BRITAIN'S SCIENTIFIC SHRINES (5)

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SCOTLAND

FOR carrying the survey of Britain's scientific shrines into Scotland, the plan adopted for the English counties is scarcely applicable, for some of Scotland's largest counties are the most sparsely populated, while for the greater part the homes and haunts and memorials, if not the birthplaces, of notable Scottish men of science are to be found in her university towns. The story of science in Scotland centres around her universities far more than is the case in England, and Scotland presents few parallels to the careers of such as Gilbert, Hales, Priestley, Jenner, Cavendish, Herschel, Dalton, Joule and Darwin. Some of England's most eminent men of science, owing to the religious tests, never entered Oxford or Cambridge, and were debarred from holding professorships in them. But in Scotland, with her educational traditions handed down from the days of John Knox, any student who could fend for himself on a meagre ration found the doors of the universities open, and, after the Reformation, the religious question seems to have shut them against very few. In attempting in a brief, and admittedly inadequate, sketch to recall to the reader some of those whose names are inscribed on the rolls of honour in science in Scotland, some part of the story of the universities must inevitably form the background.

Of the four Scottish universities, those of St. Andrews, Glasgow and Aberdeen came into existence before the Reformation, and that of Edinburgh just after; and their fortunes were affected not only by the struggles between Catholics and Protestants but also by the constant disputes between rulers, nobles, chieftains and clans, all of which were accompanied by much disorder. Recalling the circumstances, the impoverished state of the country, and the smallness of the population, it is not a little surprising that the universities managed to exist at all. In one of his many studies of the social history of Scotland, the Rev. H. G. Graham (1842–1906) said that even by 1650, after the Crowns of England and Scotland had been united, the total population of the country was only about 900,000, while the inhabitants of Glasgow numbered about 10,000, those of Aberdeen some 6,000, and those of St. Andrews a mere 1,500. One of Mr. Graham's essays was entitled "Glasgow University Life in Olden Times", in which he gave a striking picture of the hard and penurious life of both teachers and taught. Here, as elsewhere, the religious upheaval had its baneful effects on the young university, and with the coming of the Reformation, wrote Mr. Graham, "away fled Popish churchmen, students and masters, and when we see the august University once more all that is left of it consists of twelve individuals: a principal, three regents, four poor students, the principal's servant, an œconomus, a cook and a janitor. To such a miserable remnant are the functions and privileges left, with a meagre revenue of £25 yearly." From this deplorable state of things the University was rescued by the reformer and universal scholar, Andrew Melville (1545–1622 ?), who in 1574 at the age of twenty-nine, constituting the whole teaching staff in himself, lectured on Greek, Hebrew, Chaldee, Syriac, philosophy, physics, logic, rhetoric and chirology, and soon filled his rooms with students. In 1580 Melville returned to St. Andrews; but he had put the University of Glasgow on its feet again and by 1631 the half-ruined houses and tenements sheltering both professors and students were being replaced by the College in the High Street, which was destined to see the labours of a long line of distinguished men, including Adam Smith, Cullen, Black and their great successors, Thomas Graham, Rankine and Lord Kelvin. The ancient cathedral, in a part of which the University first met, still stands majestically at the top of the High Street, and at the foot of the hill the visitor can stroll through Glasgow Green, where on one Sunday afternoon in 1765 James Watt, pondering over the working of the University's model Newcomen engine, conceived the idea of a separate condenser. But all traces of the College which served the University for more than two centuries have been swept away, though some fragments of its masonry are incorporated in the Gatehouse at Gilmorehill.

With such a curriculum as that of Melville there was little room for mathematics; but it is worth noting that Melville's career coincided almost exactly with that of John Napier (1550–1617), who in the seclusion of Merchiston Castle, near Edinburgh, spent the greater part of his life in study and gave to the world his famous work on logarithms. He, like Melville, had studied at St. Andrews, and spent some time on the Continent, before marrying and settling down in his ancestral home. Ball says of him that "the business of his life was to show that the pope was anti-Christ but his favourite amusement the study of mathematics and science". It may be presumed that to-day no one reads Napier's commentary on the Apocalypse, but logarithms are in use all the world over. His famous book, "Mirifici Logarithmorum Canonis Descriptio", was published in 1614, and its tercentenary was the occasion of a notable commemoration by the Royal Society of Edinburgh, presided over by Lord Moulton, "a distinguished mathematician before he was a great lawyer". In his inaugural address, Lord Moulton said that though every fact known about Napier had become commonplace, it "left the man very imperfectly disclosed, but sufficed to show him strong and self-reliant, of solitary habits, of profound and untiring industry . . .", while "the invention of logarithms came on the world as a bolt from the blue. No previous work had led up to it, nothing had foreshadowed it or heralded its arrival. It stood isolated, breaking in upon human thought abruptly without borrowing from other workers or following known lines of thought." There were many other contributions to the tercentenary commemoration, which were all published in a special volume edited by Dr. C. G. Knott, a member of the staff of the University of Edinburgh, which was founded when Napier was engrossed in his studies at Merchiston Castle. Napier died on April 4, 1617, and was buried in the old church of St. Cuthbert. Among the memorials to him is his statue, which stands beside those of John Hunter, James Hutton, Sir Henry Raeburn and others in the Scottish National Portrait Gallery.

The next important figure in the history of science in Scotland is that of James Gregory (1638–75), who

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was educated in the University of Aberdeen and held the chair of mathematics first at St. Andrews and then at Edinburgh. The University of St. Andrews was founded in 1411 by Bishop Henry Wardlaw, that of Glasgow was founded in 1451 by Bishop Turnbull on a bull issued by Pope Nicolas V, a great patron of art and literature, while that of Aberdeen was founded in 1494 by Bishop William Elphinstone on a bull issued by Pope Alexander VI, who has been described as the most profligate prelate who ever sat on the apostolic throne. Whatever Alexander's misdeeds, Aberdeen benefited by his sanction for the establishment of its University, and it was not long before the present King's College was built, to be followed about a century later by Marischal College, founded in 1593 by George Keith, the Earl Marischal of Scotland. The present Marischal College dates only from 1906, when it was opened by King Edward VII.

Among those who were educated at King's College was Dr. Duncan Liddel (1561–1613), to whom Aberdeen owed its first chair of mathematics. A native of Aberdeen, Liddel spent the years 1579–1607 at various places in Germany, studying and teaching philosophy, medicine and mathematics, and making the acquaintance of Tycho Brahe. Returning home in 1607 with a comfortable fortune, he gave land to the University of Aberdeen and before his death made provision for founding a chair of mathematics at Marischal College. His death took place on December 17, 1613, and a memorial to him was placed in St. Nicolas Church. It was about forty years after Liddel's death that James Gregory became a student at Marischal College, and it was at Aberdeen he published his treatise on optics and invented the Gregorian form of reflecting telescope. He further increased his reputation by his visits to London and to Padua, and on June 11, 1663, was elected a Fellow of the Royal Society. Soon after this he was made professor of mathematics at St. Andrews, and in 1674 he was elected the first exclusively mathematical professor in the University of Edinburgh. His inaugural address was delivered in November 1674. Eleven months later, while showing his students the satellites of Jupiter, he was struck blind and died three days later at the age of thirty-six. He had, however, already done enough to give him a place among the immortals, and in 1938 both St. Andrews and Edinburgh joined in commemorating the tercentenary of his birth.

But James Gregory was only one of a remarkable family of men of science, members of which for two hundred years held professorships in one or other of the Scottish universities. They were the Bernoullis of Scotland. The founder of the family was David Gregory, minister of Drumoak, near Aberdeen, and from his two sons David (1627–1720) and James (1638–75) the dynasty descended. Science seems to have been in their blood, and one of them belonging to the sixth generation, Duncan Farquharson Gregory (1813–44), a Cambridge wrangler and the first editor of the *Cambridge Mathematical Journal*, appears to have been cast in the very same mould as his famous ancestor James. Omitting much that is of interest, a word or two should be said about the third David Gregory (1661–1708), one in a family of thirty-two children, because in 1683 he was elected to the chair previously held by his uncle; secondly, because he was the first in Edinburgh to teach the Newtonian philosophy; and thirdly, because he was the first Scottish mathematician to occupy a chair in an English university, being appointed in 1691 Savilian professor of astronomy at Oxford. That his influence was felt far outside Edinburgh is shown by Whiston, who in his memoirs said that in his own study of the "Principia" he was "greatly excited thereto by a paper of Dr. Gregory's when he was professor in Scotland wherein he had given the most prodigious commendations to that work, as not only right in all things, but in a manner the effect of a plainly divine genius, and had already caused several of his scholars to keep acts, as we call them, upon several branches of the Newtonian philosophy; while we at Cambridge, poor wretches, were ignominiously studying the fictitious hypotheses of the Cartesian, which Sir Isaac Newton had also himself done formerly . . .". Among Gregory's students who had "kept the acts" was John Keill (1671–1721), who accompanied his instructor to Oxford, opened at Hart Hall the first course of lectures in the new philosophy given in the University, and afterwards was given the Savilian chair of astronomy. In a previous article, mention has been made of David Gregory's monument at Maidenhead. His successor's tomb is in St. Mary's Church, Oxford.

The progress of scientific studies in Scotland in the seventeenth and eighteenth centuries and the outlook of her men of science were affected by many causes. With the union of the Crowns of England and Scotland in 1603 and the union of their Parliaments a century later, together with the diminution and disappearance of internal strife in both countries, came a loosening of the bonds between Scotland and France, and an increase in the intercourse between north and south of Britain with advantage to both. With London as the capital of the united kingdoms, it was only natural for the more adventurous to seek their fortunes in it, and from the early eighteenth century onwards Scottish men of science are found in ever increasing numbers taking their place in the scientific institutions of the capital. The very first president of the Royal Society was the Scotsman Sir Robert Moray, and among his successors in the eighteenth century were the Earl of Morton and Sir John Pringle. Pringle, like Moray, Watt, Telford, John Hunter, Baillie, Simpson, Lyell, Kelvin and Ramsay, is among the Scottish men of science buried or commemorated in Westminster Abbey.

It is generally admitted that in the eighteenth century the study of mathematics made little progress in England. It was much the same in Scotland, although in Colin Maclaurin (1698–1746) Scotland had one of the first mathematicians of the day, and his death in the Archbishop of York's Palace through illness brought on by his exertions in organizing the defences of Edinburgh against the Jacobites in 1745 was a very great loss. Maclaurin was much interested in astronomy, and had encouraged his pupil James Short (1710–68), the famous London telescope maker; but on the whole astronomy attracted few Scottish students. There was, however, much greater activity in the realms of chemistry and physics, which, like botany, were regarded as the handmaids of medicine, and were studied as such and not as separate sciences to be pursued for their own worth. Almost without exception, teachers in the Scottish universities possessed a medical degree, and it was as a great centre of medical education that Edinburgh became famous. On this matter there are many interesting notes in a paper by Mr. J. N. J. Hartley, entitled "The Early History of the Museum of the Royal College of Surgeons of Edinburgh", and published in the *Edinburgh Medical Journal* of 1948.

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Mr. Hartley is the conservator of the museum housed in Surgeons' Hall, and in the course of his remarks he gives particulars of some of the many teachers and schools of medicine and anatomy, referring especially to the first Alexander Monro (1697–1767) or Alexander Monro "*Primus*", who was appointed in 1720 by the Town Council to be the first professor of anatomy in the University. Of this distinguished man, Sir Alexander Grant wrote: "he was not only the Father of the Edinburgh Medical School, but also the first professor of any kind who drew great attention to the University of Edinburgh from without and gave it the beginnings of its celebrity".

It was while Monro was thus adding to the reputation of Edinburgh that the University of Glasgow became almost as famous, partly through the work of William Cullen (1710–90) and Joseph Black (1728–99). A biography of Black was the last book written by Sir William Ramsay. In it is an illustration of the old College in the High Street, in which, Black lived and worked, and reproductions of Kay's portraits of Cullen, Black, Adam Smith and James Hutton. Cullen was the first to teach chemistry at Glasgow as a separate subject, he was the first to lecture in the vernacular instead of Latin, and in 1755 at Glasgow he published his fruitful essay on "Cold produced by Evaporating Fluids". From 1746 onward the careers of Cullen and Black were linked together, for Black was Cullen's pupil and his successor in the chair of chemistry at Glasgow in 1756, and again in the chair of chemistry at Edinburgh ten years later.

Though Black lived to the age of seventy-one and came to be regarded as the Nestor of British chemists, his two great discoveries of the nature of 'fixed air' and the doctrine of latent heat were made while he was a young professor at Glasgow. Among other men of science associated with Glasgow in the eighteenth century were Dr. Robert Simson (1687–1768), professor of mathematics for nearly fifty years, whose "Elements of Euclid" formed the basis of numerous editions; John Anderson (1726–96), the somewhat litigious professor of natural philosophy, who sent a gun to Paris as evidence of his sympathy with the French Revolutionaries, and who by his will founded the famous Andersonian Institution, now incorporated in the Royal Technical College, Glasgow; Alexander Wilson (1714–86), who while engaged in typefounding became Glasgow's first professor of astronomy; Thomas Melvill (1726–53), the young divinity student who with Wilson recorded the temperature of the upper air by means of kites, and was the first to use a prism for examining the effect of introducing salts into the flame of burning spirits; John Robison (1739–1805), the close friend of Watt, who during 1774–1805 was professor of natural philosophy at Edinburgh; and William Irvine (1743–87), who held the chair of chemistry at Glasgow during 1770–87. In the story of Scotland's heritage of science, all these Glasgow worthies hold an honourable place.

Black's removal to Edinburgh occurred at a time when, in the words of Sir Archibald Geikie, "the Scottish capital had not yet begun seriously to suffer from the centripetal attractions of London. It was the social centre of Scotland, and retained within its walls most of the culture and intellect of that ancient kingdom." At Edinburgh, Black not only found his old master Cullen but also the philosopher Adam Ferguson (1723–1816), then professor of "pneumatics and moral philosophy", and Matthew Stewart (1717–85), the professor of mathematics. To Edinburgh in 1768 came the farmer–manufacturer–naturalist James Hutton (1726–97), to devote himself to scientific pursuits and to gain for himself a place among the giants of the heroic age of geology. These famous men were afterwards joined by John Playfair (1748–1819), preacher, writer, geologist and natural philosopher, who introduced the works of the French mathematicians into Scotland; Daniel Rutherford (1749–1819), the professor of botany who discovered nitrogen; and the wealthy landowner Sir James Hall, Bart. (1761–1832), of Dunglass, like Playfair an enthusiastic supporter of Hutton's views and himself the founder of experimental geology. In the whole range of science there were no more admirable characters than Hutton and Playfair. Of Hutton, Geikie wrote: "His character was distinguished by its transparent simplicity, its frank openness, its absence of all that was little or selfish, and its overflowing enthusiasm and vivacity"; while Dugald Stewart in his sketch of Playfair wrote: "Independently, in short, of his high attainments, Mr. Playfair was one of the most amiable and estimable of men: delightful in his manners, inflexible in his principles and generous in his affections, he had all that could charm in society or attach in private".

In Edinburgh in the eighteenth century, as elsewhere, there were clubs and convivial gatherings of writers, artists, lawyers and others, and it was from one of these, the Philosophical Club, formed in 1739, that sprang the Royal Society of Edinburgh, inaugurated in 1782, with John Robison as one of its secretaries. A few years before this, in 1776, Edinburgh had seen the laying of the foundation stone of the observatory on Calton Hill, which has in turn belonged to the City and to the Government and again to the City. It has seen many ups and downs, has often suffered from neglect—even as a Royal observatory—but after being reconditioned was taken over by the Astronomical Society of Edinburgh in 1938 and in October of that year was formally reopened by the late Sir James Jeans. Under the inspiring directorship of Mr. N. S. Matthew, it is now widely used for educational purposes.

Edinburgh's first official astronomer appears to have been the naval surgeon Dr. Robert Blair, who in 1783 was appointed professor of practical astronomy. His appointment came about in a very unusual manner. In 1782 Blair was serving in the West Indies in H.M.S. *Resolution*, in which on January 23, 1782, Captain Lord Robert Manners died of wounds received some months before. Now Manners was a son of the famous Marquess of Granby who had fought at Culloden, and a brother of Charles Manners, fourth Duke of Rutland, who was well known in government circles. Blair's devotion to his captain becoming known, the family, wrote Dr. John Doran in his "Memories of our Great Towns", "With generous alacrity importuned the Government to do something for him, and at their solicitation the Crown actually founded for Blair a Professorship of Practical Astronomy in the University of Edinburgh! The naval surgeon and physician had seen enough of the stars to know Orion's belt from Charles' Wain; but had he been ignorant of both it would not have much mattered, as the Astronomical Professorship was a sort of nominal office, without any charge. But if Dr. Blair was not a practical astronomer he was an experimental philosopher of great repute and his experiments and observations on the refrangibility of light excited considerable interest in his own

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day. . . ." Blair continued to hold his office until his death on December 22, 1829, at Westlock, Berwickshire. For a few years after this, the chair of astronomy remained vacant, but in 1834, shortly after his return home from South Africa, Thomas Henderson (1798–1844), the advocate's clerk who had risen to be the Astronomer Royal at the Cape, was appointed to it, and about the same time was given charge of the Calton Hill Observatory and made Scotland's first Astronomer Royal. Henderson's immediate successor was Charles Piazzi Smith (1819–1900), who was born at Naples and had the Italian astronomer Giuseppe Piazzi as his godfather, and he in turn was followed by Ralph Copeland (1837–1905), who superintended the building and equipment of the new Royal Observatory at Blackford Hill, made possible by the generosity of the Earl of Crawford.

Of greater importance to learning in Edinburgh than the erection of the Calton Hill Observatory was the building of the "New College of Edinburgh", the foundation stone of which was laid in the fateful year 1789. Unlike those of Glasgow, St. Andrews and Aberdeen, the University of Edinburgh owed nothing to bishops and popes, for its original college was opened by the Town Council and given university status by James VI, afterwards James I of England. Its constitution differed from those of the other universities, and in many matters, even in the appointment of professors, the Town Council held the control. This lasted until the University gained its independence by statute in 1858. The new College was not erected before it was needed, for its principal, the historian William Robertson, had written in 1768 that "a stranger when conducted to view the University of Edinburgh might, on seeing such courts and buildings, naturally enough imagine them to be almshouses for the reception of the poor . . ."; while twenty years later, a writer in the *Scots Magazine* said that "the buildings of the University are in the same ruinous condition that they were in 1768 and the most celebrated University at present in Europe is the worst accommodated".

With the completion of the new College fresh faces appeared among the staff, and the lecture rooms became even more crowded. Black's death in 1799 had left open the way for his deputy, the botanical professor's son, Thomas Charles Hope (1766–1844), who had held the chair of chemistry at Glasgow and had learnt something of the new chemistry direct from the lips of Lavoisier and Berthollet. For forty-three years he lectured and experimented, and it is recorded that at one time his students numbered 575, while the total number who had listened to him was something like 16,800. There was nothing like this in the English universities. His famous colleague, John Leslie (1766–1832), who was born in the same year as Hope, had abandoned a career in the Church for science, had travelled on the Continent and in the United States and had become known for his experiments in radiation before succeeding Playfair in 1805 in the chair of mathematics, which he exchanged for that of natural philosophy in 1819. His first appointment, owing to something he had said about cause and effect, led to an unfortunate controversy, in the course of which Sir Joseph Banks, the president of the Royal Society, wrote to Leslie sympathizing with him and adding: "Surely a man may fulfil his duty to his Creator without assenting unconditionally to every undigested tenet which our half-informed predecessors have left behind as a legacy to their more enlightened posterity. If it has pleased God to permit his creatures to increase in wisdom He will not condemn them for assenting to new opinions which their reason demonstrates to be just." Leslie was knighted at about the same time as Brewster, John Herschel and Charles Bell, and died on November 3, 1832. It was some time before the youthful James David Forbes (1809–68) was appointed to succeed him, and for a few months the natural philosophy lectures were given by John Scott Russell (1808–82), afterwards a famous naval architect. Another of the new professors was William Wallace (1768–1843), who held the chair of mathematics from 1819 until his retirement in 1838, when the Town Council paid Cambridge a compliment by choosing as his successor the Rev. Philip Kelland (1808–79), a Somerset curate's son who had been senior wrangler and first Smith's prizeman. Kelland proved unequalled as a teacher, and he died while president of the Royal Society of Edinburgh.

In such a sketch as this it would be only proper to include a mention of some of the famous Scottish inventors and engineers of the time, such as Watt, Telford and Rennie; William Murdoch, Sir William Fairbairn and James Nasmyth; Henry Bell and William Symington, the pioneers of the steam boat; the Napier family of marine engineers and the Stevenson family of lighthouse builders, but space does not permit more. In view, however, of the approaching meeting of the British Association in Edinburgh, it is only appropriate to conclude by recalling the part played by Scottish men of science in its formation.

The story of the British Association was told in its official history published in 1921; but many more details are to be gleaned from such works as the "Home Life of Sir David Brewster" (1869), "The Life and Letters of James David Forbes" (1873) and other memoirs. It was Brewster and Forbes together with John Robison (1778–1843), the wealthy son of the natural philosopher, and the soldier-administrator-astronomer Sir Thomas Makdougall Brisbane, Bart. (1773–1860), who were prominent in founding the Association; and they were among the Scottish contingent who, with their English and Irish supporters in September 1831, by coach or chaise, on horseback or foot, converged on York for the inaugural and epoch-making gathering. At York the founders received a warm welcome from the Yorkshire Philosophical Society, finding in the keeper of its Museum, John Phillips (1800–74), a most willing secretary; in the Rev. William Vernon Harcourt (1789–1871) a far-sighted vice-president, and in his father, the Archbishop of York, a graceful host. From the Archbishop's Palace at Bishopthorpe, at one in the morning of September 30, after a lecture by Scoresby on magnetism, Brewster wrote that "the assemblage of beauty, fashion, and philosophy was really splendid . . .", while "the Archbishop has invited fifty or sixty of the philosophers to dine here to-morrow, among whom are Sir T. Brisbane, Thos. Allan and the rest of our Scotch party. . .".

In 1832 the newly formed Association met at Oxford and in 1833 at Cambridge; and then, largely through Forbes, at Edinburgh with Sir Thomas Brisbane as president and Robison as local secretary. Some supporters had suggested Dublin, but Forbes would have none of this and wrote to Brisbane in 1833: "It appears to me that it is little short of the duty of the Royal Society [of Edinburgh] to convey to the meeting of the British Association an invitation to make Edinburgh the place of their next meeting. . . . It has always been considered that the origin

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of the Society was in a great measure Scottish, and Sir D. Brewster, Mr. Robison and yourself have always been looked upon as its founders. . . ." A copy of this letter he sent to Sir Roderick Murchison, saying: "My dear friend, you are a Scotsman, and though a deserter, you should not quite desert what is due to your country. Only look back and remember what Scotland did for the Association. . . ." Forbes had his way. The meeting was successful and he had the pleasure of entertaining Whewell, Peacock and Vernon Harcourt, of the last-named of whom he wrote, "I learn every year to look with more admiration and affection on that remarkable man". Brisbane, whose name is perpetuated by the capital of Queensland, it may be added, died at his birthplace, Brisbane House, Largs, at the age of eighty-six, and Brewster died at the same age at Allerly, Melrose, but Forbes died at Clifton at the age of fifty-nine. Forbes's grave is in the Dean Cemetery, Edinburgh, and that of Brewster in the grounds of Melrose Abbey.

RESEARCH IN OCEANOGRAPHY

THE sea, covering as its does three-quarters of the surface of the earth, presents unnumbered problems to whet intellectual curiosity and adventure, while economic and utilitarian motives for its scientific study are also pressing. Marine biology has always been actively pursued; in earlier days largely by amateurs and latterly by professionals at a number of well-equipped and well-staffed marine laboratories. Since zoology cannot be studied without regard for marine species, the universities of Britain have always fostered and, no doubt, always will foster, marine research on a considerable scale. Fewer botanists have found such interest in the plants of the sea. Economic stimulus has stimulated investigation of the shore seaweeds, and a research association now exists for this purpose alone.

Fundamental marine zoology has found its economic counterpart in fisheries research undertaken by the Laboratories at Lowestoft and Aberdeen, both full of vigour and ideas. These laboratories have had to study not only fish but also the food of fish and the waters which nourish and transport it. Study of the invertebrate fauna of the sea and the sea bed is in a healthy state; so is the physical and chemical study of the waters which fill the shallow seas frequented by fishing vessels. A re-deployment of effort is in progress; more hands would provide quicker results, but, in relation to the scientific man-power of the country, the staff available, especially in quality, is reasonable.

The Antarctic has become one of the best known of the major oceans by the tireless work of the Discovery Committee and its ships and staff, the contributions of which both to marine biology and to physical oceanography have been great. None the less, the motive for all their work has been economic —to provide a scientific foundation for the whaling industry. There have been huge fields of physical investigation which were neither proper for their study nor could they be undertaken with their limited staff. The entire expenses of the Discovery Committee have been met by the Government of the Falkland Islands from a cess levied on all whales processed in the Falklands or their territorial waters. Great Britain's contribution has been a negative one—revenue derived by taxation of the staff who live here.

Investigations to secure safer navigation have always been and remain the concern of the Hydrographer of the Navy. There was a time when the British Hydrographic Office unaided charted the seas of all the world. To-day the Admiralty's fleet of survey ships forms only a part of the survey fleet of the world, but the quality of its work ranks as high as ever. Tidal investigations flourish both at the Admiralty and at the Liverpool Tidal Institute, the annual report* of which has just been published.

Theoretical investigations of much importance, especially in hydrodynamics, have been made by a few gifted free-lances in the universities, but physical oceanography has been ill organized. Apart from nuclear physics, oceanography is probably the most expensive of all scientific techniques, so that there has been little opportunity for experimental physical investigation or for deep-sea research. Submarine geology and geophysics are in the hands of a few men at a single university, who have had to borrow ships when needed as best they could.

At a meeting of the Scientific Advisory Committee of the War Cabinet in January 1944, Vice-Admiral Sir John Edgell, then Hydrographer of the Navy, expressed the view that Great Britain, in its contribution to research in oceanography, had fallen seriously behind other countries, and suggested that a British oceanographical institute should be set up without delay. Inquiry showed that there was a considerable body of opinion in favour of concentrating the efforts upon physical studies, which had been neglected as compared with marine biological research. However, the Scientific Advisory Committee considered that the work of the proposed institute should embrace both physical and biological oceanography. In July 1946, the Colonial Office raised the question of the future of the Discovery Investigations. This matter was considered by various government departments interested and by the Advisory Council on Scientific Policy in conjunction with the earlier proposals, and as a result the National Oceanographic Council and the National Institute of Oceanography came into being (see *Nature*, March 17, p. 415). The steps leading to the formation of the Institute are indicated in its first annual report†.

The National Institute, with Dr. G. E. R. Deacon as first director, has taken over the Oceanographic Group of the Royal Naval Scientific Service at the Admiralty Research Laboratory at Teddington, and also the Discovery Investigations, which had ceased to be the responsibility of the Falkland Island Dependencies on March 31, 1949; the Institute is also gradually taking over part of the work of the Oceanographical Branch of the Hydrographer of the Navy. The R.R.S. *Discovery II* and R.R.S. *William Scoresby* were purchased by the Admiralty from the Government of the Falkland Islands Dependencies and presented to the Institute. The shore work of the Institute remains dispersed among five establishments in the London area and one in Cornwall. The very desirable concentration under the director in one place remains to be achieved.

Both the research vessels were under requisition during the War, and their equipment in store was destroyed by enemy action. Both ships have needed extensive refitting and re-equipment before resuming

* Liverpool Observatory and Tidal Institute: Annual Report, 1950. Pp. 16.

† Annual Report of the National Institute of Oceanography 1949–50. Pp. 48. (Cambridge: At the University Press, 1951.) 5s. net.

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