

Antarctic winter scientific stations to the International Polar Year, 2007–2009

R. K. Headland

Scott Polar Research Institute, University of Cambridge, Lensfield Road, Cambridge, CB2 1ER

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ABSTRACT. The earliest winter scientific station established in the Antarctic was in 1883 as part of the first International Polar Year (IPY) programme. Subsequently, to the IPY of 2007–2009, scientific stations have been deployed on 139 sites (103 on the Antarctic continent, 36 on the peri-Antarctic islands), by 24 countries for a cumulative total of 2666 winters to that of 2008. This paper summarises the winter dates, locations, and national status of all stations in the region. It thus includes all winter stations of the three IPYs and those of the International Geophysical Year (1957–1958). The positions of 120 of these winter stations are south of 60°S, the boundary of the Antarctic Treaty of 1959 (although many of them predate the Treaty).

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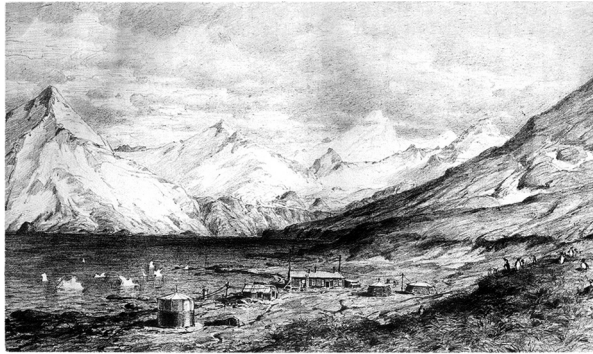
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Introduction

The history of winter scientific stations in the Antarctic region began with the first International Polar Year (1882–1883), in which there was only one station, at Moltke Harbour in Royal Bay, South Georgia (Fig. 1). There was, however, one other main station in Tierra del Fuego with subsidiary stations there and in the Falkland Islands. For the Second International Polar Year (1932–1933) two stations contributed Antarctic data: King Edward Cove in South Georgia and ‘Orcadas’ in the South Orkney Islands. In addition observers worked aboard ten vessels of the whaling fleet during the 1932–1933 austral summer, and on *Discovery II* circumnavigating the Antarctic (1931–1933). For the International Geophysical Year (1 July 1957 to 31 December 1958) 54 Antarctic stations contributed data during the 1957 winter; 15 were on the peri-Antarctic Islands (two of which had also been operational in 1932–1933) and 39 on Antarctica. In the 1958 winter 53 stations were open. 23 of these

stations, including both those of 1932–1933, are also contributing data for the International Polar Years of 2007–2009 (although three of these have not been open continuously). This involves a total of 44 Antarctic winter stations: 17 on the islands and 27 on the continent for the 2007 and 2008 winters. These stations are identified below. In addition many automatic weather stations and automatic geophysical observatories are operating.

No single generally accepted definition of the Antarctic regions exists. For this record the broad definition adopted by the Scientific Committee on Antarctic Research (SCAR) is used: Antarctica, its offshore islands, and the Southern Ocean, the northern boundary of which is the Antarctic convergence. Sub-Antarctic islands that lie north of the convergence and yet fall into SCAR’s area of interest include Ile Amsterdam, Ile Saint-Paul, Iles Crozet, Prince Edward Island, Iles Kerguelen, Macquarie Island, and Gough Island. In addition, the Auckland Islands and Campbell Island (which are listed in SCAR’s earlier records) are included. Thus all winter stations on Antarctica (the continent), and the 19 peri-Antarctic islands are listed. Scientific stations, including meteorological and other observatories, form the vast majority, but not the only, of Antarctic sites occupied for winter. A description of the other sites appears at the end of this account. The history of Antarctic winter observations began in 1883 but has discontinuities as stations opened, closed, or changed status. The determination of a winter station is occasionally difficult, especially where one lasted for less than a calendar year. The pragmatic concept of a station operating during the austral mid-winter solstice has been adopted which provides a satisfactory solution. Records for Antarctic summer research stations and similar establishments are far more disparate than those for winter ones. They pre-date any winter stations; the earliest was in 1829–1830 (HMS *Chanticleer* at Deception Island, South Shetland Islands). In the 1874–1875 summer there were six stations with two subsidiary stations of four nationalities, with a degree of international coordination, to observe the Transit of Venus from four of the peri-Antarctic islands.



Deutsche Station Süd-Georgien (Moltke Hafen) 1882-1883.

Fig. 1. The German station at Royal Bay, South Georgia in 1883. This was the earliest Antarctic winter station. (from Neumayer 1891)

The following lists record Antarctic meteorological observatories, or other scientific stations, that were open during the winters indicated. Some stations changed name (for example specific names were applied to

some British ones in 1977, and Argentine ones where designations of military rank were dropped after 2000), or were transferred to other nationalities, operated jointly or collaboratively, or occupied sites of former stations. Brief notes record these events. In a few cases a note appears where the national status of the operating country changed. In summary, stations on 139 sites, which have been occupied for 2666 cumulative winters to that of 2008, are listed. These were operated by 24 countries (including collaborative stations). Many stations received specific names, which are recorded in inverted commas, others, especially early ones, are named for their topographic locality only. The numbers in the national, international, and geographical lists of stations indicate the position clockwise following the coast from the prime meridian and are shown on the accompanying maps (Figs. 1 and 2). Some stations were originally on, or later in, ice shelves that move, thus their geographical coordinates are subject to minor, but continuous, variation. The others quoted are, in general, from recent surveys and have a high degree of reliability; some of the earlier ones may not be so precise

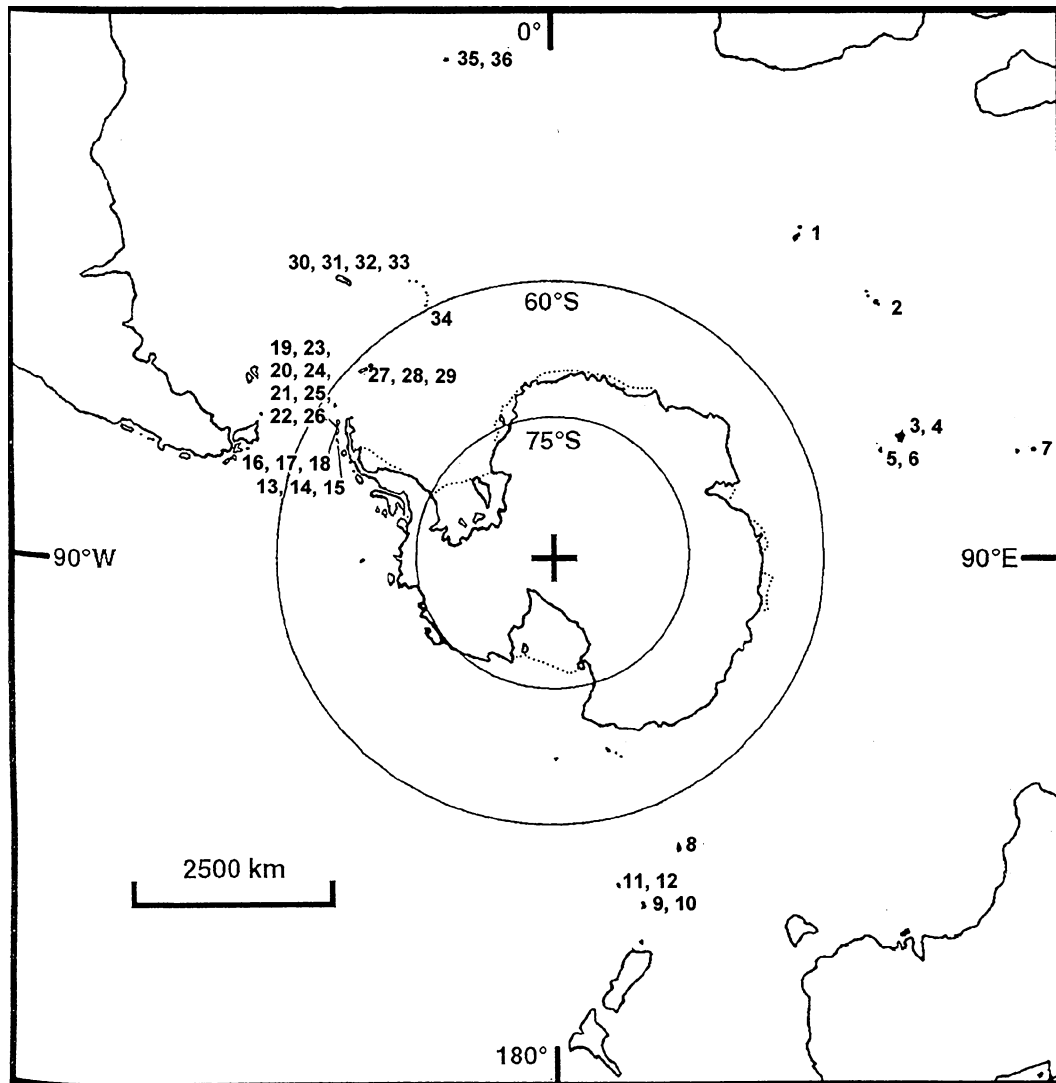


Fig. 2. Winter stations on the peri-Antarctic Islands.

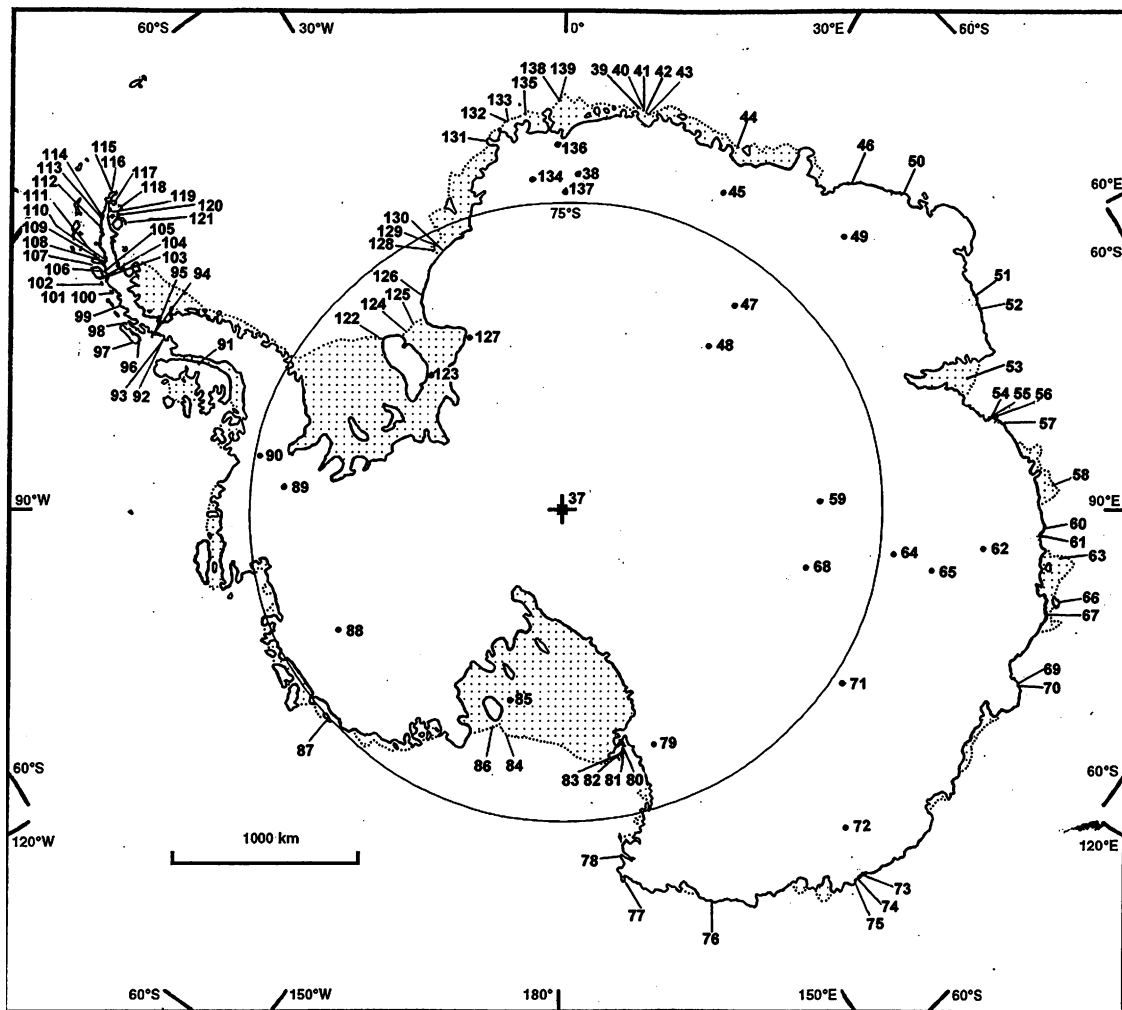


Fig. 3. Winter stations on Antarctica.

(and there are disparities between a few records). All coordinates, in degrees and decimals, have been rounded to the nearest 0.01° .

National stations

Within each nation these are set out in chronological order. The numbers in italics indicate the positions on the maps (Figs. 2 and 3). The number of winter stations in each year is shown in Fig. 4.

Argentina

Current Argentine operations are coordinated by the Dirección Nacional del Antártico of the Ministerio de Relaciones Exteriores. Most scientific functions are the responsibility of the Instituto Antártico Argentino.

- ‘Orcadas’, Laurie Island, South Orkney Islands (60.74°S , 44.74°W , transferred from Britain); 1904–current [28]
- ‘Melchior’, Gamma Island (64.33°S , 62.98°W); 1947–1961, 1969 [107]
- ‘Decepción’, Deception Island, South Shetland Islands (62.98°S , 60.70°W); 1948–1969 [13]
- ‘Almirante Brown’, Paradise Harbour (64.88°S , 62.87°W); 1951–1959, 1965–1983 [108]

‘General San Martín’ (now ‘San Martín’), Barry Island (68.13°S , 67.10°W , site of 1935 British station); 1951–1958, 1976–current [94]

‘Esperanza’, Hope Bay (63.39°S , 56.99°W , site of 1903 Swedish refuge and 1945 British station); 1952–current [116]

‘Teniente Cámara’, Half Moon Island, South Shetland Islands (62.60°S , 59.95°W); 1953–1959 [16]

‘General Belgrano’, Filchner Ice Shelf (77.78°S , 38.23°W); 1955–1983 [124]

‘Ellsworth’, Filchner Ice Shelf (77.72°S , 41.12°W , transferred from United States); 1959–1962 [122]

‘Teniente Benjamín Matienzo’, Seal Nunataks (65.05°S , 60.30°W); 1959–1969, 1970–1972, 1975 [121]

‘Alfárez Sobral’, southern Filchner Ice Shelf (81.07°S , 40.60°W); 1965–1969 [123]

‘Petrel’, Dundee Island (63.48°S , 56.23°W); 1967–1977 [117]

‘Vicecomodoro Marambio’ (now ‘Marambio’), Seymour Island (64.24°S , 56.66°W); 1969–current [118]

‘Corbeta Uruguay’, Thule Island, South Sandwich Islands (59.29°S , 27.25°W); 1977–1981 [34]

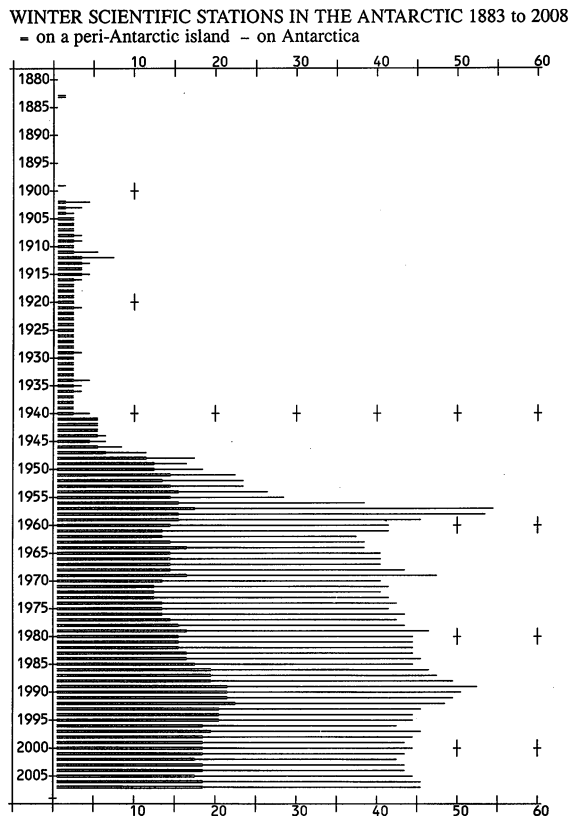


Fig. 4. Number of winter stations 1883 to 2008.

'Primavera', Hughes Bay (64.22°S, 61.33°W); 1978–1981 [113]

'Teniente Jubany' (now 'Jubany'), King George Island, South Shetland Islands (62.24°S, 58.66°W); 1981–current [24]

'General Belgrano II' (now 'Belgrano II'), Luitpold Coast (77.87°S, 34.63°W); 1984–current [126]

Total: 17 sites (4 used by earlier expeditions) occupied for 442 cumulative winters.

Australia

The Antarctic Division of the Department of Environment and Water Resources (its designation in late 2007) is responsible for operating current Australian stations.

Buckles Bay, Macquarie Island (54.50°S, 158.95°E, transferred from Australasian Antarctic Expedition); 1914–1915, re-established 1948–current [8]

Atlas Cove, Heard Island (53.02°S, 73.37°E, occupied by United States, 1969); 1948–1954 [5]

'Mawson', Mawson Coast (67.60°S, 62.87°E); 1955–current [52]

'Davis', Ingrid Christensen Coast (68.58°S, 77.97°E); 1957–1964, 1968–current [57]

Taylor Glacier, Mawson Coast (67.45°S, 60.83°E); 1958–1959 [51]

'Wilkes', Windmill Islands, Budd Coast (66.25°S, 110.58°E, transferred from United States); 1959–1968 [70]

Amery Ice Shelf (69.47°S, 71.40°E); 1968 [53]

'Casey', Vincennes Bay, Budd Coast (66.28°S, 110.52°E); 1969–current [69]

Spit Bay, Heard Island (53.01°, 73.75°E); 1992 [6]

Total: 9 sites (2 used by earlier expeditions) occupied for 226 cumulative winters.

Belgium

The Belgian Committee for the International Geophysical Year deployed this station.

'Roi Baudouin', Breidvika, Prinsesse Ragnhild Kyst (70.42°S, 24.30°E, became a joint station with Netherlands); 1958–1960 [44]

Total: 1 site occupied for 3 cumulative winters.

Brazil

The navy and air force provide logistic support and scientific coordination is by the Comissão Interministerial para os Recursos do Mar.

'Comandante Ferraz', King George Island, South Shetland Islands (62.08°S, 58.39°W, formerly 'Base G'); 1986–current [26]

Total: 1 site (used by an earlier expedition) occupied for 23 cumulative winters.

Chile

The navy, air force, and army provide logistic support and scientific coordination is by the Instituto Chileno Antártico.

'Capitan Arturo Prat', Greenwich Island, South Shetland Islands (62.30°S, 59.68°W); 1947–current [17]

'Presidente Eduardo Frei Montalva' (renamed 'Teniente Rodolfo Marsh Martín' 1981–1994, including 'Professor Julio Escudero'); King George Island, South Shetland Islands (62.21°S, 58.97°W); 1969–current [20]

'General Bernardo O'Higgins Riquelme' (incorporated 'Luis Risopatron' 1957–1958), Cape Legoupil (63.20°S, 57.90°W); 1948–current [114]

'Presidente Gabriel González Videla', Paradise Harbour (64.82°S, 62.87°W, site of 1921 British station); 1951–1964, 1968 [109]

'Presidente Pedro Aguirre Cerda', Deception Island, South Shetland Islands (62.93°S, 60.60°W); 1955–1967 [14]

Total: 5 sites (1 used by an earlier expedition) occupied for 191 cumulative winters

China (Peoples' Republic)

The Chinese Arctic and Antarctic Administration operates both stations.

'Chang Cheng' ['Great Wall'], King George Island, South Shetland Islands (62.22°S, 58.96°W); 1985–current [19]

'Zhongshan' ['Sun Yat-Sen'], Princess Elizabeth Land (69.37°S, 76.39°E); 1989–current [55]

Total: 2 sites occupied for 44 cumulative winters.

Czechoslovakia or Czech Republic

A station organized by privately.

‘Václav Vojtěch’, Nelson Island (62.25°S, 58.98°W); 1989–1992, 1997 [18]

Total: 1 site occupied for 5 cumulative winters.

France

Terres Australes et Antarctiques Françaises maintains the current stations and the scientific programmes are the responsibility of Institut Français pour la Recherche et la Technologie Polaires. Jean Charcot led the two largely private early expeditions.

Booth Island (65.08°S, 64.00°W); 1904 [105]

Petermann Island (62.17°S, 64.17°W); 1909 [102]

Camp Heurtin (later ‘la Roche Godon’, now ‘Martin-de-Viviès’), Ile Amsterdam (37.83°S, 77.59°E); 1950–current [7]

Port Martín, Terre Adélie (66.83°S, 141.40°E); 1950–1951 [74]

Port-aux-Français, Iles Kerguelen (49.35°S, 70.20°E); 1951–current [4]

Ile des Péterels (now ‘Dumont d’Urville’), Terre Adélie (66.66°S, 140.00°E); 1952, 1956–current [73]

‘Charcot’, inland Terre Adélie (69.37°S, 139.02°E); 1957–1958 [72]

Ile de la Possession (now ‘Alfred-Faure’), Iles Crozet (46.43°S, 51.87°E); 1964–current [2]

Total: 8 sites occupied for 222 cumulative winters.

German winter stations (including German Democratic Republic (DDR) and Federal Republic of Germany (FRG))

The Alfred Wegener-Institut für Polar- und Meeresforschung is responsible for current activities. The DDR station was supported by the Academy of Science and the Zentralinstitut für Physik der Erde of the German Democratic Republic.

Moltke Harbour, South Georgia (54.51°S, 36.06°W); 1883 [33]

Baie de l’Observatoire, Iles Kerguelen (49.41°S, 69.90°E); 1902 [3]

DDR Station (later ‘Georg Forster’), Schirmacheroasen (70.77°S, 11.83°E); 1976–1991 [40]

‘Georg von Neumayer’ (FRG), Ekströmisén (70.62°S, 08.37°W); 1981–1992 [132]

‘Neumayer’, Ekströmisén (70.63°S, 08.26°W); 1993–current [133]

Total: 5 sites occupied for 46 cumulative winters.

India

The Department of Ocean Development coordinates Indian activities.

‘Dakshin Gangotri’, Schirmacheroasen, Prinsesse Astrid Kyst (70.09°S, 12.00°E); 1984–1989 [42]

‘Maitri’, Schirmacheroasen, Prinsesse Astrid Kyst (70.77°S, 11.74°E); 1990–current [39]

Total: 2 sites occupied for 25 cumulative winters.

Japan

Japanese National Antarctic Expeditions are responsible for all these stations.

‘Syowa’, Ongul, Kronprins Olav Kyst (69.01°S, 39.59°E); 1957, 1959–61, 1966–current [46]

‘Mizuho’, inland Dronning Fabiolafjella (70.70°S, 44.33°E); 1973–1984 [49]

‘Asuka’, inland Sør Rondane (71.57°S, 24.32°E); 1987–1991 [45]

‘Dome Fuji’, inland Valkyrjdomen (77.32°S, 39.72°E); 1995–1997 [47]

Total: 4 sites occupied for 67 cumulative winters.

Korea, South

Expeditions are organised by the Korean Polar Research Institute.

‘King Sejong’, King George Island, South Shetland Islands (62.22°S, 58.79°W); 1988–current [23]

Total: 1 site occupied for 21 cumulative winters.

New Zealand

The early stations were the responsibility of the Public Works Department and Campbell Island continued with the Department of Conservation. Continental stations are operated by Antarctica New Zealand.

Port Ross, Auckland Islands (50.54°S, 166.27°E); 1941–1943 [9]

Carnley Harbour, Auckland Islands (50.82°S, 166.07°E); 1941–1944 [10]

Tucker Cove, Campbell Island (52.54°S, 169.74°E); 1941–1957 [11]

Beeman Point, Campbell Island (52.55°S, 169.15°E); 1958–1995 [12]

‘Scott Base’, Ross Island (77.85°S, 166.76°E, combined station in 1957); 1958–current [80]

Lake Vanda, Wright Valley, Victoria Land (77.53°S, 161.55°E); 1969–70 [79]

Total: 6 sites occupied for 115 cumulative winters.

Norway

The first was a private expedition led by Roald Amundsen, from the International Geophysical Year the Norsk Polarinstitut has operated the stations.

Grytviken (1905–06) and King Edward Point (1907–09, later ‘Base M’ and ‘Grytviken’), South Georgia (54.28°S, 36.50°W, whaling station site, continued by Britain) 1905–1909 [32]

‘Framheim’, Bay of Whales (78.50°S, 164.33°W, later site of ‘Little America I, II, and III’); 1911 [84]

‘Norske Stasjon’ [‘Norway Station’], Kronprinsesse Märtha Kyst (70.50°S, 02.87°W, transferred to South Africa) 1957–1959 [135]

‘Troll’, Jutulssén (72.00°S, 02.53°E); 2005 – current (station previously used by a private expedition) [38]

Total: 3 sites occupied for 13 cumulative winters

Poland

The Polish Academy of Sciences is responsible for operation of this station.

‘Henryk Arctowski’, King George Island, South Shetland Islands (62.17°S, 58.47°W); 1977–current [25]

Total: 1 site occupied for 32 cumulative winters.

Russian or Soviet Union

These stations were and are operated by the Arctic and Antarctic Institute in St Petersburg.

‘Mirnyy’, Queen Mary Land (66.55°S, 93.01°E); 1956–current [61]

‘Oazis’, Bunger Hills (66.27°S, 101.75°E); 1956–1958 [67]

‘Pionerskaya’, inland Queen Mary Land (69.73°S, 95.50°E); 1956–1961, 1963 [62]

‘Komsomol’skaya’, inland Queen Mary Land (74.10°S, 97.50°E); 1957–1959 [64]

‘Vostok-1’, inland Queen Mary Land (72.15°S, 97.60°E); 1957 [65]

‘Vostok’, South Geomagnetic Pole (78.47°S, 106.80°E); 1958–1961, 1963–1993, 1997–2001, 2003–current [68]

‘Sovetskaya’, inland Wilhelm II Land (78.38°S, 87.53°E); 1958 [59]

‘Lazarev’, Prinsesse Astrid Kyst (69.93°S, 12.92°E); 1959–1960 [43]

‘Druzhba’, Queen Mary Land (66.72°S, 86.40°E); 1960 [58]

‘Mir’, Queen Mary Land (65.75°S, 92.47°E); 1960 [60]

‘Pobeda’, Queen Mary Land (64.65°S, 98.57°E); 1960 [66]

‘Novolazarevskaya’, Schirmacheroasen, Prinsesse Astrid Kyst (70.77°S, 11.86°E); 1961–current [41]

‘Molodezhnaya’, Enderby Land (67.68°S, 46.13°E); 1963–2002 [50]

‘Bellingsgausen’, King George Island, South Shetland Islands (62.20°S, 58.96°W); 1968–current [21]

‘Leningradskaya’, Oates Land (68.50°S, 159.38°E); 1971–1979, 1981–1990 [76]

‘Russkaya’, Marie Byrd Land (74.72°S, 137.12°W); 1980–1990 [87]

‘Progress’, Larsemann Hills (69.40°S, 76.40°E); 1988–1989, 1991 [55]

‘Progress II’, Larsemann Hills (69.38°S, 76.38°E); 1998–2000, 2003–current [56]

Total: 18 sites occupied for 289 cumulative winters.

South Africa

The South African National Antarctic Expeditions operates these stations.

Transvaal Cove, Marion Island, Prince Edward Islands (46.87°S, 37.86°E); 1948–current [1]

The Glen, Gough Island (40.32°S, 09.85°W, transferred from Britain); 1956–1962 [35]

‘Norske Stasjon’ (later ‘SANAE’, transferred from Norway), Kronprinsesse Märtha Kyst (70.50°S, 02.87°W); 1960–1962 [135]

‘SANAE II’, Kronprinsesse Märtha Kyst (70.50°S, 02.53°W); 1963–1977 [138]

Transvaal Bay, Gough Island (40.37°S, 09.87°W); 1963–current [36]

‘Borga’, inland Borgmassivet (72.75°S, 03.50°W); 1969 [134]

‘Sarie Marais’ inland Grunehogna, Ahlmannryggen (72.05°S, 02.78°W); 1971–1977 [137]

‘SANAE III’, Kronprinsesse Märtha Kyst (70.32°S, 02.37°W); 1978–1994 [139]

‘SANAE IV’, inland Vesleskarvet (71.67°S, 02.83°W); 1997–current [136]

Total: 9 sites (1 used by an earlier expedition) occupied for 169 cumulative winters.

Sweden

This largely private station was established and led by Otto Nordenskjöld.

Snow Hill Island (64.47°S, 57.20°W); 1902–1903 [120]

Total: 1 site occupied for 2 cumulative winters.

Ukraine

The Academy of Sciences is responsible for operation of this station.

‘Academician Vernadskiy’, Argentine Islands (65.25°S, 64.26°W, transferred from Britain); 1996–current [101]

Total: 1 site (used by an earlier expedition) occupied for 13 cumulative winters.

United Kingdom

The British Antarctic Survey (established as ‘Operation Tabarin’ to 1945, subsequently Falkland Islands Dependencies Survey until 1962) operates all the current stations whilst various, largely private, bodies organised several of the earlier ones, British military forces maintained the station on South Georgia for 19 years.

Cape Adare, Borchgrevink Coast (71.28°S, 170.23°E); 1898, 1911 [77]

Hut Point, Ross Island (77.85°S, 166.64°E, later site of ‘McMurdo’); 1902–1903 [81]

Scotia Bay, South Orkney Islands (60.74°S, 44.73°W, transferred to Argentina); 1903 [28]

King Edward Point (later ‘Base M’ and ‘Grytviken’), South Georgia (54.28°S, 36.50°W, observations began at a Norwegian whaling station 1905) 1910–current [32]

Cape Royds, Ross Island (77.55°S, 166.15°E); 1908 [83]

Cape Evans, Ross Island (77.63°S, 166.40°E); 1911–1912, 1915–1916 (site subsequently used by private expeditions) [82]

Waterboat Point, Paradise Harbour (64.82°S, 62.86°W, later site of ‘Presidente Gabriel González Videla’); 1921 [109]

Winter Island, Argentine Islands (65.25°S, 64.27°W, later ‘Base F’ [I], now ‘Wordie’); 1935, 1947–1953, 1960 [100]

Barry Island, Debenham Islands (68.13°S, 67.10°W, later site of ‘General San Martín’); 1936 [94]

‘Base A’, Port Lockroy, Wiencke Island (64.83°S, 63.52°W); 1944–1946, 1948, 1952–63 [106]

‘Base B’, Deception Island, South Shetland Islands (62.98°S, 60.57°W, site of former summer whaling station); 1944–67 [15]

‘Base E’, Stonington Island, Marguerite Bay (68.18°, 67.00°W); 1945–1949, 1958, 1961–1974 [92]

‘Base C’, Cape Geddes, South Orkney Islands (60.70°S, 43.58°W); 1946 [29]

‘Base D’, Hope Bay, Tabarin Peninsula (63.40°S, 56.99°W, site of 1903 Swedish refuge, also occupied by ‘Esperanza’ from 1952); 1945–1947, 1950, 1952–1961 [116]

‘Base F’ [III] (later ‘Faraday’), Galindez Island, Argentine Islands (65.25°S, 64.25°W, formerly on Winter Island, transferred to Ukraine); 1954–1995 [101]

‘Base G’, Admiralty Bay, King George Island, South Shetland Islands (62.08°S, 58.42°W, site occupied by Brazil from 1986); 1949–1960 [26]

‘Base H’ (now ‘Signy’), Signy Island, South Orkney Islands (60.72°S, 45.60°W, site of former summer whaling station); 1947–1995 [27]

‘Base V’, View Point (63.53°S, 57.38°W); 1954–1963 [119]

Ample Bay, South Georgia (54.05°S, 37.38°W); 1954 [31]

‘Base N’, Anvers Island (64.77°S, 64.08°W); 1955–1957 [103]

‘Base Y’, Horseshoe Island, Marguerite Bay (67.81°S, 67.30°W); 1955–1960, 1969 [95]

The Glen, Gough Island (40.36°S, 09.87°W, transferred to South Africa); 1955 [35]

‘Base O’, Danco Island (64.73°S, 62.60°W); 1956–1958 [110]

‘Base W’, Detaille Island (66.87°S, 66.79°W); 1956–1958 [98]

Portal Point, Reclus Peninsula (64.50°S, 61.77°W); 1957 [112]

‘Base J’, Prospect Point (66.00°S, 65.34°W); 1957–1958 [99]

‘Halley Bay’ (later ‘Base Z’), Brunt Ice Shelf (73.52°S, 26.75°W); 1956–1966; ‘Halley Bay II’, 1967–1973; ‘Halley Bay III’ (later ‘Halley’) (75.58°S, 26.54°W); 1974–1983 [128]

‘Base T’, Adelaide Island (67.77°S, 68.84°W, transferred to Chile); 1961–1976 [97]

Bird Island, South Georgia (54.00°S, 38.05°W); 1963, 1983–current [30]

‘Base KG’, Fossil Bluff, Alexander Island (71.33°S, 68.27°W); 1961, 1968–1975 [91]

‘Base R’ (later ‘Rothera’), Adelaide Island (67.57°S, 68.12°W); 1976–current [96]

‘Halley IV’, Brunt Ice Shelf (75.58°S, 26.67°W); 1983–1990 [129]

Metchnikoff Point, Brabant Island (64.03°S, 62.51°W); 1984 [111]

‘Halley V’, Brunt Ice Shelf (75.58°S, 26.54°W); 1990–current [130]

Total: 34 sites occupied for 479 cumulative winters.

United States

Early United States stations were private with naval support; Richard Byrd was leader of several. The National Science Foundation coordinates research while military organizations and a private contractor operate the stations.

‘Little America’, Bay of Whales (78.50°S, 164.33°W, site of ‘Framheim’); 1929, ‘Little America II’, 1934; ‘Little America III’ (‘West Base’); 1940 [84]

‘Bolling Advance Base’, Ross Ice Shelf (80.13°S, 163.95°W); 1934 [85]

‘East Base’ (later ‘Oleona’), Stonington Island, Marguerite Bay (68.18°S, 67.00°W); 1940, 1948 [93]

‘Little America V’, Kainan Bay (78.16°S, 162.28°W); 1956–1958 [86]

‘Williams Air Operations Facility’ (now ‘McMurdo’), Ross Island (77.85°S, 166.67°E, site of 1902 British base); 1956–current [81]

South Pole, inland (now ‘Amundsen-Scott’, rebuilt 1975 and from 2004) (90°S); 1957–current [37]

‘Byrd’, inland Rockefeller Plateau (80.00°S, 120.00°W); 1957–1971 [88]

‘Wilkes’, Windmill Islands, Budd Coast (66.25°S, 110.58°E, transferred to Australia); 1957–1958 [70]

‘Ellsworth’, Filchner Ice Shelf (77.72°S, 41.12°W, transferred to Argentina); 1957–1958 [122]

‘Eights’, inland Ellsworth Land (75.25°S, 77.10°W); 1964 [90]

‘Palmer’, Anvers Island (64.77°S, 64.05°W); 1965–current [104]

‘Plateau’, inland Polar Plateau (79.25°S, 40.50°E); 1966–1968 [48]

Atlas Cove, Heard Island (53.02°S, 73.37°E, former Australian station); 1969 [5]

‘Siple’, inland Ellsworth Land (76.93°S, 84.25°W); 1973–1975, 1977–1980, 1982–1983 [89]

Total: 14 sites (3 used by earlier expeditions) occupied for 191 cumulative winters

Uruguay

The Instituto Antártico Uruguayo of the Ministerio de Defensa Nacional operates the station.

‘General José Artigas’, King George Island, South Shetland Islands (62.18°S, 58.90°W); 1986–current [22]

Total: 1 site occupied for 23 cumulative winters.

International stations

Australasian Antarctic Expedition (1911–1914, Australia and New Zealand)

This was an essentially private expedition, with government support, led by Douglas Mawson.

Buckles Bay, Macquarie Island (54.50°S, 158.95°E, transferred to Australia); 1912–1913 [8]

Commonwealth Bay, George V Land (66.90°S, 142.67°E); 1912–1913 (site subsequently used by private groups) [75]

Shackleton Ice Shelf, Queen Mary Coast (66·17°S, 95·42°E); 1912 [63]

Total: 3 sites occupied for 5 cumulative winters.

Belgium and Netherlands

The Belgian and Netherlands Academies of Science operated this station.

‘Roi Baudouin’, Breidvika, Prinsesse Ragnhild Kyst (70·42°S, 24·30°E, formerly Belgium); 1965–1966 [44]

Total: 1 site reoccupied for 2 cumulative winters.

Commonwealth Trans-Antarctic Expedition winter stations (1955–1958, Britain, New Zealand, Australia, and South Africa)

This was a privately organised expedition with a degree of support from the associated governments.

‘Shackleton’, Filchner Ice Shelf (77·95°S, 37·27°W); 1956–1957 [125]

‘South Ice’, Coats Land (81·93°S, 29·50°W); 1957 [127]

‘Scott Base’, Ross Island (77·85°S, 166·76°E, combined station with New Zealand); 1957 [80]

Total: 3 sites occupied for 4 cumulative winters.

French and Italian winter station

French cooperation is as above, the Italian partner is the Comitato Nazionale per la Ricerca e per lo Sviluppo dell’Energia Nucleare e delle Energie Alternativa ‘Concordia’, inland Dome Circe (74·10°S, 123·40°E); 2005–current [71]

Total: 1 site occupied for 4 cumulative winters.

New Zealand and United States winter station

Joint station coordinated with the Antarctic Research Programmes of New Zealand and the United States.

Cape Hallett, Borchgrevink Coast (72·42°S, 170·27°E); 1957–1964 [78]

Total: 1 site occupied for 8 cumulative winters.

Norwegian-British-Swedish Expedition winter station (1949–52)

This was a private expedition, with support from the governments involved, led by John Gjøaver.

‘Maudheim’, Quarisen (71·05°S, 10·93°W); 1950–1951 [131]

Total: 1 site occupied for 2 cumulative winters.

Stations in geographical order: peri-Antarctic islands

These stations are set out clockwise by island, from 0° longitude.

Prince Edward Islands

1. Transvaal Cove, Marion Island; South Africa

Iles Crozet

2. ‘Alfred-Faure’, Ile de la Possession; France

Iles Kerguelen

3. Baie de l’Observatoire; Germany
4. Port-aux-Français; France

Heard Island

5. Atlas Cove; Australia, United States
6. Spit Bay; Australia

Ile Amsterdam

7. ‘Martin-de-Viviès’; France

Macquarie Island

8. Buckles Bay; Australasian Antarctic Expedition, Australia

Auckland Islands

9. Port Ross; New Zealand
10. Camley Harbour; New Zealand

Campbell Island

11. Tucker Cove; New Zealand
12. Beeman Point; New Zealand

South Shetland Islands

13. ‘Decepción’, Deception Island; Argentina
14. ‘Presidente Pedro Aguirre Cerda’, Deception Island; Chile
15. ‘Base B’, Deception Island; Britain
16. ‘Teniente Cámara’, Half Moon Island; Argentina
17. ‘Capitan Arturo Prat’, Greenwich Island; Chile
18. ‘Václav Vojtěch’, Nelson Island; Czech Republic
19. ‘Chang Cheng’ [‘Great Wall’], King George Island; China
20. ‘Presidente Eduardo Frei Montalva’, King George Island; Chile
21. ‘Bellingshausen’, King George Island; Soviet Union and Russia
22. ‘General José Artigas’, King George Island; Uruguay
23. ‘King Sejong’, King George Island; Korea (Seoul)
24. ‘Jubany’, King George Island; Argentina
25. ‘Henryk Arctowski’, King George Island; Poland
26. ‘Comandante Ferraz’, ‘Base G’, King George Island; Brazil, Britain

South Orkney Islands

27. ‘Signy’, Signy Island; Britain
28. ‘Orcadas’, Laurie Island; Britain (Scotia Bay), Argentina
29. ‘Base C’, Laurie Island; Britain

South Georgia

30. Bird Island; Britain
31. Ample Bay; Britain
32. King Edward Point; Norway (‘Grytviken’), Britain
33. Moltke Harbour; Germany

South Sandwich Islands

34. ‘Corbeta Uruguay’, Thule Island; Argentina

Gough Island

35. The Glen; Britain, South Africa
36. Transvaal Bay; South Africa

Stations in geographical order: Antarctica

These stations are set out along the coast and inland going clockwise order from 0° longitude.

37. 'Amundsen-Scott'; United States
38. 'Troll'; Norway
39. 'Maitri'; India
40. 'Georg Forster'; Germany (GDR)
41. 'Novolazarevskaya'; Soviet Union and Russia
42. 'Dakshin Gangotri'; India
43. 'Lazarev'; Soviet Union
44. 'Roi Baudouin'; Belgium, Belgium and Netherlands
45. 'Asuka'; Japan
46. 'Syowa'; Japan
47. 'Dome Fuji'; Japan
48. 'Plateau'; United States
49. 'Mizuho'; Japan
50. 'Molodezhnaya'; Soviet Union and Russia
51. Taylor Glacier; Australia
52. 'Mawson'; Australia
53. Amery Ice Shelf; Australia
54. 'Zhongshan' ['Sun Yat-Sen']; China
55. 'Progress II'; Soviet Union and Russia
56. 'Progress'; Soviet Union
57. 'Davis'; Australia
58. 'Druzhba'; Soviet Union
59. 'Sovetskaya'; Soviet Union
60. 'Mir'; Soviet Union
61. 'Mirny'; Soviet Union and Russia
62. 'Pionerskaya'; Soviet Union
63. Shackleton Ice Shelf; Australasian Antarctic Expedition
64. 'Komsomol'skaya'; Soviet Union
65. 'Vostok-1'; Soviet Union
66. 'Pobeda'; Soviet Union
67. 'Oazis'; Soviet Union
68. 'Vostok'; Soviet Union and Russia
69. 'Casey'; Australia
70. 'Wilkes'; United States, Australia
71. 'Concordia'; France and Italy
72. 'Charcot'; France
73. 'Dumont d'Urville'; France
74. Port Martín; France
75. Commonwealth Bay; Australasian Antarctic Expedition
76. 'Leningradskaya'; Soviet Union
77. Cape Adare; Britain
78. Cape Hallett; United States and New Zealand
79. Lake Vanda; New Zealand
80. 'Scott Base'; New Zealand, Commonwealth Trans-Antarctic Expedition
81. 'McMurdo'; Britain (Hut Point), United States
82. Cape Evans; Britain
83. Cape Royds; Britain
84. 'Framheim', 'Little America I - III' ('West Base'); Norway, United States
85. 'Bolling Advance Base'; United States
86. 'Little America V'; United States
87. 'Russkaya'; Soviet Union
88. 'Byrd'; United States
89. 'Siple'; United States
90. 'Eights'; United States
91. 'Base KG'; Britain
92. 'Base E'; Britain,
93. 'East Base' ('Oleona'); United States
94. 'General San Martín'; Britain (Barry Island), Argentina
95. 'Base Y'; Britain
96. 'Rothera'; Britain
97. 'Base T'; Britain
98. 'Base W'; Britain
99. 'Base J'; Britain
100. Winter Island ('Wordie'); Britain
101. 'Academician Vernadskiy'; Britain ('Faraday'), Ukraine
102. Petermann Island; France
103. 'Base N'; Britain
104. 'Palmer'; United States
105. Booth Island; France
106. 'Base A'; Britain
107. 'Melchior'; Argentina
108. 'Almirante Brown'; Argentina
109. 'Presidente Gabriel González Videla'; Britain (Waterboat Point), Chile
110. 'Base O'; Britain
111. Metchnikoff Point; Britain
112. Portal Point; Britain
113. 'Primavera'; Argentina
114. 'General Bernardo O'Higgins Riquelme'; Chile
115. 'Esperanza'; Argentina
116. 'Base D'; Britain
117. 'Petrel'; Argentina
118. 'Marambio'; Argentina
119. 'Base V'; Britain
120. Snow Hill Island; Sweden
121. 'Matienzo'; Argentina
122. 'Ellsworth'; United States, Argentina
123. 'Alferez Sobral'; Argentina
124. 'General Belgrano'; Argentina
125. 'Shackleton'; Commonwealth Trans-Antarctic Expedition
126. 'Belgrano II'; Argentina
127. 'South Ice'; Commonwealth Trans-Antarctic Expedition
128. 'Halley I, II, and III'; Britain
129. 'Halley IV'; Britain
130. 'Halley V'; Britain
131. 'Maudheim'; Norway, Britain, and Sweden
132. 'Georg von Neumayer'; Germany (FRG)
133. 'Neumayer'; Germany
134. 'Borga'; South Africa
135. 'Norske Stasjon' / 'SANAE'; Norway, South Africa
136. 'SANAE IV'; South Africa
137. 'Sarie Marais'; South Africa
138. 'SANAE II'; South Africa
139. 'SANAE III'; South Africa

Observations regarding winter stations on peri-Antarctic islands

The 17 national stations currently open are all operated by the same organisations which conduct Antarctic programmes generally. These notes describe various specific factors in the same order as that in which the islands are listed.

The German station on Iles Kerguelen, where five men wintered in 1902, was operated by Erich von Drygalski's expedition (1901–1903) that wintered aboard *Gauss* beset in pack ice drifting in the Davis Sea. The building survived at least a decade before it succumbed to the weather.

A United States Coast and Geodetic Survey party used the Atlas Cove site on Heard Island in 1969 as part of a satellite observation programme. In the 2005–2006 and subsequent summers much of the original 1948 Australian station, which had become seriously dilapidated, was demolished and removed.

After Sir Douglas Mawson's Australasian Antarctic Expedition (1911–1914) left Macquarie Island the Commonwealth Meteorological Service of Australia continued recording data for two winters before the loss of a ship and exigencies of World War I necessitated its closure. Five men wintered for 1912 and 1913, and three for 1914 and 1915. The station was reestablished by the Australian National Antarctic Research Expeditions 33 years later. The remains of the first station were demolished after the next one was established in 1947.

The stations on Auckland and Campbell Islands were deployed during the World War II for coast-watching. Subsequently the one on Campbell Island remained open. On 2 November 1958 the original station at Tucker Cove closed and a new one at Beeman Point, about 1 km distant, opened. This was eventually transferred to the New Zealand Department of Conservation that replaced it with an automatic station in 1995. All but the Beeman Point station are now derelict.

The South Shetland Islands have had 14 winter stations and almost as many summer ones. The Argentine, British, and Chilean stations on Deception Island were severely affected by volcanic eruptions beginning in 1967; the Chilean one was destroyed, the British severely damaged, and the Argentine one evacuated as a precaution. King George Island is the most crowded island, currently a total of eight national winter stations are operating, and there are many summer stations. The relatively small Fildes Peninsula has four winter stations with several summer ones, all in close proximity. A degree of redundancy in research and observations is apparent. The complex Chilean station 'Presidente Eduardo Frei Montalva' has a major air base and runway. It incorporates sub-stations operated by different organisations; each bearing a separate name (notably 'Teniente Rodolfo Marsh Martín' and 'Profesor Julio Escudero'). A German summer sub-station, 'Dallmann', operates with the Argentine 'Jubany' station. The Brazilian station, in Admiralty Bay, was established near the closed British 'Base G', which had become dilapidated and was demolished in 1996.



Fig. 5. 'Casa Moneta', Laurie Island, South Orkney Islands. Built in 1905, the oldest continuously used building in the Antarctic photographed about 1920. (photograph provided by Tutta Holtan)

In the South Orkney Islands observations at the Scotia Bay station, began on 26 March 1903 when *Scotia*, with a complement of 33, of the Scottish National Antarctic Expedition, led by William Bruce, wintered. The observatory was moved ashore on 1 November 1903, transferred to Argentina on 22 February 1904, and is now operated, as 'Orcadas', by the Argentine Navy. It has the oldest continuous record of Antarctic meteorological and geomagnetic observations. The ruin of the original building remains as a historic site and a second one, built in 1905, remains as the oldest continuously occupied structure in the Antarctic. It is now the station's museum, 'Casa Moneta' (Fig. 5). The British Antarctic Survey Signy Island station was partly demolished and removed in 1998, but remains a summer station.

On South Georgia, after the first International Polar Year, the next meteorological records were begun, on 17 January 1905, by a Norwegian whaling enterprise based in Buenos Aires, the Compañía Argentina de Pesca. They were initiated, with other scientific research, by the Norwegian Carl Anton Larsen, founder of the station, with assistance from the Naturhistoriska Riksmuseet, Stockholm, and the Argentine Oficina Meteorológica from which instruments were borrowed. This was the beginning of continuous observations on the island. The company was granted a whaling licence by the Falkland Islands Dependencies government, as were all whaling stations on the island. This imposed a condition of providing meteorological data on the whaling stations. In 1907 the observatory was moved a short distance to King Edward Point where the original building remained until 1974 when it was demolished by the British Antarctic Survey. The island's administrative centre was also established there and a large, although disparate, variety of scientific endeavours were based on it. Notable among these was research on the whaling industry. The whaling companies were relieved of the meteorological condition of their leases from 1951 when the Falkland Islands and Dependencies meteorological service took over the

station. It then became a forecasting station staffed by a team of meteorologists rather than one observer alone. This, in turn passed to the British Antarctic Survey from 1969 to 1982 ('Base M' and 'Grytviken'), and thence, until 2001, to British military forces before the Survey resumed operations. For part of the military period an automatic observatory functioned near Horse Head, on the opposite side of King Edward Cove. See also the subsequent notes on other winter whaling stations below. The main building of the Moltke Harbour station, built in August 1882, was burnt during World War I and the others succumbed to the elements by the mid 1920s.

On the South Sandwich Islands the Argentine naval station on Thule Island, opened in November 1976, was closed on 20 June 1982 by the Royal Navy because of its involvement in the war of that year. Observations had ceased several days earlier; thus, although it was occupied until a day before mid-winter, it has not been included as operating for the 1982 winter. It was destroyed in February 1983, with the exception of a small refuge hut.

The Gough Island Scientific Survey, from Britain, established a station early in 1955 at The Glen. This was transferred to South Africa in May 1956. In summer of 1963–1964 a new station was opened at Transvaal Cove, a more favourable site. The remains of the old station were demolished in October 1987.

Observations regarding winter stations on Antarctica

National Antarctic programmes operated all the 27 stations open during the 2008 austral winter. Historical and other notes on some of them follow in geographical order of individual stations or associated groups of stations.

The name 'Amundsen–Scott' was adopted for the South Pole station in 1961, the 50th anniversary of its attainment. The original station became buried, and subsequently crushed, by the accumulating ice. On 9 January 1975 a new station, deployed beneath a geodesic dome, was opened and other buildings for specialised functions were added progressively. On 12 January 2007 a third station was opened which replaced that beneath the dome (Fig. 6).

'Troll' was established as a Norwegian summer station in 1990 but was leased to a private group of adventurers for the 2000 winter. On the Prinsesse Astrid Kyst 'Maitri', 'Novolazarevskaya', and the now closed and removed 'Georg Forster' are within reasonable walking distance of each other. During the last winter of 'Georg Forster' it was reported as having a complement of one man who closed it on his departure; thus, in this record, it is regarded as a sub-station of 'Novolazarevskaya' for that time (1992). 'Dakshin Gangotri', India's first station, is deeply buried by snow and ice, and has probably been crushed.

The Japanese headquarters station is 'Syowa' which is situated on Ongul, a small rocky island. It has a ski runway on fast ice between the island and the mainland coast. This is to maintain the three inland stations: 'Asuka', 'Dome Fuji', and 'Mizuho' as well as field camps.

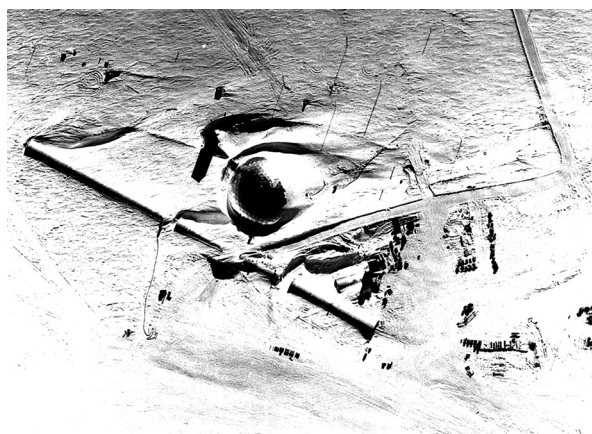


Fig. 6. 'Amundsen Scott' station at the South Pole in 1985. (USGS photograph)

The Australian 'Mawson' station, established on 13 February 1954, is the oldest continuously operating station south of the Antarctic Circle. The Taylor Glacier station operated for two winters as a remote station based on 'Mawson' from where it was 100 km west. A fire destroyed it in August 1959. In the Larsemann Hills 'Progress', 'Progress II' (which replaced it), and 'Zhongshan' are all close, with an Australian and Romanian joint summer station 'Law' in their proximity, again an easy walk, about 4 km, connects them.

In Queen Mary Land 'Mirny' was the headquarters for the Soviet Antarctic expeditions from its establishment in 1956 until replaced by 'Molodezhnaya' in 1971. 'Mirny' resumed as the Russian headquarters in 1996. 'Druzhba', 'Mir', and 'Pobeda' operated as remote stations of 'Mirny' during the 1960 winter. 'Mirny' was also the base station for long inland traverses by Kharkovchanka trains, which established 'Komsomol'skaya' and 'Vostok-1', before 'Vostok' was opened on 1 December 1957, near the South Geomagnetic Pole. 'Sovetskaya' and 'Pionerskaya' were also established by traverses from 'Mirny', which continued and deployed a summer station at the Pole of Inaccessibility (87.12°S, 55.03°E) in 1957–1958. 'Oasis' station, Bunger Hills, was transferred from the Soviet Union to Poland in 1958, renamed 'Antoni Bolesław Dobrowolski', but occupied by a Polish team during the 1958–1959 summer only.

The station on the Shackleton Ice Shelf was one of the two continental stations of Sir Douglas Mawson's Australasian Antarctic Expedition; eight men wintered there in 1912. It was lost when the ice-shelf calved. The United States International Geophysical Year station 'Wilkes' was transferred to Australia when the programme finished, it closed after a temporary station 'Repstat' was built, which was in turn replaced by 'Casey', a short distance away.

The first station in Terre Adélie was at Port Martín, built by France, but this was destroyed by fire on 23 January 1952. The complement wintered, in difficult circumstances, in a refuge on Ile des Pétrels. This was subsequently extended and became 'Dumont d'Urville'.

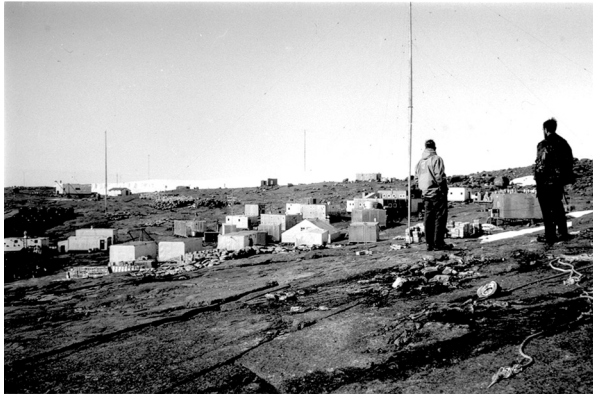


Fig. 7. 'Mawson Station' in 1964. (Charles Swithinbank)

A major runway was constructed there from 1986; but, owing to damage from a glacial surge, has not been completed. 'Charcot' and 'Concordia' are inland stations, the latter operated jointly by France and Italy. Nearby Commonwealth Bay station was the main station of Mawson's Australasian Antarctic Expedition (1911–1914) and it is now an historic site maintained by the Mawson's Hut Foundation and the Australian Antarctic Division (Fig. 7). In 1912, 18 men wintered and seven did so in 1913. The earliest radio transmission received from Antarctica came from this station on 25 September 1912. Recent winter occupations have been adventurers in modern huts who have asserted a degree of private tenure on Antarctica.

Cape Adare was the site of the earliest wintering on Antarctica by ten men of a British, multinational, expedition commanded by Carsten Borchgrevink in 1899. Captain Scott's northern party of six men also built a hut on the site in 1911. The Antarctic Heritage Trust (N.Z.) is now responsible for their remains, substantial for Borchgrevink's one and ruins for Scott's (Fig. 8). The hut of the former is the earliest human habitation on Antarctica. Cape Hallett was a joint United States and New Zealand station originally deployed to provide



Fig. 8. Carsten Borchgrevink's huts at Cape Adare. This was the earliest wintering site on Antarctica (1899). Photographed during Captain Scott's *Discovery* expedition. (Scott Polar Research Institute photograph)

weather information for flights from New Zealand to 'McMurdo'. It closed for winter after the main building burnt on 6 March 1964. The remaining buildings have accommodated summer parties and a private mountaineering expedition. All buildings were removed during the 2004–2005 summer and most are now displayed in the Canterbury Museum, Christchurch, New Zealand.

On Ross Island, huts of British expeditions during the 'heroic period' remain at Hut Point, Cape Royds, and Cape Evans; these huts and their environs are maintained by the Antarctic Heritage Trust (N.Z.). The site of the first, off which *Discovery* wintered twice, is now occupied by the United States headquarters station 'McMurdo' (originally 'Williams Air Operations Facility' that was established in tents near Hut Point). This station supplies 'Amundsen–Scott' at the South Pole, as well as providing major air facilities for field research. It is the largest Antarctic station. 'Scott Base' started as a combined station with the Commonwealth Trans-Antarctic Expedition and New Zealand Royal Society International Geophysical Year Expedition and is about 4 km distant from 'McMurdo'. It was used by the support party of the former, with members from Britain, New Zealand, Australia, and South Africa in 1957, and New Zealand has subsequently maintained it. Of the original station only one hut remains, which is now a museum in the immediate vicinity of a modern station. Lake Vanda station was supplied from 'Scott Base', much of it was removed during the late 1990s.

Several semi-permanent features persist on the eastern part of the Ross Ice Shelf. 'Framheim', where nine Norwegians wintered, was in the ephemeral Bay of Whales, from where Roald Amundsen led the first expedition to reach the South Pole. This was followed by Richard Byrd's United States stations 'Little America' (1929), 'Little America II' (1934), and 'Little America III' or 'West Base' (1940). Byrd was alone at 'Bolling Advance Base' from May to October 1934, the earliest wintering in the interior, before being rescued after suffering carbon monoxide poisoning. 'Little America IV' was a summer station in 1946–1947. As with Kainan Bay with 'Little America V' these stations have successively succumbed to the calving of the Ross Ice Shelf.

Marie Byrd Land, inland from the 'Phantom Coast', is one of the least accessible parts of Antarctica. The site of 'Byrd' station was selected on the basis of easily remembered coordinates (80.00°S, 120.00°W). In 1970–1971 it was closed owing to burial and crushing by ice. Surface summer stations were subsequently deployed in its vicinity, the second was built on sledges so it could be moved periodically to avoid burial. 'Byrd', and the other United States inland stations, 'Siple' and 'Eights' were deployed by aircraft although occasional tractor traverses reached them.

Marguerite Bay was the site of the second base of the British Graham Land Expedition (1934–1937) on Barry Island during 1936 when nine men wintered. This was reported destroyed by a blizzard on 17 June 1951 shortly

after the Argentine station 'General San Martín' was deployed. 'Base T' was the base station for Fossil Bluff deployment by aircraft and dog sledge, until replaced by 'Rothera' where a large runway was built in 1989–1990. 'Base T' was transferred by the United Kingdom to Chile and subsequently become a summer station renamed 'Teniente Luis Carvahal Villarroel'. 'Base Y', on Horseshoe Island, is now a historic site under the provisions of the Antarctic Treaty. Likewise the two stations on Stonington Island, 'East Base' (1940) renamed 'Oleona' (1948) of the United States, and 'Base E' of the United Kingdom are historic sites. There was an interesting degree of disagreement between their commanders when both were occupied in 1948; they are barely 250 m apart. 'Oleona' was the site of the first women to winter in Antarctica.

Farther north on the Bellingshausen Sea side of the Antarctic Peninsula lie several stations. The first, on Argentine Islands, was that of the British Graham Land Expedition (1934–1937) on Winter Island for the 1935 winter (nine men ashore and seven aboard *Penola*). This was apparently swept away by a surge wave and a replacement station, 'Base F' [I] (now 'Wordie'), was deployed farther away from the shore on the same small island. This was replaced by the current station, also 'Base F' [II] (later 'Faraday'), on adjoining Galindez Island, a short trek away in winter but separated by a narrow strait in summer. On 6 February 1996 the station was transferred from the United Kingdom to Ukraine and renamed 'Academician Vernadskiy'. 'Wordie' is now a historic site. Jean-Baptiste Charcot led two French expeditions aboard *Français* with a complement of 20 (1903–1905) and *Pourquoi Pas?* with a complement of 30 (1908–1910); in both places the ship wintered while huts and observatories were deployed ashore at Booth Island in 1904 and Petermann Island in 1909. The huts were removed when the expeditions departed and few signs of them now remain. An Argentine refuge hut, 'Groussac', was built on the latter island in 1955. The British station on Anvers Island, 'Base N', was made available to the United States Antarctic Research Program in the 1964–1965 summer to accommodate a team building 'Palmer' station in the vicinity. It was accidentally destroyed by fire on 28 December 1971 during renovation work.

The British station at Port Lockroy, 'Base A', was opened on 11 February 1944 since when there has been continuous occupation of the Antarctic continent. Now, after much restoration, it is open as a summer station maintained by the Antarctic Heritage Trust (U.K.) as a museum and is now a historic site. Paradise Harbour was the site of a two-man British winter party in 1921 which was transported by whaling vessels. The base was mainly built in a beached whalers' *jolle*, a lighter for carrying water to a floating factory. It is a declared historic site although barely more than the bottom of the boat may now be discerned. The Chilean station, 'Presidente Gabriel González Videla', now occupies the site. 'Almirante Brown', of Argentina, was a more extensive station until

the main building was destroyed by arson on 12 April 1984.

Portal Point, on Reclus Peninsula in Charlotte Bay, had a British refuge hut that was occupied for one winter by a field party involved in a glaciological survey. It was moved in entirety and now stands in the garden of the Falkland Islands Museum, Stanley. During 1984 a winter station at Metchnikoff Point, Brabant Island, was operated by a British Combined Services Expedition led by Chris Furse. The Chilean army station at Cape Legoupil, 'General Bernardo O'Higgins Riquelme', incorporated a partly autonomous scientific station, 'Luis Risopatron', for two winters during the International Geophysical Year.

The earliest wintering at Hope Bay was in 1903, when three men from the Swedish Antarctic Expedition in *Antarctic*, led by Otto Nordenskjöld endured an arduous time there. 'Base D' was established in 1945 but burnt on 8 November 1948 with the loss of two lives. Its ruins remain apparent. An Argentine station, 'Esperanza', was established there in December 1951. In February 1952 an attempt to reinstate the British station resulted in the 'Hope Bay incident' when Argentine military personnel opened fire over the British party and resisted the landing until the Governor of the Falkland Islands Dependencies arrived with two naval vessels and resolved the problem. The new British station, reinstated in March 1952, was transferred to Uruguay on 8 December 1997, refurbished as a summer station 'Ruperto Elchiribehety'. Both stations at Hope Bay, and the earlier remains burnt to the ground, are within an easy walk of each other. The partly restored Swedish stone hut, with that expedition's main base on Snow Hill Island (where six men wintered in 1902 and 1903), and the ruin of the stone hut on Paulet Island where the shipwrecked crew of *Antarctic* endured a winter (1903), are historic sites maintained by the Instituto Antártico Argentina. 'Marambio' station, on Seymour Island, is a major air force base for Argentine air operations.

Stations on the Filchner Ice Shelf are moving slowly with the ice, thus their coordinates vary progressively as they approach the calving edge of the ice-front. 'General Belgrano', of the Argentine Army, was closed when its safety became dubious and replaced by 'General Belgrano II' on Bertrab Nunatak, Luitpold Coast. The latter, in common with other Argentine station names incorporating a military rank, was renamed 'Belgrano II' in 2000. The United States International Geophysical Year station 'Ellsworth' was transferred to Argentina when the programme finished. 'Alferez Sobral', 360 km south on the ice shelf, was established from 'General Belgrano'. 'Shackleton' was the main base of the crossing party of the Commonwealth Trans–Antarctic Expedition which had British, New Zealand, Australian, and South African participation. 'South Ice' was an inland station established by that expedition.

On the Brunt Ice Shelf 'Halley Bay' was established by the Royal Society for the International Geophysical Year. At midnight on 13 January 1959 it was transferred to the

Falkland Islands Dependencies Survey and became 'Base Z'. Weight of accumulating snow crushed it, and 'Halley Bay II', followed by 'Halley Bay III', was constructed in the vicinity. The third was renamed 'Halley' because the ice bay was an ephemeral feature. The problem of calving of the ice-shelf remained and eventually all these stations were lost to the sea. 'Halley IV' and 'Halley V' were subsequently deployed farther from the ice front and 'Halley VI' is being planned.

Kronprinsesse Märtha Kyst was the site of the earliest international station, 'Maudheim' of the Norwegian-British-Swedish Expedition (1949–1952) where 15 men wintered in 1950 and 14 in 1951. 'Norske Stasjon' was deployed by Norway for the International Geophysical Year and transferred to South Africa after this ended. Several rebuildings and relocations were necessary as the stations became deeply buried by snow and ice. SANAE II was 20 km inland from 'Norske Stasjon' and the most recent, 'SANAE IV' is 200 km inland and on rock. 'Borga' and 'Sarie Marais', both inland stations, were mainly for geological research.

The two German stations on Ekströmisen, 'Georg von Neumayer' and 'Neumayer', suffer from the same problems of snow burial and calving ice shelves; they are about 12 km apart. The first, established in 1981, was closed and dismantled in the 1990–1991 summer when the latter was opened. A replacement station is being constructed during the 2007–2008 summer.

Research vessels beset and adrift

Ships adrift in the Southern Ocean, wintering while beset in pack-ice, were: *Belgica*, with a complement of 17, for the 1898 winter in the Bellingshausen Sea and Amundsen Sea; *Gauss*, with 32 aboard, for 1902 in the Davis Sea; *Deutschland*, with 33 aboard, for 1912; *Endurance*, with 28 aboard, for 1915 both in the Weddell Sea; and *Aurora*, with 18 aboard, also for 1915 in the Ross Sea. For all but the last, in which conditions were particularly difficult, meteorological and other data were recorded, and collections made. From the first three, specimens survived, but all those aboard *Endurance* were lost when she sank. *Mikhail Somov* was beset in the Amundsen Sea for the 1985 winter until extracted on 27 July. The vessel was again beset for winter in 1991. During the 2000 winter *Polarstern* made a scientific cruise in the Weddell Sea.

Other sites occupied during Antarctic winters

As well as the complements aboard beset ships there are various other sites where parties wintered in Antarctic regions, sometimes in very arduous circumstances, but which cannot be regarded as systematically observing meteorological phenomena or conducting other scientific work. Some of these were by sealers, whalers, pastoralists, marooned and stranded groups, private expeditions of adventurers and others, and occasional private yachts.

Sealers, mainly during the 1800s, are known to have wintered on Prince Edward Islands (earliest recorded

in 1806), Iles Crozet (1806), Iles Kerguelen (1792), Heard Island (1856), Macquarie Island (1811), Auckland Islands (1808), Campbell Island (1810), South Shetland Islands (1821), South Georgia (1816), and Gough Island (1837). There are few descriptions of these events, probably because few of the sealers had any literary ambition. Iles Kerguelen and South Georgia, with their abundant harbours and other anchorages, were used by wintering sealing vessels. Heard Island possesses no secure anchorages but was notable in that sealers inhabited it continuously for about 25 years from about 1855. Likewise Macquarie Island had perennial sealing gangs, with supply vessels arriving at least annually. The most severe winterings of gangs of sealers were two on the South Shetland Islands, in Esther Harbour (61.92°S, 57.98°W) during 1821 (10 men), and at Potter Cove (64.23°S, 58.70°W) in 1872 (6 men, only one of whom survived). George Comer, leader of a sealing gang that wintered on Gough Island during 1888 systematically recorded basic weather conditions in a diary. Archaeological studies are currently being undertaken at several of the sites occupied by sealers.

There were a few unsuccessful attempts to establish a pastoral industry on Iles Kerguelen (earliest attempt made in 1908), Ile Amsterdam (1871), Ile Saint-Paul (1843), Auckland Islands (1849), Campbell Island (1893), and South Georgia (1905). With the exception of the last these all involved shepherds and others wintering before the enterprises were abandoned. In several instances sheep and cattle remained on the islands, becoming feral. Sheep and other domestic animals were supplied in summer to many of the earlier stations to supplement the diet of station personnel. It was once thought that sheep might be raised successfully on Macquarie Island by the meteorological staff, but the experiment proved a failure.

Whalers, during the 1900s, wintered at four of the six stations on South Georgia. The industry also had land stations on Iles Kerguelen, South Shetland Islands, and South Orkney Islands, but these were not occupied during winter except once on Kerguelen. The South Georgia stations all recorded basic weather information which was regularly submitted to the Falkland Islands Dependencies magistrate. These data, from Husvik, Stromness, and Leith, are variable in quality, but some are valuable (in contrast Grytviken data were from a well-equipped observatory run by a meteorologist).

Groups of men marooned or stranded for winter were rarely able to maintain records and those who were could record only very basic data. They were, in chronological order: three men at Hope Bay and 20 at Paulet Island (63.58°S, 55.78°W) during 1903 from the Swedish Antarctic Expedition led by Otto Nordenskjöld (1901–1903); six men of the 'Northern Party' on Inexpressible Island (74.90°S, 163.65°E) from Captain Scott's second expedition during 1912; 22 men on Elephant Island (61.17°S, 55.23°W) and three men at Hut Point, from the Weddell Sea (1914–1916) and Ross Sea (1914–1917)

parties, respectively, of Sir Ernest Shackleton's Imperial Trans-Antarctic Expedition, during 1916.

Adventurers and others wintered at several sites in huts, tents, or aboard yachts. In chronological order these are as follows. In 1961 at Undine South Harbour (54.52°S, 37.58°W), South Georgia, Duncan Carse spent a winter as an 'experiment in living alone'; his hut was destroyed by a surge wave on 20 May after which he used a tent until rescued in September. In 1980 a party of four of the 'Trans-Globe Expedition' led by Sir Ranulph Twisleton-Wykeham-Fiennes, wintered in a prefabricated reinforced cardboard hut near 'SANAE III' station before two of them continued to cross the continent. Seven consecutive winters were spent on Ross Island at Cape Evans, near Captain Scott's 1911 hut. The 'Footsteps of Scott' expedition, led by Robert Swan was there for the 1985 winter in a prefabricated hut, and three of them remained for 1986 until evacuated early in 1987. The station, then named 'World Park', was enlarged, and occupied by a Greenpeace party to promulgate their political aspirations. Groups of four wintered there from 1987 to 1991 after which it was removed with a substantial quantity of contaminated soil. In 1995 a hut was built and occupied for the winter at Commonwealth Bay, Sir Douglas Mawson's base, by a Donald McIntyre with his wife. They have subsequently leased the site to others who have wintered there including one, Albert Winklemayer, who did so alone during 1997. The Norwegian station 'Troll' was occupied during the 2000 winter by a party of four adventurers, two of whom traversed to the South Pole in the next summer.

From the 1980s private yachts have made increasingly frequent visits to Antarctica and the peri-Antarctic islands. More than 24 have arrived in some recent summers. A few have remained for a winter, occasionally alone, usually in the vicinity of a summer or winter station including: Petermann Island (1981), Rauer Islands near 'Davis' station (1983), Pléneau Island and Port Lockroy (1990), Deception Island and Hovgaard Island (1991). Similarly yachts recently wintered in King Edward Cove (South Georgia) and at Port-aux-Français (Iles Kerguelen), and others undoubtedly wintered elsewhere but are not recorded.

Automatic stations and observatories

In recent years many automatic weather stations and geophysical observatories, small and large, have been deployed in Antarctic regions for various periods. Some have produced long continuous records. Stations such as 'Mario Zucchelli', established in 1987 by Italy in Victoria Land are remotely controlled from distant centres (in Rome in this instance). Although contributing much data these are not recorded in this paper. Similarly a wide variety of summer stations exist, many of which were formerly used during winters, thus almost twice as many stations, in total, are open during the brief Antarctic

summer. Most of these will, in various ways, be involved with the International Polar Years of 2007–2009.

International Polar and Geophysical Years

One Antarctic station, number 33 on the map, was open for the first International Polar Year of 1882–1883. Two stations, numbers 28 and 32, were open for the second International Polar Year of 1932–1933. For 1957, the first winter of the eighteen month long International Geophysical Year, 54 stations were open, numbers: 1, 4, 7, 8, 11, 13, 14, 15, 16, 17, 26, 27, 28, 32, 35, 37, 46, 51, 52, 57, 61, 62, 64, 65, 67, 70, 72, 73, 78, 80, 81, 86, 88, 94, 95, 98, 99, 101, 103, 106, 107, 108, 109, 110, 112, 114, 115, 116, 122, 124, 125, 127, 128, and 135. For the 1958 winter 53 stations were open as four were reopened or established (44, 59, 68, 92) and five closed (46, 65, 112, 125, and 127). During the two winters of the 2007 to 2009 International Polar Year 44 stations were open: 1, 2, 4, 7, 8, 19, 20, 21, 22, 23, 24, 25, 26, 28, 30, 32, 36, 37, 38, 39, 41, 46, 52, 54, 55, 57, 61, 68, 69, 71, 73, 80, 81, 94, 96, 101, 104, 114, 115, 118, 126, 130, 133, and 136 (17 on the peri-Antarctic islands and 27 on Antarctica).

Fate of stations

The fate of a station is a consequence of various accidental and deliberate forces of man or nature or combinations of these. Antarctic weather is responsible for steady dilapidation after regular maintenance ceases at a station. Careful shuttering and weather proofing a building merely prolongs the process. Indeed the amount of restoration and maintenance has become a major factor in the conservation of the historic huts which, when they were constructed, were intended to last a few years only. Financial obligations are severe, thus a few large closed stations that would be very expensive to maintain or clear, remain succumbing to the elements. The ineluctable processes of burial and compression, with calving of ice shelves, affect all stations on ice. All the early ones have gone, and modern ones require regular rebuilding and removal to sites more distant from the ice-front. Some bases built on rock near coasts have been affected by tidal surges and blizzards (the two British Graham Land Expedition huts are examples). Other cataclysms, notably volcanic eruption, have also destroyed stations. Fire is always a major emergency in polar regions and has caused the demise of many stations, in whole or in part.

In several instances bases, notably some of those of the British Antarctic Survey and the joint New Zealand United States station, have been removed with the exception of the foundations after their original purpose has been served (such as after survey and geological or other investigations in the region have been completed). Such demolition and removal has not always been with the consent of the body that established a station. Operation of several stations has changed over time and examples of transfer between different nationalities exist beginning in 1904 when the Laurie Island meteorological observatory

was transferred to Argentina. Many stations have been open for summers, both before and after they were occupied during a winter, and some of these have automatic observatories for their unmanned periods.

Maps, figures, and illustrations

The two maps (Figs. 2 and 3), of the continent and of the peri-Antarctic islands, are derived from *SCAR Bulletin*. The histogram (Fig. 4) represents a chronology of Antarctic winter stations. The illustrations show a selection of a few of the more historic winter stations (Figs. 1, 5–8).

Sources

The principal source for this compilation has been materials gathered towards the revision of the *Chronological list of Antarctic expeditions and related historical events* first published in 1989 (Headland 1989). A new work, *A chronology of Antarctic exploration*, will include a comprehensive description of sources (Headland in press). For most stations these are: annual reports of

the countries involved, their reports to the Scientific Committee on Antarctic Research, the annual station lists in the *SCAR Bulletin*, and those submitted in exchanges of information under the Antarctic Treaty. Details of recent stations have been secured from material distributed by the Secretariat of Council of Managers of National Antarctic Programmes.

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