	Prof. Dr. Alfred Merz "Meteor" Captain (later Admiral) Dr. h.c. Fritz Spiess	Oceanic explorations around the Bouvet Island. (Deutsche Forschungsgemeinschaft under the presi- dency of Dr. F. Schmitt-Ott)
1928-1929	Dr. Ludwig Kohl-Larsen "Thorhammer"	Glazier measurements on South Georgia.
1938-1939	Alfred Ritscher Captain (Expedition leader) "Schwabenland" Captain Alfred Kottas	Exploration of "Neuschwabenland" (approx. 600,000 km <sup>2</sup> ). 11,600 <u>aerial photographs</u> (oblique aerial photographs with Zeiss RMK 21/18) taken from 20 January to 4 Feb- ruary 1939. Maps 1 : 1,500,000, 1 : 500,000, 1 : 50,000 (see par.2) (Government of the Reich, Deutsche Forschungsgemein- schaft under the presidency of Prof. Dr. Rudolf Mentzel)

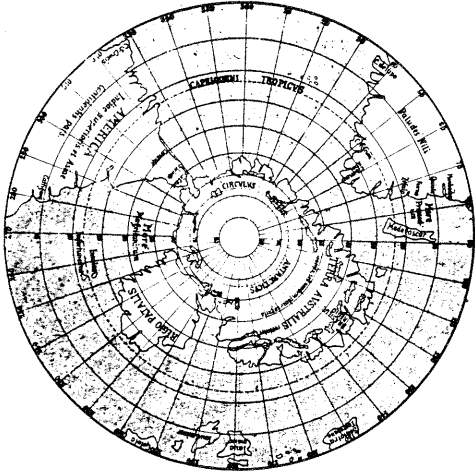


Figure 1 JOHANNES SCHÖNER from Nürnberg produced a number of globes from 1515-1533 depicting for the first time in years the "terra australis" [1]. The map shown here corresponds to the Earth globe "opusculum geographicum" from 1533.



Figure 2 The German naturalist and doctor honoris causa of the university of Oxford JOHANN REINHOLD FORSTER (1729-1798) and his son GEORG FORSTER (1754-1794) participated in the great reconnaissance voyage of the Englishman JAMES COOK to the southern seas [2], [3]. (Engraving by Beyel after a painting by Rigauds London 1780/from [3], volume 4)

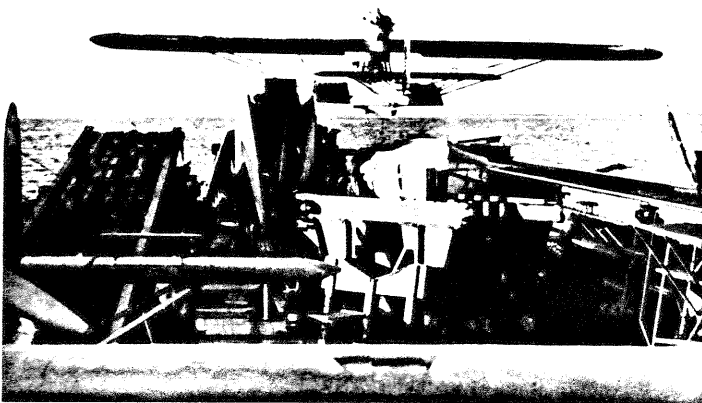


Figure 3 Catapult take-off of a survey aircraft of the Antarctic expedition of 1938/39.



Figure 4 Captain ALFRED RITSCHER (1879-1963). Photo taken a few days before the departure of the "Schwabenland" from Hamburg in December 1938 for the Antarctic expedition. (By kind permission of Mrs. Ilse Ritscher).

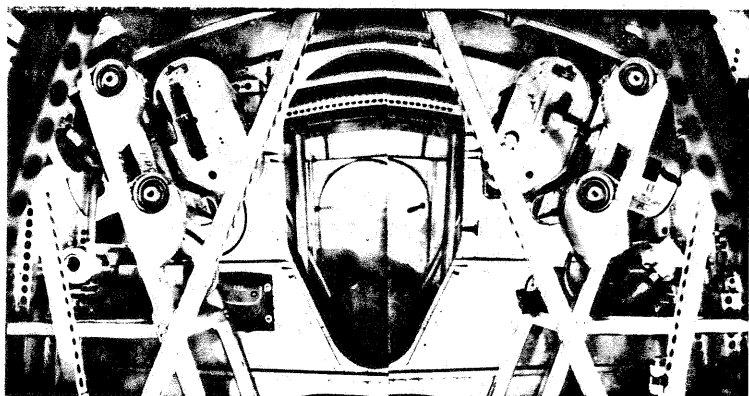


Figure 5 Positioning of the RMK 21/18 in the survey aircraft of the Antarctic expedition of 1938/39.



Figure 6 Some of the crew members and servicing personnel of the survey aircrafts of the Antarctic expedition of 1938/39 (from left to right): aircraft mechanic Franz Preuschhoff, captain of the aircraft Rudolf Mayr, radio operator Herbert Ruhnke, photographer/camera operator Siegfried Sauter. (By kind permission of Mr. Siegfried Sauter)



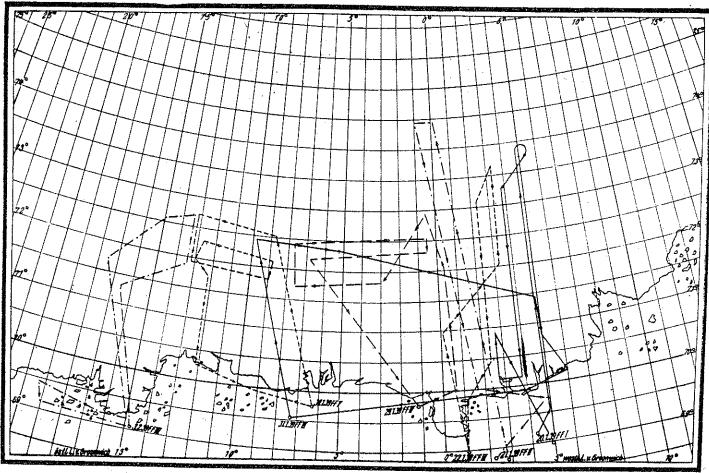


Figure 7 Flight lines I - VII of the aerial surveys of Neuschwanland 1939. (Reduction of the original map with status of 1939)

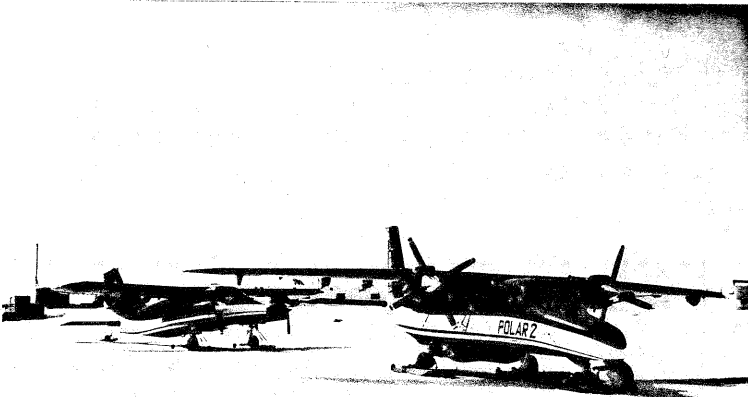


Figure 8 The survey aircraft DO 228-100 "Polar 2" and the rescue/transport aircraft DO 128-6 "Polar 1" were put into service at Bremerhaven on 16 December 1983. First Antarctic mission: 1983/84

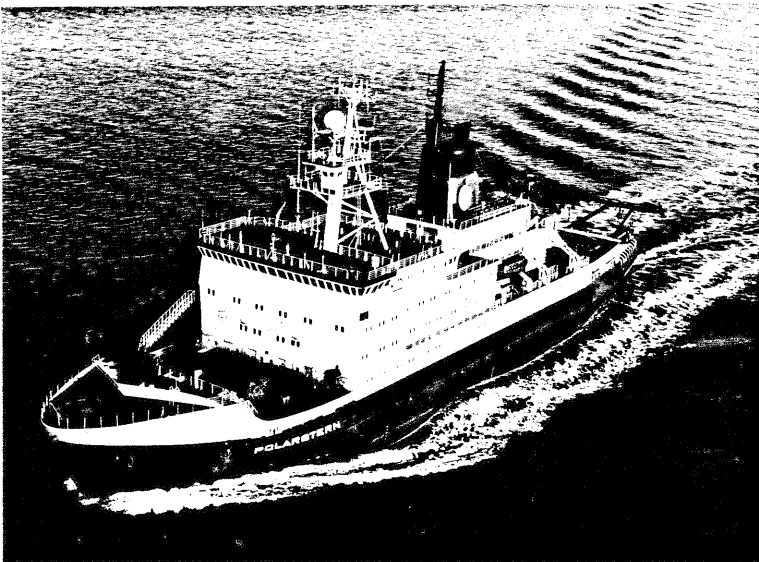


Figure 9 The German polar research and supply vessel "Polarstern", put into service on 9 December 1982, accomplished her first Antarctic mission successfully in 1982/83.