

CHAPTER I

THE BACKGROUND

1. The setting (see Map 1, page 2)

British Antarctic Territory, South Georgia and the South Sandwich Islands were previously known collectively as the Falkland Islands Dependencies (FID). They comprise the segment of Antarctica lying between 20°W and 80°W plus the off-lying islands and associated archipelagos and islands to the north; in 1962, that part lying south of 60°S was re-named British Antarctic Territory (BAT).

Geographically the area is diverse, including, from south to north, part of the polar ice cap, the long, narrow Antarctic Peninsula, a multiplicity of small off-shore islands, the major island groups of the South Shetland Islands, the South Orkney Islands and the South Sandwich Islands, and South Georgia. Topography is equally varied. The high, gently sloping ice cap - sparsely punctured by rocky nunataks and serrated peaks of buried mountain ranges - is largely featureless away from fields of crevasses, sastrugi and major ice streams. The Antarctic Peninsula, one of the most rugged parts of Antarctica, has a narrow, spinal, ice-covered plateau in the north averaging 1500–2400 m above sea level and dropping, on either side, in sheer scarps, from the foot of which numerous glaciers flow down through coastal mountains towards the sea. The west coast, indented by bays and fjords opening out on to channels dotted with islands, contrasts markedly with the east coast, fringed for most of its length by an extensive ice shelf. The islands are rugged and mountainous, or capped by smooth ice domes. Much of the coast of both the peninsula and islands is ice cliff and, south of 60°S, exposed rock accounts for very little of the total area.

The latitudinal extent of the whole area (54°S to the Pole) exposes it to a variety of climatic regimes and, in parts, the accented topography has a major influence on local weather conditions. South of 60°S, low temperatures, shortness of the working season and hazardous travelling and sea ice conditions were expected, but two other factors that have had a major influence on fieldwork in the Antarctic Peninsula are the persistent blizzards and gusting winds that sweep off the plateau and the frequent occurrence of low cloud and mist over both land and sea¹.

2. The reasons for survey

Topographical survey and mapping have been carried out, since 1944, as an integral part of the overall work programme of the Falkland Islands Dependencies Survey (FIDS) - later the British Antarctic Survey (BAS) - and its predecessor, the naval Operation Tabarin. They were done, within constraints of funding and logistics, in the areas and, as far as feasible, to the accuracies required for particular purposes. The survey was initially exploratory. It was not planned to provide an accurate framework over the whole territory, but, at a later date, the development of electronic distance measuring equipment, of transport facilities, of satellite surveying and of computers enabled the separate schemes to be linked together (see Chapter 3).

The most potent reasons for survey during the first decades were political - in the light of territorial claims by other nations - and secondarily economic. The main purpose was to record the results of exploration and publish maps on which topographical features were delineated and named. This is illustrated by two objectives of the FIDS scientific programme for 1948²: "To obtain

knowledge of the Dependencies and advance the general development of the FID and of the Antarctic region as a whole' and 'To carry out observations and investigations whose results will benefit the whaling industry' (whose revenues were then funding the operation). At that time, surveying and meteorology were the most important activities in FID³. By 1949, there was already a pressing need too for base maps on which scientists could plot their results and plan future work, but it was recognised that - without an aerial survey - detailed, accurate mapping was only feasible in areas of special interest, such as near a Base⁴. Increased shipping activities generated a demand for better and more accurate charts and also for a triangulation link between the South Shetland Islands and the Antarctic Peninsula to control detailed coastal and hydrographic work being carried out by Royal Navy and FIDS ships³.

Once the first objectives were achieved and preliminary mapping produced of the most frequented areas, politicians and scientists demanded more accurate, more detailed and, as exploration proceeded, more extensive coverage. Increased activity was related directly to the availability of funding and it was the political pressures that generated funds to enable modern techniques of air survey and electronic distance measuring to be used in FID. The formation of the international Special (later Scientific) Committee for Antarctic Research and the ratification of the Antarctic Treaty in 1961 gave a wider dimension to the need for surveying and mapping (see Chapter 6). Countries were encouraged to produce national map series at specific scales and to a common specification, and to exchange maps and data. In later years, the increased use of aircraft in FID highlighted the need for accurate position-fixing throughout the area for navigation, and the great expansion of field programmes in other disciplines extended the area for which accurate coordinates and small-scale mapping were required.

In addition to the sober political, economic and scientific reasons for survey and mapping given above, one must also mention the determination and sheer enthusiasm of two individuals. South Georgia was mapped during four expeditions initiated and led by Duncan Carse between 1951 and 1957, and the initial mapping of southern Coats Land and of the Shackleton Range was carried out by the Trans-Antarctic Expedition initiated and led by Dr Vivian Fuchs in 1955–58.

3. The role of the Directorate of Colonial (later Overseas) Surveys

Initially, field data and compilations from each Base were sent to the Discovery Committee for retention, but, in mid-1946, the Colonial Office (CO) asked its newly formed Directorate of Colonial Surveys (DCS) - set up specifically to survey and map British dependent territories - to undertake mapping of FID.

In 1948, when responsibility for FIDS was transferred to the Governor of the Falkland Islands and Dependencies and an advisory FID Scientific Committee (FID ScC) was set up in London*⁵, responsibility for drawing up the whole scientific programme rested with the Commander (later Director) FIDS, under the direction of the Governor. Both the Governor and the FID ScC agreed that DCS should continue to be responsible for mapping; DCS agreed to treat FID like any other it for retention⁷; the transfer of the 1944–47 records was completed by the end of the year⁸.

* The first meeting on 12/5/48 was attended by: J.M. Wordie (Chairman), Dr N.A. Mackintosh (Discovery Committee), N.B. Kinnear (Br. Museum), Rev. W.L.S. Fleming (Scott Polar Research Institute), Dr B.B. Roberts (FO Res. Dept.), R.W. Piper (CO Res. Dept.), and also Lt Col W.D.C. Wiggins (Dep. Dir. DCS), Dr E.S. Willbourn (Dir. Col. Geol. Surveys) and P.A. Carter (CO, Sec'y).

In 1949, plans for the creation of a FID Scientific Bureau expressly excluded mapping (together with hydrography and meteorology) from the proposed functions, because the Treasury wished to ensure that full use was made of existing scientific organisations⁹.

DCS was thus charged to undertake mapping, but it did not control the field survey programme. This was a major difference between its work for FID and for other territories, where (with local collaboration) it both planned and executed the fieldwork to meet needs identified by colonial governments. In 1949, the CO confirmed to the Governor that DCS had no responsibility for the location of a season's field survey operations (that rested with the Governor), though it could make recommendations to the FID ScC¹⁰. In 1956, FIDS asked DCS to prepare an annual comprehensive survey plan for the Governor's consideration, and this procedure was confirmed the following year¹¹. DCS/DOS† consulted closely with Dr Adie to ensure that proposed survey and geological programmes were compatible and, from 1958, desirable survey requirements were discussed annually with the Director of FIDS/BAS and modified, when necessary, in the context of other field programmes and logistic commitments. A working survey programme was then drawn up for each Base annually until 1974-75, when the Director of DOS advised that field survey should be suspended for about five years to enable mapping to catch up and techniques to be reviewed in the light of the rapid development of survey instrumentation - satellite position-fixing and inertial navigation¹².

From the late 1950s, DCS/DOS assisted FIDS/BAS in interviewing candidates for survey posts and in arranging and mounting short survey courses. Technical instructions were issued on various aspects of surveying and, by 1969, these were consolidated and partially revised by DOS professional surveyors, who had Antarctic experience with FIDS¹³. The Directorate supervised the working up of field survey results into the forms required for map production and most returning surveyors spent several months at DCS/DOS doing this. Its survey, cartographic and computing staff provided guidance and professional advice and, as activities increased, a map officer was made responsible for internal and external liaison on FIDS matters, for co-ordinating the mapping programme and for managing the growing survey and mapping archive. The DCS/DOS Computing Section carried out or checked both interim and 'final' computations and adjustments of all survey schemes prior to the overall adjustment in 1985 (see Chapter 3). Survey stores were originally loaned by DCS and later purchased, housed, issued and serviced by DOS on behalf of FIDS/BAS, until they were transferred to BAS Headquarters in 1980¹⁴ (see Appendix 3).

With the reduction in field survey activities, the Director of DOS resigned from the BAS Advisory Committee in 1977, but the Directorate continued to provide professional advice, on request, and to be closely involved in BAS survey and map production. It housed and managed the survey archive until 1984, when DOS became the Overseas Surveys Division (OSD) of the Ordnance Survey, and the collection of survey data, field sheets, compilations and air photographs, which had been built up and documented over the years, was transferred to BAS in Cambridge.

DCS, like FIDS, was set up as an instrument of colonial policy. Its role changed as it became part of successive 'aid' Departments; its services were made available to all developing countries and its activities were funded from the annual overseas aid budget. BAS, with its expanding scientific investigations, became part of the Natural Environment Research Council (NERC) on 1 April 1967. From April 1969, DOS had to charge for map production and for its one junior post devoted solely to BAS work (which became a BAS contract post in 1973), but no charges were made for the other services which it continued to provide. Within BAS, survey and mapping now had to compete with other disciplines for both priority and money, but there was no focal point to

† In 1957, the title Directorate of Colonial Surveys (DCS) was changed to Directorate of Overseas Surveys (DOS).

CHAPTER 2

FIELD SURVEY

I. General

By 1944, most of the Antarctic Peninsula, apart from some areas in the east, had been seen or briefly sighted either from ships or from the air. The coasts of the islands visited by whalers and sealers had been charted in varying degrees of accuracy, and some systematic land survey had been done by the British Graham Land Expedition (BGLE) between 1934 and 1937; it had mapped part of the west coast of the Antarctic Peninsula and the coasts of George VI Sound from 70° to 72°S and also travelled eastwards at 69°45'S, proving that major trans-peninsula straits, reportedly sighted previously from the air, did not exist.

FIDS, with the advantage of permanent occupation, gradually established a series of Bases. These were accessible from the sea and hopefully provided access to the interior or to adjacent coastal areas for initial exploration and investigation; they were then opened and closed for logistic reasons or to meet the needs of the overall scientific programme (see Map 1, page 2). Field survey parties operated from each Base and before the advent of regular air support, they sometimes worked from seven to eight Bases simultaneously. Their progress and achievements will be described chronologically under type of survey and in the geographical areas outlined on Map 2 (page 8). For reasons of space, only the surveyors (both official and unofficial) are named, but all survey reports make grateful acknowledgement of the help of all Base members who made the field work possible.

In the late 1950s, field survey in FID was revolutionised by three events. In 1955–57, systematic vertical air photography was taken of the northern and western part of the Antarctic Peninsula and of the off-lying islands; it extended as far south as approx. 67°40'S (see Chapter 4). Secondly, in the summer of 1958–59, the recently invented Tellurometer - an electromagnetic distance-measuring instrument able to operate in poor visibility and inside a tent - was used, for the first time in the Antarctic, by a party of FIDS surveyors under the direction of DOS surveyor, G.F. Reid. Thirdly, the Government agreed in 1958 that FIDS should have regular air support¹, and the first plane, an Otter, was operational early in 1960. As a result of all these advances, the scope and speed of field survey were increased enormously and, in much of FID, exploratory survey gave way to systematic triangulation and traversing; the new surveys were more accurate and more comprehensive than the old, but they were still severely constrained by the climate and the terrain.

In the late 1960s, the development of satellite technology enabled new survey techniques to be used in FID (and in Antarctica in general) and the region was linked to the world-wide US PAGEOS triangulation network. Imagery capable of enlargement to at least 1:250,000 was recorded regularly by orbiting satellites - from the early 1970s - and made available to all by the US. Surveying was also revolutionised by the development of Doppler satellite equipment able to establish precise position and height in the field; its applications were particularly significant as performance was not affected by poor weather or visibility. During the 1970s, a series of short air-supported USGS/BAS operations established satellite fixes throughout BAT (see Map 8, page 39) to position earlier surveys and provide some planimetric control south of 74°S. Systematic survey then ceased, to enable mapping to catch up on fieldwork, as funds permitted.

CHAPTER 5

MAPPING

1. Policies and priorities

In the 1940s, mapping policy was clear. Field survey was carried out to explore and record the topography of FID, and maps were required to show what had been discovered. Detail was sparse and it was agreed by CO, FO, FIDS and DCS that a scale of 1:500,000 would be suitable for a regular series of maps of the territory north of 75°S^{1,2}. Initially, the maps were to be printed, but not published, as they were primarily for internal and official use - for administrative, political and planning purposes³; but, by 1948, FO agreed to their publication⁴. In 1948, FID ScC agreed that returning surveyors should spend time at DCS producing compilations of their work, suitable for incorporation into the new maps, and that copies of these larger scale compilations would be made available to scientists⁵. By the end of the decade, with the completion of the provisional 1:500,000 series, the surveying of much new detail and the scientists' need for adequate base maps, a new 1:200,000/1:100,000 series was devised to be the basic record of FIDS mapping⁶. (In future, 1:500,000 maps would be derived from this series). FO, wanting publicity for British achievements in FID, agreed that the new series should be included in DCS normal 'Complimentary Distribution' to selected libraries and mapping organisations in the UK and abroad, but ruled that they should not be put on public sale⁷.

In the 1950s, the overall policy was to map the whole of FID, north of 75°S, (mainly at 1:200,000), primarily to provide a base for scientific work, but also for general use. Surveyors' compilations were issued as a preliminary edition when necessary, but, in the days of long exploratory journeys, a map could become out-of-date very soon after it was published, e.g. on Sheet W66.60 Jason Island was found to be a peninsula⁸. CO considered it important both politically and from the standpoint of scientific reputation that maps should be published with or without names⁹. (International agreement on names was sometimes a lengthy procedure - see Appendix 4).

The situation changed towards the end of the decade, as demands increased for more accurate maps and each discipline had its own priorities. With increasing scientific activity (particularly during IGY 1957-58), maps were required in widely different areas, sometimes at the same time. Furthermore, FO place-name priorities were not necessarily the same as FIDS scientific priorities¹⁰. With the acquisition of aerial photography, too, surveyors no longer mapped detail in a form that could be quickly reproduced as an interim map, though when control was complete, some were able to plot base maps for their scientific colleagues. DOS responded rapidly by producing, as an interim measure, uncontrolled mosaics (PLDs) from all the photography taken by FIDASE (see para. 4.1). Mapping at 1:200,000 from large-scale air photography was necessarily a lengthier, costlier activity than fair-drawing from compilations. Firstly, control had to be complete for the whole sheet, and secondly the mapping had to compete, at all stages, in the Photogrammetric Sections of DOS with urgent mapping for development schemes in both dependent and independent Commonwealth countries. In 1959, FO expressed a strong desire to speed up the production of maps, lest US and Argentinian maps should swamp the world. Priority was to be given to 1:200,000 sheets, where no previous edition existed and where scientific work was current. DOS felt that it was a waste of scarce time and resources to produce series maps of the

photographed areas before the control was completed, because they would have to be re-done¹¹. Unfortunately, overall field priorities, logistics and weather rarely permitted surveyors to complete their work within a designated map sheet during a particular period. The Director of DOS, Brig. Martin Hotine, had to explain to FO, CO and FIDS that DOS could not increase its effort, except at the expense of other commitments, and that no further work could be accepted under CD&W (Colonial Development and Welfare) financial arrangements. He urged them to ask the Treasury for a special provision of manpower and money - say £22,500 for 12 people for a number of years¹². It is not known if this suggestion was followed up, but it was not implemented.

The establishment of the international Scientific Committee on Antarctic Research (SCAR) and the signing of the Antarctic Treaty, which came into force in 1961, enabled political rivalry in scientific activities to be replaced by international co-operation and collaboration. It had implications for map production. The SCAR Working Group on Geodesy and Cartography brought together map-makers from all participating countries to share experiences, exchange data and maps; and to work on a common Map Specification and illustrated List of Recommended Symbols to try and achieve conformity in the maps produced by different agencies¹³. Uniformity was not achieved, but map production in each country was recognised as contributing to international coverage of the continent.

By 1969, DOS activities were funded from the annual UK Overseas Aid budget, while BAS mapping was required primarily to support scientific programmes, so, from April of that year, DOS had to charge BAS for map production. It was recognised by BAS and NERC that 'since priorities of scientists change more rapidly than new maps can be produced, BAS should continue with a systematic programme of basic 1:200,000 mapping, working from north to south, as the Americans are likely to commence work in the south (of the Antarctic Peninsula)'. It was also agreed that production could be speeded up by contracting out some stages of the work, by seeing if universities might be interested in large-scale photogrammetric mapping of small areas (if there was a research input), and by doing small report maps in-house¹⁴. All these recommendations were acted upon. By 1973, the Director of DOS suggested that BAS might ask FCO for a special grant to enable five standard sheets to be produced a year¹⁵. Two years later, in a time of financial stringency at NERC, the whole £30,000 requested for mapping was cut out of the BAS programme¹⁶.

Meanwhile, ERTS (later LANDSAT) 1 was launched in July 1972 and, courtesy of the US authorities, the first high quality satellite images of the Antarctic were soon made available to the international community. After experimentation at DOS, who liaised closely with USGS, the first 1:250,000 imagery maps were requested by BAS in October 1973 and published in 1974. They were greeted with enthusiasm as providing '90% of the information for 1% of the cost of a conventional topographical map'¹⁷ and as being 'the greatest breakthrough in the history of BAS mapping'¹⁸. No further conventional 1:250,000 sheets were taken up and, for the rest of the period, priority for topographical mapping was given to the production of imagery maps of areas south of 65°S in which scientific activities were current.