SIR ANTHONY SEYMOUR LAUGHTON DSc
29 April 1927 — 27 September 2019
SIR ANTHONY SEYMOUR LAUGHTON DSc

29 April 1927 — 27 September 2019

Elected FRS 20 March 1980

BY ROGER C. SEARLE*

Durham University, Durham DH1 3LE, UK

Anthony (Tony) Laughton was an oceanographer who promoted the science of oceanography in Britain. Focusing on the shape of the seafloor, his work included underwater photography, ocean drilling, long-range side-scan sonar and scientific charting of the ocean floor. Following undergraduate studies at King’s College, Cambridge, he joined Maurice Hill (FRS 1962) at the Cambridge Department of Geodesy and Geophysics, beginning a career in marine geophysics. Following his PhD, he spent a year at Lamont Geological Observatory, USA, where he met many leading US workers, and became interested in deep-seafloor photography and bathymetric mapping. Returning to the UK, he joined the National Institute of Oceanography (Institute of Oceanographic Sciences from 1973) at Wormley, Surrey, and became director in 1978. He developed the first UK seafloor camera, was an enthusiastic supporter and user of the revolutionary Precision Echo Sounder and later of the GLORIA long-range side-scan sonar. He played a significant part in the International Indian Ocean Expedition, subsequently developing a new understanding of the Gulf of Aden. A consummate committee man, he had a vital role in reviving the General Bathymetric Chart of the Oceans and promoted UK involvement in the international Deep-Sea Drilling Project. He was an accomplished amateur musician (playing French horn), small-boat sailor and handyman.

EARLY LIFE

Anthony (Tony) Seymour Laughton was born in Golders Green in 1927. Seymour was a family name, supposed by them to be connected to the Tudor Lady Jane Seymour. His father was an interior designer and his mother a singer and amateur pianist; he had one brother. His parents were ‘far from being wealthy’ (24)†, but provided a conventional middle-class upbringing.

* E-mail: r.c.searle@durham.ac.uk
†Numbers in this form refer to the bibliography at the end of the text.
having a live-in housekeeper/cook and nanny, and affording private schools for their sons. During World War II the family moved to Gerrards Cross in Buckinghamshire. Tony had an early introduction to the wider world through visits with his father to Covent Garden, Smithfield and Billingsgate markets with their sometimes exotic products and travellers’ tales of foreign parts.

Tony began school in 1933 at Heysham School, Hampstead. He joined Abinger Hill Preparatory School in Surrey, which had ‘very liberal educational principles’ (24), in 1936. He much enjoyed Abinger Hill, and considered this to have been a very formative period. At the start of World War II Abinger Hill School closed and Tony went straight to Marlborough School for the start of summer term 1939. He rapidly advanced and took the School Certificate exam in 1941, aged 14, achieving eight subjects. He disliked the Army Officer Training Corps, but did well in the Sea Cadets Corps. He also developed his interest in music there. In 1942 he gained the Higher Certificate with distinctions in physics and maths, and won a Minor Scholarship to King’s College, Cambridge, which he chose for its musical tradition.

WAR SERVICE

Tony was called up in 1944 and chose the Navy. He left Marlborough to attend Naval Short Course training at the University of Cambridge in 1945. There he undertook basic naval training and attended courses on philosophy, logic and metaphysics. He continued naval training, which introduced him to marine navigation (he passed the exam with 100% and a special commendation), working on ships and handling marine equipment, all of which provided valuable background for his future career in oceanography. He relished the many opportunities for handling small boats and dinghies.

Commissioned as midshipman in the Royal Naval Volunteer Reserve in 1946, he spent most of his naval service mine-sweeping. In summer 1947 he was dispatched to Kiel (Germany) as first lieutenant on a motor launch. There they escorted back to Germany three captured ships of Jewish refugees bound illegally for the new state of Israel. Probably during this time he acquired an excellent pair of Zeiss binoculars, which he later said came from a U-boat. He was demobbed in December 1947.

While waiting for the Cambridge Michaelmas term to begin, Tony worked at the British Aluminium Research Laboratories, performing glass-blowing, analysis of aluminium alloys and photographic work. The last would also prove valuable later.

CAMBRIDGE

In October 1948 Tony returned to Cambridge to take up his scholarship at King’s College. He read physics, mathematics, chemistry and mineralogy for the Natural Sciences Tripos, recalling several ‘stimulating lectures’ in classical physics given by Professor Sir Lawrence Bragg FRS (24). In 1950 he gained a First in Tripos Part I and, as a returning servicemen, could then graduate after only two years. Nevertheless, he spent a third year at King’s and sat Part II in physics. He recalled lectures by Paul Dirac FRS and Brian Pippard (FRS 1956). He was elected secretary of the King’s College ‘Amalgamation Club’ (Junior Common Room) in 1951.

Following Tripos Part II, Tony was encouraged to stay at Cambridge to do research. His first choice was low temperature physics with Pippard, but his Part II results were not good
enough. He then decided to join Professor Otto Frisch FRS to do nuclear physics using the Cambridge cyclotron, but this was ruled out when a mandatory blood test showed he had a low white cell count. However, during his time as an undergraduate he had struck up a deep and enduring friendship with Maurice Hill (FRS 1962), who had been elected a fellow at King’s two years earlier. When he mentioned his problem, Hill invited Tony to join him in marine geophysics at the Department of Geodesy and Geophysics, beginning a lasting and extremely fruitful partnership.

In 1951, at Hill’s suggestion, Tony began research to measure the sound velocity in increasingly compacted sediments in the laboratory. He learned how to build a pressure vessel and the required electronics, and learned basic geophysics from Harold Jeffreys’ (FRS 1925, later Sir Harold Jeffreys) book, *The Earth* (Jeffreys 1924). In summer 1952 Tony took part in his first marine ‘cruise’ or expedition, on RRS *Discovery II* in the British Southwest Approaches and nearby Porcupine Bight. The principal scientist (leader of the science team) was Henry Herdman, an oceanographer at the recently formed National Institute of Oceanography (NIO). They collected sediment cores for Tony’s laboratory work and conducted seismic refraction lines off the edge of the continental shelf, showing it was underlain by oceanic crust, producing Tony’s first publication (1).

USA

In 1954 Hill facilitated a one-year visit by Tony to the Lamont Geological Observatory (LGO), New York, which had been founded in 1949 by Maurice Ewing (ForMemRS 1972), a friend of Hill. Tony obtained a Royal Society John Murray studentship and a Fulbright studentship to support the visit, and sailed for New York in March 1954.

On this visit, Tony met many of the foremost oceanographers of the time and became aware of new techniques that he eventually introduced in Britain. As Ewing, his formal ‘host’ for the visit, was away when he arrived, he was greeted by Frank Press (ForMemRS 1985; subsequently president of the National Academy of Sciences and science advisor to President Jimmy Carter). Tony then joined Ewing on Cruise 2 of the schooner *RV Vema* in the Gulf of Mexico, being put in charge of the *ca* 100-shot deep-sea camera, whose operation he had to learn by dismantling it. He often ran the daily camera ‘stations’ single handedly, including developing and printing the film on board.

At LGO Tony met Bruce Heezen, who, with Marie Tharp, was to produce a set of ocean floor physiographic maps that transformed our view of the ocean floor (e.g. Heezen & Tharp 1954). This focus on seafloor photography and bathymetric mapping clearly impressed Tony, feeding his life-long interest in the shape of the seafloor (5).

Once, Tony and Heezen drove from New York to a physical oceanographic conference at Woods Hole Oceanographic Institution (WHOI) in Massachusetts, where he also met leading oceanographers John Isaacs, Harry Hess (a founding father of the seafloor spreading theory) and others, including George (later Sir George) Deacon FRS, who had founded NIO and who offered Tony a position there if his application for a Cambridge fellowship failed.

Tony sailed on three *Vema* cruises while at LGO, appreciating Ewing’s method of systematic, continuous underway geophysical measurements and daily sampling operations. He received tutorials from Ewing and wrote up his thesis, which he completed in 1956. At the end of his year in the USA, he rode Greyhound buses to California and visited Scripps Institution of Oceanography (SIO), where he met more leading oceanographers.
Tony returned to England in 1955. He took up Deacon’s offer of a post at NIO (achieved without an interview), where he stayed until his retirement. He had received offers of positions at both LGO and SIO, but preferred to stay in England. NIO had moved to its permanent home in the hamlet of Wormley, Surrey, in 1949. For the next 10 years Tony collaborated extensively with the University of Cambridge group, particularly Maurice Hill, until the latter’s death in 1966.



Seafloor camera

Installed at NIO, Tony began building an improved deep-sea camera (figure 1) with invaluable help from the NIO engineering group, particularly ‘Dickie’ Dobson (3). The camera electronics utilized techniques and circuits used by John Swallow (FRS 1968) in his current-following floats. A major problem at this time was making a penetration of the pressure case that allowed electrical connections but excluded water. Tony developed such a watertight cable penetration, leading to the NIO ‘camera plug’. Two further innovations were the use of O-rings as pressure seals, as he had seen being used in the USA (rather than the flat rubber washers then used at NIO), and the use, as windows, of truncated Perspex cones seated on O-rings. He also arranged the design of special camera lenses to correct aberration introduced at the water–air boundary.

The camera was trialled in the spring of 1956 on Tony’s first geophysical cruise at NIO. He conducted 13 camera stations, including one with colour film, to a depth of 4800 m (2). The camera and the underwater photos were shown at the Royal Society Soirée in June 1957 and at the British Association meeting in Dublin that September. Tony and others continued to use the camera for many years, and about a dozen cameras were eventually made for sale.

In September 1957 Tony was invited by the president of the Royal Society of Arts (RSA), a friend of his father, to talk on ‘Exploring the deep ocean floor’ (24). The RSA subsequently awarded him a silver medal.

Precision Echo Sounder

Tony had a life-long fascination with maps—‘a decent map, not just a diagram without a scale . . . but a proper map, with contours of the land . . .’ (24). He attributed the beginning of such interest perhaps to the map of the Hundred Acre Wood in Milne’s Winnie the Pooh, or possibly to following in his own mind the journeys of Ransome’s Swallows and Amazons. On the 1956 cruise, he began producing hand-contoured charts to guide the dredging and coring stations.

Deep-water echo-sounders then were limited in accuracy by the method of timing the returning sound pulses. These were displayed on a rotating drum whose speed was controlled by a mechanical governor, needing frequent calibration using a stop-watch. Prompted by a similar development in the USA, John Swallow and Tony determined to build the Precision Echo Sounder (PES) based on the commercial Mufax facsimile machine, which utilized a precision electronic time base (figure 2). They tested it in 1958, achieving 1 fathom (1.8 m) precision, demonstrated by contouring the extremely flat Tagus Abyssal Plain west of Portugal.

Tony was aware of work being done by Heezen in the USA on turbidites feeding abyssal plains, and initiated similar work in the UK. The 1958 cruise investigated the turbidite overflow channel between the Biscay and Iberia Abyssal Plains (4). In 1959 Tony presented
Figure 1. Tony on board ship with the deep-sea underwater camera he designed at NIO, showing the camera (middle) and flash (bottom) mounted on a frame. At the bottom of the frame is a cable with a weight (out of shot) at its lower end that, when it touched the bottom, would trigger the camera. At the top of the frame is a ‘pinge’, which would transmit a sound pulse to the ship to facilitate monitoring of the camera operation. The camera was used by geologists, biologists and physical oceanographers, both at NIO and in other labs. (Photograph originally published in (23).)
Tony undertook a 25-lecture tour of Canada in 1961, standing in for Hill at the latter’s invitation. This gave him the opportunity of meeting more leading Canadian oceanographers at Dalhousie, Carleton, McGill, Toronto and British Columbia universities. He then drove down the west coast to again visit SIO in La Jolla.

On his return, Tony became involved in the design of the new RRS Discovery, which was launched in 1962 as a replacement for RRS Discovery II. He participated in her public display in London, and worked on her shakedown cruises.

International Indian Ocean Expedition and the Gulf of Aden

In 1958 the International Council of Scientific Unions (ICSU; now the International Science Council) had formed the Special Committee on Oceanographic Research (later the Scientific Committee on Oceanographic Research—SCOR) to help address interdisciplinary science in the oceans. SCOR noted that oceanographic work had been focused on the northeast Pacific and North Atlantic, and wished to promote study of the Indian Ocean. They proposed a major, multi-disciplinary cruise: the International Indian Ocean Expedition (IOE). The UK offered its new research ship RRS Discovery and the naval survey ship HMS Owen. In 1960 Tony was
invited to join the Geology, Geophysics and Bathymetry Subcommittee of the SCOR Indian Ocean Working Group, chaired by Bob Fisher of SIO.

In 1960–1961 and 1961–1962 *HMS Owen* made gravity, magnetic and bathymetric traverses through the Gulf of Aden and across the Carlsberg Ridge, followed by detailed surveys. The PES was used, and Tony sailed from Plymouth to Gibraltar setting it up. In August 1963 he joined *RRS Discovery* in Aden for the major geology and geophysics cruise of the IIOE, with Maurice Hill as chief scientist and scientists from Cambridge and Liverpool universities, the Admiralty’s Hydrographic Department and NIO; Tony was in charge of seabed photography (7).

This cruise led Tony to a major study of the Gulf of Aden. He showed that the Carlsberg Ridge in the northwest Indian Ocean, already recognized as a seafloor-spreading centre, was offset westwards into the Gulf of Aden along a transform fault, part of what he named the ‘Owen Fracture Zone’. By combining the available data, he showed the Gulf was also a spreading centre, having been formed as the Arabian Peninsula moved northwards away from Africa. This was presented at the Royal Society meeting ‘A discussion concerning the floor of the Indian Ocean’, organized by Maurice Hill (6, 8).

The 1970 publication (8) included several novel charts, achieved through an association Tony developed with the Royal College of Art’s Experimental Cartography Unit. There was a ‘physiographic map’ (figure 3) of the kind pioneered by Heezen & Tharp (1954), a coloured bathymetric chart (figure 4) and an ‘anaglyph map’, in which depth contours were printed in red and green, separated by a distance proportional to their depth, so that when viewed through bi-coloured glasses a 3D impression was obtained.

The IIOE saw the preparation of the *Geological-geophysical atlas of the Indian Ocean*, with Tony as one of four invited associate editors under Gleb Udintsev of the USSR Academy of Sciences. Tony spent 10 years on the editorial board, and much time contouring the bathymetry of the Indian Ocean. This bathymetry made a significant contribution to the ongoing GEBCO (General Bathymetric Chart of the Oceans) project (discussed below). The Indian Ocean atlas was finally published in Moscow in 1975 (16) although, as Tony acknowledged, with such a long lead time many felt it was by then out of date.

**Ocean drilling**

In 1969, Tony became involved in the recently formed Deep-Sea Drilling Project (DSDP). This initially American programme arose from the abandoned Project Mohole, which had aimed to drill to the Earth’s mantle under the ocean. Tony wrote to the DSDP chief scientist suggesting the UK should contribute to the North Atlantic programme, and was encouraged to formulate a UK proposal. He organized two meetings at the Royal Society to prepare proposals for nine possible sites supported by survey data. Five proposals were accepted for DSDP Leg 12, for which Tony was invited as co-chief scientist—the first non-US scientist to be so.

Though initially feeling too busy, he was persuaded by Sir Edward Bullard FRS to ‘lead the UK participation in DSDP’ and eventually agreed (24). He was joined by Bob Whitmarsh, a recent Cambridge PhD graduate and recruit to Tony’s group at NIO. The two visited several institutions to collect supporting data, before joining the drill-ship *Glomar Challenger*. Tony’s extensive North American contacts proved invaluable throughout this preparation phase.

DSDP Leg 12 investigated Orphan Knoll (an isolated shallow region off NE Canada) and showed it to be a continental fragment; they drilled in the Labrador Basin to determine the age and nature of the Greenland/Canada breakup (9); they investigated details of the crust on the
Figure 3. Tony’s physiographic map of the Gulf of Aden, made using results from the International Indian Ocean Expedition (8). It uses the technique pioneered by Bruce Heezen and Marie Tharp of indicating the shape of the seafloor (the ‘physiography’) based on limited sounding information, rather than using detailed contours where no data exist. Tony subsequently used this method to illustrate his interpretations of GLORIA side-scan sonar images (15).

Figure 4. Part of another novel chart type pioneered by Tony, again from the Gulf of Aden. The shape of the seafloor is indicated by precise contours (here at 100 fathom (180 m) intervals), and the position of each sounding is indicated by a dot, showing the degree of data control. Interpretation is enhanced by the addition of colour shading. Tony used the same techniques in a widely-used set of charts of the bathymetry of the northeast Atlantic (14). (Online version in colour.)
Reykjanes Ridge and Rockall Plateau; and they determined the date of opening of the Bay of Biscay (10). The cruise was a scientific success and established the UK as a major player in the ocean drilling community.

Tony felt that being co-chief on Leg 12 had ‘vastly extended his feeling for and knowledge of marine geology’ (24), although writing the Leg 12 final report took him away from other work. He remained part of DSDP as a member of the Atlantic Advisory Panel and later as UK representative on the Planning and Executive committees.

Bathymetric charts and GEBCO

In the 1950s and 1960s Tony had been hand-contouring available soundings to produce bathymetric base maps for interpretation and planning future operations. He had been impressed by the ‘brilliant work’ (24) done by Bruce Heezen, Maurice Ewing and Marie Tharp in interpreting the early, widely-spaced and poorly navigated bathymetric sounding lines in the form of physiographic diagrams, utilizing knowledge of the geological processes of the ocean floor.

At this time the only additional depth data available were the ‘collected soundings’ of ships, mostly on passage, that happened to have deep-sea echo-sounders. These soundings were compiled onto 1:1 million equatorial scale Mercator projection ‘plotting sheets’ by the Admiralty’s Hydrographic Department and similar departments elsewhere. Tony took to hand-contouring these ‘collected soundings’ sheets in the NIO areas of interest, using current knowledge of marine geology to guide the contouring in areas between soundings. The 20 or 30 sheets of the eastern North Atlantic provided a rich resource at NIO (and IOS—the Institute of Oceanographic Sciences—as it later became) as a basis for further interpretation and cruise planning.

In 1975 Tony began collating these contoured sheets into a widely-used five-chart series covering the northeast Atlantic in Mercator projection at an equatorial scale of 1:2.4 million, using the same format as his Gulf of Aden chart (see figure 4). Published as Admiralty Charts, they were sometimes accompanied by descriptive papers (14). Importantly they, and all Tony’s charts, showed the positions of soundings, allowing the reliability of the contours to be assessed.

Tony played a major part in the GEBCO seafloor mapping project, which had been started by Prince Albert I of Monaco in 1903 to chart the world’s oceans. In 1966 Tony joined the GEBCO committee, then battling with lack of money and manpower to publish updated editions of its 1:10 million scale charts. Bruce Heezen, Gleb Udintsev and marine geologist Bill Menard (of SIO) were already involved, but struggled to influence the quality of the charts under preparation, which failed to reflect current scientific ideas (12). In 1968, at the request of UNESCO’s Intergovernmental Oceanographic Commission (IOC), SCOR formed Working Group 41 Morphological Mapping of the Ocean Floor (WG41). Tony, as a member of both the GEBCO and SCOR committees, was appointed to the working group and soon became its chairman. Meanwhile, the president of the International Hydrographic Organisation (IHO) and the secretaries of ICSU, GEBCO and the IOC proposed that the current GEBCO charts be abandoned and the GEBCO committee should become a joint IOC/IHO body with equal representation of oceanographers and hydrographers. Their report, endorsed by SCOR and accepted by IOC, resulted in the rebirth of GEBCO as a scientifically useful project.

In 1974 Tony helped define the specifications for a new, fifth edition, GEBCO chart set, with each of the 18 charts to be prepared by one or two scientific coordinators familiar with
their area. He was appointed coordinator for the NW Indian Ocean, and used the bathymetry he had produced with Fisher for sheet number 5.05, the first to be published (13). He subsequently used the contours from his NE Atlantic work in sheet 5.04, for which he was joint coordinator. The fifth edition charts became widely used, and were often seen papering the walls and corridors of oceanographic institutions worldwide.

In 1977, the joint IOC/IHO Guiding Committee for GEBCO formed a subcommittee on digital bathymetry. This led to the publication in 1994 of the GEBCO Digital Atlas, re-released and updated in 1997, 2003 and 2015.

Tony became vice-chairman of the GEBCO Guiding Committee in 1983 and chairman in 1986. In 2003 he was involved in obtaining funding from the Nippon Foundation for a training programme in undersea mapping, which, to this day, trains some six international students each year. He also chaired the GEBCO Centenary Organising Committee in 2003, and retired from GEBCO immediately after the centenary.

**GLORIA**

Tony had been aware since his early work that there was a gap between the scale covered by cameras (millimetres to metres) and that covered by contoured soundings (hundreds of metres or more) (5). NIO had used short-range side-scan sonar, developed from the anti-submarine ASDIC used during World War II, for studying the geology of the continental shelf (e.g. Stride et al. 1969). In 1965, NIO Director George Deacon agreed that the side-scan sonar principle could be scaled up “to give detailed morphological information about the seabed” (24), and the development of the instrument GLORIA (Geological LOng-Range Inclined Asdic) began (Rusby et al. 1969). Tony first sailed with it in the open Atlantic in 1969, where they imaged part of the Eurasia–Africa plate boundary, the GLORIA Fault (11).

From 1969 to 1975, Tony led four major cruises in *RRS Discovery* using GLORIA, including several areas on the Mid-Atlantic Ridge (MAR). First was the FAMOUS (French–American Mid-Ocean Underwater Study) area. The FAMOUS project had surveyed a ‘typical’ seafloor-spreading plate boundary near 37° N, using most methods except long-range side-scan. The GLORIA records, when mosaicked, provided an unprecedented view of the ocean floor, while individual sonographs produced views similar to oblique aerial photographs (15) (figure 5). These data indeed bridged the scale gap, covering an area of some 20 000 km² at a resolution ca 50 m, revealing details of the geological faulting and volcanism at a seafloor-spreading centre (17). Other GLORIA studies of the MAR targeted the 41° N Kurchatov Fracture Zone (now recognized as an oblique-spreading non-transform offset), and an area around 45° N where future ocean drilling was scheduled, and GLORIA provided a valuable site survey. This was the last use of GLORIA Mark I.

Following these scientific successes, an improved, less cumbersome Mark II was developed. Its first deployment was led by Tony in 1977, investigating the oblique-spreading Reykjanes Ridge and the double-stranded Charlie–Gibbs transform fault at its southern end. This was his last cruise as principal scientist. The science party included Marie Tharp, Bruce Heezen’s lifetime partner and collaborator. During the cruise we received news of Heezen’s death during a submersible study of the Reykjanes Ridge. *Discovery* diverted to Reykjavik to allow Tharp to disembark, while Tony supported her with his typical compassion. The port call also provided the opportunity for Tony, who had been suffering excruciating toothache, to visit a dentist. He returned a few hours later a transformed man, a great smile replacing his former grim look!
Figure 5. A GLORIA side-scan sonar image and corresponding bathymetry of Palmer Ridge, NE Atlantic. Bathymetric contours in fathoms (1 fm = 1.8 m). The sonographic image is presented with the ship’s track along the top and slant-range to the seabed increasing downwards. The image has been corrected so that slant-range and along-track distance have the same scale. The area covered by the sonograph is indicated by the grey box, the vehicle’s track by the bold line, and the direction of insonification by black arrows. Thus, the first reflections from the top of the sonograph provide a profile of the depth under the track, rather like a horizon, so the sonograph presents a view similar to an oblique aerial photograph. This interpretation technique was promoted and used extensively by Tony. (Originally published in (23).)

**Directorship**

Tony was appointed director of IOS in 1978. As director, his view was that IOS had a responsibility to ‘provide advice and research expertise when there are national needs’ while at the same time to ‘constantly move ahead at the frontiers of the subject’ (24). He balanced the needs of directed research with providing the time and resources for staff to pursue ‘blue-skies’ studies. A continual struggle with IOS’s parent body, the Natural Environment Research Council (NERC), dogged Tony’s directorship. In 1965 the old NIO had become part of the newly formed NERC, which, in 1973, then merged it with the Institute of Coastal Oceanography and Tides, at Bidston, and the Unit of Coastal Sedimentation, in Taunton, to form IOS. While continuing to back his independent scientists, Tony had a difficult relationship with the secretary of NERC, whose ideas were often strongly opposed to Tony’s. For example, when Tony found that directors of the dozen or so NERC institutes (many of
which had been set up with independent charters and had enjoyed considerable autonomy) ‘resented the increasingly centralized approach which NERC was enforcing’, he represented these views to NERC (24).

As director, Tony was increasingly involved in administration. Collaborative publications arising out of his past work continued, but his publications were increasingly restricted to overview papers describing developments he had influenced (18, 21). Tony excelled in committee work and administration. He prepared meticulously, mastered detail and could get members to reach consensus. He served on some 20 Royal Society committees throughout his career, about 50 national committees and some 20 international ones. In 1997 he was invited by NERC to chair the committee overseeing the development of the new autonomous underwater vehicle Autosub. He credited the Royal Society with ‘much of the responsibility for international cooperation’ in the sciences, and particularly its series of British National Committees. He found that serving on these committees ‘provided an excellent means of keeping up with advances in the field’, meeting other researchers and influencing the progress of research; many of his cruises had been the result of collaborations developed through such networking (24).

Tony successfully interested local MP Virginia Bottomley in the problems of IOS, leading to her raising the issue in the House of Commons. The House of Lords Select Committee on Science and Technology devoted one of its investigations to Marine Science and Technology under Lord Gregson, reporting in 1985. Tony had been forbidden by the NERC secretary from submitting evidence, as ‘everything had to be done through NERC’ (24); however, he spoke his mind to individual members of the Committee when it visited IOS.

IOS now needed a larger home. Tony oversaw the beginning of an expansion into a new site at nearby Hambledon. However, the planned move there of the whole Wormley institute was abandoned when the necessary funds dried up. One of the recommendations of the Gregson Report had been for more contact between research institutes and universities, and this probably helped the decision to merge IOS with the University of Southampton’s Oceanography and Geology departments and NERC Research Vessels Services to form the Southampton Oceanography Centre (now the National Oceanography Centre, Southampton) in 1995.

A consequence of the UK Government’s 1971 Rothschild Report was that IOS was required to find a portion of its funds outside its parent body, NERC, via ‘commissioned research’. Initially this was with other government departments for whom they were already doing some work, but increasingly a major task for the director was to acquire new commissioned income.

One example was research into the disposal of high-level radioactive waste (HLRW). This followed the 1976 report of the Royal Commission on Environmental Pollution, which had recommended that long-term research programmes should be started to find safe, efficient and secure ways of disposing of HLRW. Consequently, the Department of the Environment funded IOS to undertake an eight-year research programme into the possibility of HLRW disposal into the deep ocean floor. IOS prepared guidelines for sub-seafloor HLRW disposal, researched its scientific feasibility and investigated possible disposal sites. This work contributed significantly to the Institute’s commissioned research income. In May 1985 Tony, with others, organized a two-day discussion meeting at the Royal Society on the subject (20).

Another very significant piece of commissioned research was a contract with the United States Geological Survey (USGS) to survey the whole US Exclusive Economic Zone
(EEZ)—effectively the area up to 200 nautical miles offshore—using GLORIA. The project developed following the 1983 United Nations Law of the Sea Conference (UNCLOS), which prompted the US government to investigate its EEZ. The first cruise, from May to August 1984, covered 850 000 km² of seafloor off the west coast of the USA using GLORIA Mark II deployed from the British Trawler RV Farnella (figure 6). It produced spectacular results, including images of submarine canyons on the continental margin, the long, sinuous deep-sea Cascadia channel, details of the Blanco transform fault and Gorda seafloor-spreading centre and much more. Eventually the whole US EEZ was mapped (19).

In 1986, Tony accepted the Queen’s Award for Technological Achievement on behalf of IOS, in part for the USGS work. The same year he received a knighthood in the Queen’s birthday honours, although he modestly said that it was really in recognition of the work of IOS as a whole. Another happy occasion was a visit to IOS by HRH the Duke of Edinburgh in 1982.

A more equivocal memory was when the Great Storm of October 1987 passed across south-eastern England. This coincided with a series of open days and a ceremony to rename Wormley as the IOS Deacon Laboratory in honour of its founder. The day dawned to widespread devastation, with many roads blocked by fallen trees, extensive power cuts and collapsed marquees in the IOS grounds. However, Tony rallied his troops, much damage was cleared and the naming ceremony went ahead only 2½ hours late!

Tony was invited to apply for the directorship of SIO in 1985, but, although interviewed, he decided against it. He retired from IOS on 28 April 1988—one year after his sixtieth birthday, when retirement was mandatory for public servants.

**Post-IOS**

After retirement, Tony continued with a number of committee appointments. He was in discussions to revive the Challenger Society (founded by members of the 1872–1876 Challenger Expedition), leading to a relaunch under the name ‘Challenger Society for Marine Science’ (24), and became the first president of the new society from 1988 to 1990. He served on the councils of the Marine Biological Association (1986–1987, 1989–1992) and the Society for Underwater Technology (president, 1995–1997), and was president of the Hydrographic Society from 1997 to 1999. In 1990 he accepted an invitation to become a trustee of the Natural History Museum; there, he chaired a working group on the future development of their Earth Sciences Wing.

Tony remained interested in research. He was a guest investigator on his last research cruise, to the Reykjanes Ridge on the US ship RV Maurice Ewing, in 1990. He particularly enjoyed the Royal Society/Royal Geographical Society ‘Shoals of Capricorn’ programme (1998–2001). This aimed to investigate the oceanography and ecology of the Mascarene Ridge (for which ‘Shoals of Capricorn’ was an old name) and neighbouring islands in the Indian Ocean, foster collaboration and establish local research programmes. He joined the board of the Shoals programme in 1998 to advise on geology, and was also a member of its Science Advisory Panel, undertaking to produce ‘the best bathymetric map’ of the area (24). He and others organized a two-day Royal Society Discussion Meeting on ‘Atmosphere–ocean–ecology dynamics in the western Indian Ocean’, including his last research publication (22).

Later he and others produced an important book telling the history of NIO, describing the development of the science and the individuals involved (23).
Tony was active in other areas too. He was a governor of nearby Charterhouse School (1981–2000), where, as the only scientist on the governing body, he oversaw the complete refurbishment of the school’s science laboratories. In 1995 he became chairman of the
governors, his first task being to deal with the aftermath of the resignation of a disgraced headmaster.

Tony was a lay member of the council of University College London from 1983 to 1993, and he received an Honorary DSc from Southampton University in 2019 (figure 7). Throughout his career he acknowledged ‘guidance from a number of distinguished scientists—Maurice Hill, Teddy Bullard, Maurice Ewing and George Deacon’ (24).

**SAILING**

Tony had two great passions outside oceanography: sailing and music. His love of sailing was inspired by reading *Swallows and Amazons* as a boy, followed by sailing during family holidays at Coverack, Cornwall, from 1936 to 1939. Starting in a rowing boat, he soon learned to use an oar as a mast. During the war he and his brother repaired a broken dinghy they found, and he enjoyed small-boat training with the Navy. Post-war, he and his brother crewed in various larger boats. While living at Gerrards Cross he built his own Yachting World Cadet dinghy from scratch (not a pre-sawn kit). After several years at NIO he bought and restored a Lymington ‘Pram’ named *Tern*, followed years later by a Wayfarer, *Swallow* (24). He also sailed during visits to family in the USA.
Tony attributed his love of music to the influence of his parents. He was taken to children’s concerts with talks by Malcolm Sergeant. He began piano lessons at age five and achieved ‘a modest standard’ by his time at Marlborough (24). A turning point was his decision to learn the French horn in his first year there, an instrument for which he developed a life-long love. In 1941 his father bought him a Boosey piston-valved horn, which he had for the next 35 years. He later said that the Marlborough chapel and choir ‘triggered a love for music’ (24).

Tony played in orchestras at Marlborough and the Cambridge University Musical Society, rising to principal horn. He played at King’s, Downing and Trinity colleges, meeting Dennis Brain and Raymond Leppard and becoming friends with the latter, and was involved in other music groups at Cambridge. In 1949 Leppard invited him to the Bothampstead Music Camp, where Leppard, Colin Davis and Roger Norrington were among the conductors. The standard was very high, and Tony considered attending it as one of the highlights of his musical career. For several years he participated in ‘musical holidays’ at Porth-en-alls on the Lizard peninsula, where he had been invited to join an orchestra rehearsing with Jacqueline du Pré (24). Later he was conducted by Roger Norrington.

After starting at NIO, Tony joined the Woking Symphony Orchestra and played with them until 1975, becoming principal horn. For many years he played in the local Haslemere Musical Society, being chairman for five years and finally president. He also played in various chamber groups in the area, and for some years organized a wind quintet (including his wife Clare) that met at his home.

Tony kept a notebook of all his performances, which included pieces by Mozart (over 100 times), Beethoven (including the Mass and Ninth Symphony) and Brahms.

**PERSONAL LIFE**

In May 1957 Tony married Juliet Chapman, and in 1959 moved into his first house, ‘Little Leat’, in Hambledon, near NIO. His first son, Andrew, was born in May 1959. Juliet separated from him in March 1962 and they divorced that August.

In 1967 Tony met his second-wife-to-be Clare Bosanquet while on holiday in Northumberland. They married in March 1973. Their first daughter, Rebecca, was born in 1974 and second daughter, Susanna, in 1977. Tony bought his house, ‘Okelands’, in Chiddingfold near IOS in 1975 and lived there until his death.

Tony was an accomplished woodworker and handyman, having ‘inherited some of the skills’ from his grandfather and developed them at Abinger Hill School, in the Navy and on research ships. He had his own workshop (his ‘den’) at Okelands, where he rebuilt the decayed ‘magnificent’ 1920s greenhouse and made a new arched oak garden door (24). He and Clare also made their own cider, using apples from the more than 30 trees in the garden.

**HONOURS AND AWARDS**

**Degrees**

1952 BA, University of Cambridge (MA 1955)
1955 PhD, University of Cambridge
Anthony Seymour Laughton

Honorary degrees
2019 Honorary DSc, University of Southampton

Fellowships
1980 Royal Society
1991 Society for Underwater Technology

Knighthood
1987 Knight Bachelor, ‘for services to oceanography’

Other distinctions
1949 Glyn Prize, King’s College, Cambridge
1951 Harold Fry studentship, King’s College
1954 John Murray studentship, Royal Society
1958 Silver Medal, Royal Society of Arts
1980 Prince Albert I of Monaco Gold Medal
1987 Founders Medal, Royal Geographical Society
1988–1990 President, Challenger Society for Marine Sciences
1989 Murchison Medal, Geological Society of London
1995–1997 President, Society for Underwater Technology
1997–1999 President, Hydrographic Society

Acknowledgements
This memoir drew extensively and has much benefited from Tony’s personal, unpublished memoirs (24). I am grateful
for comments from Bob Whitmarsh, John Gould and Howard Roe.
The frontispiece portrait was provided to the Royal Society by the subject.

Author profile

Roger Searle
Roger Searle is a marine geophysicist and emeritus professor of
geophysics at Durham University. He worked with Tony Laughton
at IOS from 1973 to 1989. He has made extensive studies of mid-
ocean ridges (initially in collaboration with Tony), using sonar and
potential field techniques. From 1994 to 1996 he was chairman of
the international research organization InterRidge. He was awarded
the Royal Astronomical Society’s Price Medal in 2011 and elected
a fellow of the American Geophysical Union in 2012. In 2013 he
published the textbook *Mid-Ocean Ridges* (Cambridge University
Press).
Biographical Memoirs

References to other authors

Heezen, B. C. & Tharp, M. 1954 Physiographic diagram of the western North Atlantic. *Geol. Soc. Am. Bull.* **65**, 1260–1261.

Jeffreys, H. 1924 *The Earth: its origin, history and physical constitution*. Cambridge University Press.

Rusby, J. S., Dobson, M. R., Edge, R. H., Pierce, F. E. & Somers, M. L. 1969 Records obtained from the trials of a long range side-scan sonar (GLORIA Project). *Nature* **223**, 125–126. (doi:10.1038/223125b0)

Stride, A. H., Curry, J. R., Moore, D. G. & Belderson, R. H. 1969 Marine geology of the Atlantic continental margin of Europe. *Phil. Trans. R. Soc. Lond. A* **264**, 31–75. (doi:10.1098/rsta.1969.0003)

Bibliography

The following publications are those referred to directly in the text. A full bibliography is available as electronic supplementary material at http://dx.doi.org/10.1098/rsbm.2020.0021.

(1) 1954 (With M. N. Hill) Seismic observations in the eastern Atlantic, 1952. *Proc. R. Soc. Lond. A* **222**, 348–356. (doi:10.1098/rspa.1954.0078)

(2) 1956 Photography at 3000 fathoms. *Engineering* **182**, 738–740.

(3) 1957 A new deep-sea underwater camera. *Deep-Sea Res.* **4**, 120–125. (doi:10.1016/0146-6313(56)90042-9)

(4) 1960 An interplain deep-sea channel system. *Deep-Sea Res.* **7**, 75–88. (doi:10.1016/0146-6313(60)90013-7)

(5) 1963 Microtopography. In *Ideas and observations on progress in the study of the seas. The sea*, vol. 3 (ed. M. N. Hill), pp. 437–472. London: Wiley Interscience.

(6) 1966 A discussion concerning the floor of the northwest Indian Ocean - The Gulf of Aden. *Phil. Trans. R. Soc. Lond. A* **259**, 150–171. (doi:10.1098/rsta.1966.0004)

(7) 1967 Underwater photography of the Carlsberg Ridge. In *Deep-sea photography* (ed. J. B. Hersey), pp. 191–206. Baltimore: Johns Hopkins Press.

(8) 1970 (With R. B. Whitmarsh & M. T. Jones) The evolution of the Gulf of Aden. *Phil. Trans. R. Soc. Lond. A* **267**, 227–266. (doi:10.1098/rsta.1970.0035)

(9) 1971 South Labrador Sea and the evolution of the North Atlantic. *Nature* **232**, 612–617. (doi:10.1038/232612a0)

(10) 1972 (Editor, with W. A. Berggren, R. N. Benson et al.) *Covering Leg 12 of the cruises of the drilling vessel Glomar Challenger, Boston, Massachusetts to Lisbon, Portugal June 1970. Initial reports of the Deep Sea Drilling Project*, vol. 12. Washington, DC: US Government Printing Office. (http://deepseadrilling.org/12/volume/12dsdp.pdf)

(11) 1973 (With R. B. Whitmarsh, J. S. M. Rusby, J. Revie & B. S. McCartney) A continuous east–west fault on the Azores-Gibraltar Ridge. *Nature* **237**, 217–220. (doi:10.1038/237217a0)

(12) 1975 *General bathymetric chart of the oceans: sheet 5.05*. Ottawa: Canadian Hydrographic Service.

(13) 1976 (With D. G. Roberts & R. Graves) Bathymetry of the northeast Atlantic: Mid-Atlantic Ridge to southwest Europe. *Deep-Sea Res.* **22**, 791–810 plus Admiralty Chart C6568 (doi:10.1016/0011-7471(75)90084-4)

(14) 1977 (With J. S. M. Rusby) Long-range sonar and photographic studies of the median valley in the FAMOUS area of the Mid-Atlantic Ridge near 37N. *Deep-Sea Res.* **22**, 279–298. (doi:10.1016/0011-7471(75)90070-4)

(15) 1978 (Editor, with G. B. Udintsev et al.) *International Indian Ocean Expedition geological-geophysical atlas of the Indian Ocean*. Moscow, USSR: Academy of Sciences, USSR, Main Administration of Geodesy & Cartography.

(16) 1979 (With R. B. Whitmarsh) A long-range sonar study of the Mid-Atlantic Ridge near 37N (FAMOUS area) and its tectonic implications. *Deep-Sea Res.* **23**, 1005–1023. (doi:10.1016/0011-7471(76)90877-9)
(18) 1981 The first decade of GLORIA. *J. Geophys. Res.* **86**, 1511–1534. (doi:10.1029/JB086iB12p11511)

(19) 1985 GLORIA survey of the Pacific EEZ of the United States. In The second International Hydrographic Technical Conference: Plymouth, 3–7 September 1984 (ed. P. B. Beazley), *Marine Policy* **9**, 78–79. (doi:10.1016/0308-597X(85)90084-3)

(20) 1986 (Editor, with L. E. S. Roberts & D. Wilkinson) The disposal of long-lived and highly radioactive wastes. *Phil. Trans. R. Soc. Lond.*, A **319**, 1–189. See https://royalsocietypublishing.org/cms/attachment/c701686a-914a-4642-99af-1c8a414200fe/front.pdf.

(21) 2003 Scientific Committee on Oceanic Research (SCOR): Working Group 41 Morphological Mapping of the Ocean Floor. In *The history of GEBCO 1903–2003*, pp. 91–94. Enschede, The Netherlands: GITC.

(22) 2005 (With T. Spencer & N. C. Flemming) Variability, interaction and change in the atmosphere–ocean–ecology system of the western Indian Ocean. *Phil. Trans. R. Soc. A* **263**, 3–13. (doi:10.1098/rsta.2004.1495)

(23) 2010 (Editor, with J. Gould, T. Tucker & H. Roe) *Of seas and ships and scientists*. Cambridge, UK: Lutterworth Press.

(24) 2013 Not all at sea: an oceanographer remembers. Unpublished memoir.