A Remembrance

Gordon de Quetteville Robin

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Gordon de Quetteville Robin died on 21 September 2004 at the age of 83. During his life he contributed significantly and innovatively to his own academic subject of glaciology and, persuaded of the high value of cooperation between national groups at an early age, promoted actively and effectively the cause of international collaboration in Antarctica. He raised the profile and contribution to polar research of the Scott Polar Research Institute, University of Cambridge, to a new peak during his influential directorship between 1958 and 1982.

Robin was best known for his pioneering contributions to the study of large ice sheets in the polar regions. He was the first to produce scientifically reliable measurements of the thickness of the Antarctic ice sheet using seismic sounding; he generated the first analysis of the temperature distribution in polar ice sheets; and, with Stan Evans, he initiated the development and implementation 40 years ago of the radio echo sounding technique to measure the thickness of ice masses using high frequency radars that remains the standard methodology, and undertook extensive airborne campaigns in Antarctica using the technique. New branches of research arose from his studies of radio echo sounding — internal layering and sub-glacial lakes. He was responsible for the first scientific proposal to measure polar ice sheets from space using satellite radar altimetry and the first to undertake an empirical study of the propagation of ocean waves into sea ice. He made a number of other significant contributions to the understanding of ice dynamics, the climate record in ice sheets, and the study of ice shelves. His written work was distinguished by innovative ideas combined with careful observation and thorough analysis.

Gordon Robin was born in Melbourne, Australia, on 17 January 1921 and educated at Wesley College in Melbourne where he enjoyed the outdoors, becoming a Rover Scout. This gave him opportunities for hiking and cross-country skiing in the mountains of Victoria. He went on to the University of Melbourne, where he read physics, gaining a Master's Degree in 1942. He joined the Royal Australian Naval Voluntary Reserve immediately upon graduating and was commissioned as a sub-lieutenant. Finding anti-submarine duties around Australia rather tedious, he moved to England, spent a month on motor torpedo boats in the English Channel, then volunteered for the submarine service. Promoted lieutenant, he joined HMS *Stygian*, which towards the end of World War II sailed in support of a midget submarine

Fig. 1. Gordon Robin at Maudheim, 1950. Photo: Valter Schytt.

(XE3) to attack Japanese cruisers in the Jahore Straits and Singapore harbour. The successful mission was the last time midget submarines were used in a wartime operation. Robin demobilised in the United Kingdom, against standing orders, and went on to study nuclear physics at Birmingham University, under Professor (later Sir Mark) Oliphant, in his cyclotron project.

Robin recalled that 'as an undergraduate around 1939 I decided that I wanted to go to Antarctica' (Fig. 1). His chance came at Birmingham; Raymond Priestley (geologist with both Shackleton (1907–09) and Scott (1910–13)) was the vice-chancellor, and he pointed Robin in the direction of the Scott Polar Research Institute in Cambridge and James Wordie. This led to an offer of a year (1947–48) as base commander at Signy Island in the

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Fig. 2. Farthest south during the seismic journey. L to R: Charles Swithinbank, Gordon Robin, Kernek with Peter Melleby stand in front of one of their 'weasels'. Photo: Charles Swithinbank.

South Orkneys with the Falkland Islands Dependencies Survey (FIDS) — providing he was prepared to leave in two weeks! Despite the short notice and Robin's developing interest in nuclear physics, Oliphant released him; it was the transforming event that would change the course of the rest of his life.

Sailing from Montevideo on SS *Trepassey*, Robin was to winter at Cape Geddes on Laurie Island, with three Falkland Islanders as companions. His first task arriving in the South Orkneys was to move the station from Cape Geddes to Signy Island, as the proximity to the Argentine station on Laurie Island was considered to have become politically too sensitive. He undertook a comprehensive plane-table survey of the island, the first seal count, including the first reports of breeding elephant seals, and studied the synoptic meteorology of the region.

Returning from Signy, Robin rejoined the Physics Department at Birmingham and the cyclotron project, gaining a lectureship in October 1948. But in 1949, with his appetite for the Antarctic already whetted, a new opportunity arose and he was recruited to the Norwegian–British–Swedish Antarctic Expedition as third-in-command and physicist in charge of the seismic survey to measure ice thickness.

During his first winter at Maudheim station in Dronning Maud Land, Robin undertook a meteorological project that required many hours in a cold, dark hut tracking balloon ascents. The seismic project was, however, his primary concern, and at the end of the winter and into the summer of 1950–51 he commenced a series of experiments on the ice shelf and onto the edge of the ice sheet.

For much of the second and very stormy winter Robin worked with Peter Melleby to prepare two 'weasels' for the next summer seismic campaign. The seismic party, which comprised Robin, Melleby, and Charles Swithinbank, left Maudheim on 18 October under strict instructions to return by the first week of January 1952 — otherwise their ship would depart for Europe without them! The journey onto the ice sheet beyond the mountains broke new ground, and they reached their farthest point on 24 November, at latitude 74.3°S, some 620 km from Maudheim and at an altitude of 2710 m above sea level (Fig. 2).

The outward soundings had not been very successful. Robin, not for the first time, demonstrated his single-mindedness and scientific tenacity with a number of careful experimental tests. By compacting the upper snow layers and using a deep hole for the charges he obtained good results. On the return journey he was able to complete the soundings and thus achieve the first and remarkably detailed profile of the ice and sub-glacial terrain. The scientific party returned to Maudheim, and the expedition sailed a week later. Reflecting on his time at Maudheim, Robin later commented that 'the NBSE was the most exciting and rewarding time of my professional life.'

Robin was given an ICI Research Fellowship at Birmingham on his return, shifting his research focus to glaciology. He worked up his material on the seismic traverse, which was submitted for a PhD in 1956 and published as an NBSE report in 1958. This major work provided exciting results regarding the thickness of the

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ice shelf and inland ice and the subglacial topography. It became a 'classic' research paper, establishing the technique on a sound scientific footing, and was the basis for the oversnow seismic work undertaken during the International Geophysical Year. At this time Robin also prepared and published a seminal paper in *Journal of Glaciology* on the problem of the temperature distribution in moving ice sheets. This was a matter that had occurred to him whilst on the seismic traverse. He was able to show elegantly the effects of heat conduction, surface accumulation, and ice flow on the steady-state temperature distribution.

In early 1957 Robin returned to Australia to the Australian National University to work on ocean waves, since the likelihood of continuing his research in glaciology appeared remote. But he had only been in Australia for a few months when he was offered the directorship of the Scott Polar Research Institute. He accepted and arrived in Cambridge in 1958, becoming the first person to hold a full-time post heading a department in polar science in a British university and arguably the world. Robin's tenure as director of SPRI was long and distinguished. Between 1958 and 1982 he oversaw both the physical and intellectual expansion of the Institute and propelled it actively to become an international centre for glaciological research as well as an outstanding focus for polar scholarship based on its unique archives and prestigious library.

In the austral summer of 1959–60 Robin joined RSS *John Biscoe* to pursue his interest in oceanography, and carried out the first systematic study of ocean wave and swell penetration into fields of loose sea ice in the Weddell Sea. The programme necessitated stopping the ship every six hours and suffering the consequent heavy rolling! Peter Wadhams has commented 'his 1963 paper on the results, published in *Philosophical Transactions of the Royal Society*, was the first observational paper on ocean wave decay in the marginal ice zone and the foundation for all later work.' Robin might have contributed much more to the field of sea-ice research but for his growing interest in the exciting prospects of radio echo sounding. Nevertheless, he took the opportunity when it arose to enable research on sea ice to be advanced, such as the determination and interpretation of the thickness of Arctic sea ice from upward-looking sonar mounted on submarines. In the early 1970s, Robin was approached by the Royal Navy, seeking information about Arctic ice conditions, and was able to negotiate an informal agreement — expertise was made available to the Navy on polar problems, while SPRI was permitted periodically to send a scientist on Arctic submarine missions to collect under-ice data. The success of these early studies went beyond the valuable scientific analyses that ensued. At that time, the publishing of such material was militarily sensitive, but the Royal Navy agreed to their publication providing the exact tracks and timings of the submarines were not disclosed. This was a major scientific and diplomatic breakthrough, a precursor to the release to the scientific community by the US Navy, on a similar basis, of a large quantity of sonar data they had gathered during the previous decade. The research expertise built up in SPRI by Robin and his team led by Peter Wadhams also ensured long-term funding for the analysis of submarine profiles from the US Office of Naval Research.

Stan Evans was recruited by Robin and joined the staff of SPRI in 1959 from the Jodrell Bank Observatory in Manchester. Working together, Robin and Evans pioneered the effective development of the radio echo sounding (RES) technique to measure ice thickness. Although similar developments were underway in the USA and the USSR, the early 1960s saw the production of a purpose-built prototype RES operating at 35 MHz that was first field-tested in Antarctica in 1963 and the following year in Greenland. The success of these experiments transformed the depth-sounding of large ice sheets.

Robin participated in the second season of work in 1964 in northwest Greenland. Evans recounted how Robin's integration of experiment and theory was a key to success:

> When we started on the Greenland traverse to Camp Century . . . we very soon ran out of bottom echo. 'Keep going up the hill,' said Robin. I already knew how the attenuation in ice would decrease with decreasing temperature, and Robin had already done his theoretical paper on temperature distributions. He knew it would get colder on the surface (of course) but he also knew how much colder it should get down below.

Based on the Greenland data, Robin was able to study ice dynamics and internally reflecting layers. He postulated these latter features represented a continuous layer, which once was at the surface and represented time horizons of equal age (isochrones).

The first continuous airborne radio echo soundings were made in Ellesmere Island in 1966 using a DHC-3 Otter by Robin, Evans, and Geoffrey Hattersley-Smith of the Canadian Defence Research Board. This fundamental work led quickly to further airborne activity in Antarctica and Greenland by scientists from several nations. Swithinbank, working with SPRI equipment, undertook the first airborne experimental season in the Antarctic Peninsula in 1966–67.

In 1967 Robin initiated a 12-year collaborative programme with the US National Science Foundation to map and glaciologically explore the Antarctic ice sheet, the Americans providing the long-range aircraft for the purpose. At the end of that campaign in 1979 — which had involved many other groups, notably the Technical University of Denmark — something over 50% of the continent had been covered by a 50–100 km grid and many new lines of exciting scientific investigations opened up at SPRI and elsewhere. Robin undertook his last RES field season in 1974–75 (having spent the spring of 1973 on the ice cap on Devon Island), handing over leadership of the programme to David Drewry.

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Fig. 3. Gordon Robin as director of the Scott Polar Research Institute. Photo courtesy of the Scott Polar Research Institute.

Robin's research using RES formed the most important, distinctive, and central part of his career, a period when he tackled several important glaciological questions, often in collaboration with his colleagues and research students. These included the identification and definition of the ice streams flowing into the Ross Ice Shelf; discovery of Lake Vostok, a large water body beneath the East Antarctic Ice Sheet close to the Soviet/Russian station Vostok (and a topic that occupied him in retirement); the flow and bottom conditions of shelves; and the investigation of large-scale ice dynamics and basal processes. Out of his work in these areas grew allied activity in studies of physical properties of ice and its deformational characteristics and relevance to behaviour such as surges.

At SPRI (Fig. 3), Robin was always generous with the time he gave to his research students. From my own experience, his style was quite distinctive: frequently challenging, often with a touch of humour, always totally supportive. 'The best theses often come from those who disagree with their supervisors,' Robin stated, and added with a wry twist 'provided they convince their supervisors or examiners they are right!' David Meldrum noted how, 'I quickly learnt to respect his incisive scientific acumen, particularly his terrifying ability to instantly identify and lay bare for penetrating scrutiny the crux of any scientific issue or argument, a rare skill which never failed to impress (and frequently disconcert) all who met him.'

In the early 1960s Robin applied the experience gained in radar sounding to the possible use of radar altimeters to profiling the surface (and possibly to the penetration) of ice sheets from space. The idea of observing Earth from space was still in its infancy, but Robin was quick to grasp the potential for investigating the polar regions and their ice cover using satellites. Having spent many years either toiling slowly over the surface of the sheet in vehicles, with all the attendant dangers, or flying in ponderous aircraft on long sorties, Robin had the vision of acquiring virtually synoptic data, at a continental scale, without the vicissitudes of weather and conventional logistics. He presented a key paper on 'Mapping the Antarctic ice sheet by satellite altimetry' at a conference in Canada in 1965, in which all the major elements for future successful satellite programmes were enunciated. His ideas were quickly taken up at NASA, in particular by Jay Zwally, and a new, satellite era in active radar remote sensing of the polar ice sheets opened. Robin took an active interest in the data from later satellite missions and contributed to a study to better understand the operation of radar altimeters over land ice and sea ice.

In the early 1970s Robin's interest widened to encompass the newly developing study of the past record of climate from ice cores. In one important study he was able to demonstrate a connection between precipitation over the Antarctic ice sheet and the temperature above the inversion layer, which has been widely used in later climate-modelling studies.

The NBSE had a profound influence on Robin's approach to scientific research, confirming in his mind the veracity of international cooperation, and he was an enthusiastic advocate of the IGY. In 1958, as a response to this international scientific interest in Antarctica, a formal coordinating body was created, the Scientific Committee on Antarctic Research (SCAR), by the International Council of Scientific Unions. The Royal Society, as the UK adhering body to both ICSU and SCAR, formed a British National Committee on Antarctic Research and appointed Robin as Permanent UK Delegate, a position in which he continued until 1984. He was elected honorary secretary of SCAR until elected president in 1970 for a four-year term (Fig. 4). During his years as secretary and president, Robin was active in shaping SCAR into a mature non-governmental international scientific organisation coordinating effectively the work of the many nations operating in the Antarctic. That SCAR was able to achieve so much and frame common programmes around contrasting national perspectives was a tribute to Robin's fundamental belief in the value of international cooperation for peaceful scientific purposes. Fred Roots has noted that his role in making the scientific cooperation a distinguishable factor in the cooperative activities and attitudes of the political Antarctic Treaty was one of Robin's most significant, but behind-the-scenes and understated, international accomplishments.

Robin did not let his concentration on purely scientific matters detract from meeting the needs of the Institute in Cambridge. He secured substantial financial support from the Ford Foundation, which, along with assistance from the University of Cambridge and other donors, was

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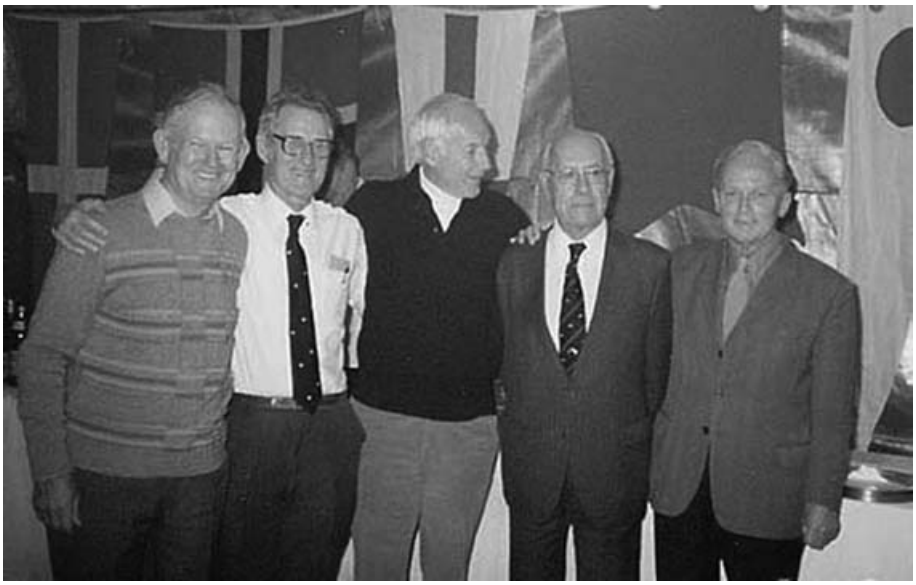

Fig. 4. Five presidents of SCAR: George Knox (New Zealand), Tore Gjelsvik (Norway), James Zumberge (United States), George Laclavère (France), and Gordon Robin (UK). Photo courtesy of SCAR.

sufficient to make a start on the SPRI 'extension' in 1966. The new facility was opened officially by Larry Gould in 1968. Its extensive scientific laboratories, additional library space, and archive facilities were a major legacy of Robin's era. Furthermore, the growing interest in the polar regions led to the idea of a post-graduate qualification in polar studies. Robin and Terence Armstrong responded to this opportunity with the development of the Diploma in Polar Studies — the first of its kind — which commenced its intake in October 1975. After five successful years, the course became a one-year MPhil degree and since 1980 has typically taken some 4–8 students per year. The MPhil has been a great success with more than 100 students graduating from this distinctive course during the last 20 years. It has set a standard emulated later by several other polar institutions around the world.

In September 1982, at the age of 61 Robin decided to take up an opportunity of early retirement presented by the University of Cambridge. His 24 years at the helm of SPRI had been the longest of any director, and his impact arguably the most significant for the Institute's development. Its international stature and reputation was high and secure. When he demitted office, he left SPRI vibrant and in a commanding position with several strong and active research groups. He was succeeded temporarily by Terence Armstrong as acting director before David Drewry was appointed director in 1984. When Drewry departed for the British Antarctic Survey in 1987, Peter Wadhams, similarly a student and colleague of Robin, was appointed director. These two successive appointments were one of the many ways in which Robin's legacy continued to influence the development of the Institute.

After retirement, Robin remained active in research. In 1993–94, whilst director of the British Antarctic Survey, this author had the privilege to invite and accompany Robin on an Antarctic visit. The trip commenced in Cape Town on RSS *Bransfield*, and we were able to sail sufficiently close to the mainland for Robin to obtain a glimpse of Cape Norvegia, nearby to Maudheim. After a few days at Halley, Robin transferred to HMS *Endurance* for passage, most importantly, to Signy Island, where he was able to spend a few days visiting the sites he had last seen 46 years previously.

In the wider Cambridge academic scene, Robin played a full and active role. He was a Fellow of Darwin College since its founding in 1964 and served as vice-master between 1974 and 1978.

Robin's significant contributions to science — glaciology and geophysics, and Antarctic exploration — have been recognised through several awards from major institutions. For his outstanding part in the scientific success of the NBSE, Robin was awarded the Polar Medal (1950–52) and also the Norwegian Medal for Civil Services (Kongens Fortjensmedalje) with the clasp 'Maudheim.' In 1953, Robin received the Bruce Medal of the Royal Society of Edinburgh. The Royal Geographical Society recognised Robin with the Back Grant in 1952 and in 1979 the Patron's Gold Medal, one of the Society's two most senior awards officially approved by HM Queen Elizabeth II. There was other recognition: an Honorary Doctorate (DPhil) from the University of Stockholm in 1978, a ScD from the University of Cambridge (1977), and, in 1986, the foremost prize in glaciology — the Seligman Crystal — of the International Glaciological Society.

Robin is survived by his wife Jean (whom he married in 1953; she had worked as Lawrence Kirwan's secretary at the Royal Geographical Society in London and had been involved in the organisation of the NBSE) and two daughters, Caroline and Elizabeth.

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