

or report in the summer of 1930. In the early summer of 1931 the Council published a Report which included subscriptions received up to 22 April 1931. In the text of this report it is spoken of as 'the first'. The next report was published in June 1932 but was not formally numbered; it reports the incorporation of the Association as a limited liability company on 3 March 1932. A year later, in 1933 another report appeared; this was later designated the 'First Annual Report', although it was, in fact, the third; perhaps this was because it was the first one to report a full year's activity since legal incorporation. The fourth report, published in 1936 was the first one to be formally numbered on the cover; it has initiated the system of numbering for all subsequent reports. Thus this report for the year ending on 31 March 1979 is labelled the 47th Annual Report, but is in reality, the forty-ninth and will be published at about the time that the Association celebrates its fiftieth birthday - there having been no report until the Association was 22 months old.

E. D. Le Cren.

REVIEW ARTICLES

THE FIRST FIFTY YEARS OF THE FRESHWATER BIOLOGICAL ASSOCIATION

E. D. LE CREN

INTRODUCTION

Though this *Annual Report* is not labelled the fiftieth, by the time it appears the Association will have been in existence for fifty years. It is thus a suitable occasion to look back and trace some of the history of the Association, especially the events that led up to its foundation and its early development. This article will deal in much more detail with the first twenty-five years than with the period since 1954. I have used as sources of information the early annual reports, minutes of the Council and Committees and some correspondence between members of the Executive Committee. I have also been aided by an account of early history by Fritsch (1937) and some notes compiled by H. C. Gilson. Unfortunately it has not been possible to include all the interesting and significant events, nor the very many amusing incidents that accompanied the informal and somewhat carefree early days.

Conception

In September 1896, D. J. Scourfield read a paper to Section D of the British Association entitled 'Wanted, a British Fresh-Water Biological Station'. In this paper (Scourfield 1897) he showed the need for an institute devoted to limnology and freshwater biology in Britain, analogous to those already in existence in continental Europe. The next year the same journal published a similar paper by A. Fritsch of Prague which ended with the hope that '... we on the Continent may soon hear that your wealthy country has done her duty by fresh-water biology'. A freshwater biological station had already been mooted for the Norfolk Broads and by 1903 a small private laboratory was operating on Sutton Broad with W. A. F. Balfour-Browne as its director and R. Gurney as a full-time researcher, but this laboratory never developed much further. At the end of the first world war there were efforts to expand commercial fisheries in fresh waters, especially in the larger lakes in Ireland. The Development Commission followed this up in 1920 by providing finance for the Irish Department of Agriculture and Fisheries to establish a laboratory on Lough Derg. This was in existence for three years from the spring of 1920, for most of which time R. Farran and A. C. Gardiner were its scientific staff. The laboratory had a base in a small building on an island in the River Shannon; the staff had two houseboats, on one of which they lived, two motor boats and assistant staff. They made some good observations on plankton and fish, but the laboratory was isolated and the time one of political turmoil in Ireland, so longer-term development was not possible.

In the 1920s the English Ministry of Agriculture and Fisheries had a small laboratory at Alresford in Hampshire which was also a base for surveys on the rivers Lark and Tees. F. T. K. Pentelow, a young member of the staff, wrote letters in 1926 to J. T. Saunders and C. F. A. Pantin in Cambridge suggesting that an independent 'Freshwater Biological Association' might start a small laboratory on the MAF Alresford site. Naught came of this, but it had the support of E. S. Russell.

F. E. Fritsch (no relation of the A. Fritsch in Prague) had also made a plea for work on freshwater algae and an inland biological station, in a paper on the phytoplankton of the Thames in 1902. In 1927 Fritsch was President of Section K of the British Association and in his Presidential Address at Leeds on the Protophyta he spoke strongly of the need for a British freshwater laboratory (Fritsch 1927). As a result of this the British Association organized for the meeting in Glasgow the following year (1928) a joint discussion between Section D (Zoology) and K (Botany) on researches in freshwater biology. This meeting was very well attended and lively. As a result the B.A. set up an *ad hoc* committee, with Fritsch as Chairman, 'to enquire into the steps to be taken to establish a freshwater biological station'. The committee met in December 1928 and soon agreed to recommend the formation of a freshwater biological association modelled on the Marine Biological Association of the U.K., which had already been in existence since 1882. This B.A. committee, having reported, disbanded, but then reconstituted itself as a planning committee for the FBA and on 30 January 1929 it wrote a letter to *The Times* setting out its ideas. It drew up a draft Memorandum of Association and Articles, solicited support from a number of academic and amateur biologists, and then convened a meeting in the rooms of the Linnean Society for 11 June 1929.

This meeting was attended by twenty-six people who took thirty-five minutes to agree (a) to the proposal to found a Freshwater Biological Association, (b) to the draft Memorandum and Articles and (c) to the election of the officers and Council. (This first meeting seems to have been a good example of the excellent ground work that has expedited most subsequent FBA business meetings!) A Council of sixteen was elected, which then met and elected a further fifty-nine members; so the Association began with a membership of eighty-five. Fritsch was elected Chairman, Scourfield Acting Treasurer, Balfour-Browne Secretary, and Lord Rothschild, President.

Embryology

One of the tasks of the new Council was to register the Association with the Board of Trade as a non-profit-making Company without share capital. In fact, this was not achieved until 3 March 1932. After protracted negotiations the Council were able to retain nearly all the

features they had incorporated into their draft Memorandum and Articles and to obtain a licence to omit the word 'Limited' from the title, although the Association is a limited liability company.

The major work of the Council and its Executive Committee of F. E. Fritsch, D. J. Scourfield, W. A. F. Balfour-Browne, J. T. Saunders and W. H. Pearsall, during the next twenty-seven months, was to obtain support and finance to start a research laboratory. The support of academic and some keen amateur biologists was relatively easy to obtain, but the Committee realized from the start that they would also need the support of those with practical interests in fresh water and of the government. They approached Dr Bourne, Director of the Water Pollution Research Board, to join the Council and invited the 2nd Lord Rothschild to be the Association's President. The Fishmongers' Company were asked for support and angling interests were canvassed through R. Beddington. The Fishmongers' Company lent their hall for a public meeting on 21 February 1930 to which sixty-four organizations were invited to send members. Lord Rothschild presided over this meeting, a record of which was subsequently printed. Fritsch spoke, explaining the aims of the Association and its ideas for a research station, as well as the ways in which basic research in biology could assist in the solving of practical problems in the management of fresh waters. There was much support on all sides for the project though in many cases this was moral rather than financial. There was also some criticism of the proposal to site the laboratory in the Lake District; several speakers said that there were more practical and economic problems on rivers. One of those present was P. A. Buxton, and he supported the Association, but said that the Council should not attempt to argue their case too strongly on economic or practical grounds; good pure science was sufficient justification and would, in the long run, prove its economic worth.

The Committee then prepared a booklet setting forth the aims of the Association and an architect's plans for a purpose-built laboratory to be sited near Newby Bridge, where it would be easy to do research both on Windermere and the River Leven. They appealed for funds and members; the Fishmongers' Company gave a capital grant of £100 and guaranteed £100 p.a. for three subsequent years. The Royal Society also gave a grant, and by the autumn of 1930 the Committee had received or had been promised an endowment fund of £500 and an initial income of £200 p.a. It was soon clear that a purpose-built laboratory would be beyond the means of the Association but the Committee ascertained that the National Trust would rent for a small sum three rooms in Wray Castle, which was sited near the west shores of the north basin of Windermere.

Throughout 1930 Fritsch, Pearsall and Saunders worked hard to get their infant association off the ground. They were aided by Scourfield (Hon. Treasurer), Balfour-Browne (acting Hon. Secretary) and Beddington

in particular. Fritsch was then Professor of Botany at East London College (later Queen Mary College), Pearsall was Reader in Botany at Leeds University and Saunders a lecturer in Zoology at Cambridge. By nature rather different men, they each contributed an essential ingredient and all were inspired by determination and united by very similar concepts as to what the FBA should be. The booklet on the aims of the Association was first drafted independently by Pearsall and Saunders who then found that their drafts were almost identical. Fritsch wrote endless letters in long-hand and tactfully but firmly made sure that everyone else did their share. Only once or twice does a note of exasperation or a hint of despair creep into these letters. Pearsall knew the Lake District well and provided a main share of the scientific inspiration. Saunders was teaching the first university course in 'hydrobiology' and it is significant that most of the early staff had been his students. He also set very high standards in administrative efficiency and integrity. Beddington was a layman, who had complete faith in the science of his colleagues. He combined a rare shrewdness in public and financial affairs with a warm generosity and humanity that won respect and help from those he approached for support.

It was a most inauspicious time to start a new venture; the world-wide financial slump was at its bottom, but in December 1930 the decision was taken to open a laboratory in Wray Castle with a staff of one scientist and Pearsall as Honorary Director. The Development Commission was approached for a grant, and on 19 March 1931 agreed to provide £450 p.a. with the possibility of an increase to £600 for the second year. The third general meeting of members was held on 25 June 1931 when it was announced that the laboratory would open that September. There were then 115 individuals and twenty organizations as members, the latter including Manchester Corporation, the Metropolitan Water Board and one or two other water undertakings.

Saunders seems to have played the major part in finding the staff. The appointment of Phillip Ullyott, newly graduated from Cambridge with first-class honours in zoology, as Assistant-Naturalist in charge was readily agreed by the others. It was then decided to offer a second appointment, at a salary of £50 p.a., to R. S. A. Beauchamp, also with first-class honours from Cambridge; he accepted. Saunders visited the area to seek an 'attendant', and, at the suggestion of R. E. Porter (the National Trust Agent), interviewed a lad of sixteen who had just left Kelsick Grammar School. George Thompson was offered the job with a warning that there was no guarantee of long employment, but he accepted, saying that he thought 'the work sounded interesting'.

Birth and childhood

On 21 September 1931 Penelope Jenkin, a research student of Saunders's at Cambridge arrived at Wray Castle, followed the next day by Beauchamp

and Ullyott and the day after by Thompson. Most of the Castle was still occupied by the Youth Hostels Association and their area was separated off by a wire netting fence. The FBA had three rooms, but also the cellars and the boat house. The labs were fitted with benches and a few sinks. The water supply was fitful because the main pipes were furred-up with rust. (An inadequate water supply has dogged the FBA through much of its life). A petrol gas machine supplied bunsen burners and some gas lights, as electricity was still many miles and several years away. The library had few books and the laboratory only the most basic equipment; most apparatus had to be made from the proverbial sealing wax and string. Nevertheless Ullyott and Beauchamp were soon doing original research involving both observations on the lake and in local becks and elegant experiments on *Planaria* in an artificial stream in the cellars (whose naturally low and stable temperatures were more reliable than those of many a modern constant-temperature room). Miss Jenkin was meanwhile making temperature observations on the lake and analysing water samples that were the start of long-term monitoring programmes.

In the university vacations the available space was crowded by visiting researchers and students whose enthusiasms overcame the primitive working and living conditions. The first 'Open Day' was held on 27 February 1932, five months after the laboratory's start, and the first Easter Class in April 1932. There were twenty-five applicants for the class, of whom eighteen were accepted. They were provided with accommodation in the youth hostel, but Beauchamp and Ullyott had to spend the day before the students' arrival buying wire netting and making a few extra beds! Several of the students on this class were later to become members of the staff or distinguished biologists elsewhere. Indeed, it is a feature of the early years that many of those appointed to the staff first came of their own accord to classes or to work as unpaid vacation students. They were successful recruits to the staff because they were enthusiastic freshwater biologists determined, if they could, to be employed by the FBA.

In March 1932 the Association was formally incorporated and was then in a position to receive the promised Development Commission grant. The 'first' *Annual Report* was published (though it was actually the third such report). Beddington had become President, and an Alderman from Nottingham who had influence in the water industry - Albert Atkey - was on the Council. The next year he was made Hon. Treasurer and subsequently he was to do much to bring in support from the water industry and guide the Association's finances. By then H. P. Moon and K. R. Allen were working as students on invertebrates and eight papers had been published from the laboratory. This *Annual Report* also mentioned that blue-green algae seemed to be more abundant than in 1921 when Pearsall had sampled the lakes; perhaps the first hint of 'eutrophication'? More rooms were rented, and in September 1932 the Youth Hostels Association

left. Money was always short; such was the state of national finances that the Development Commission reduced the promised grant of £600 to £540. Typical of the times was the Council minute deciding that another laboratory must be furnished for visitors and so money would have to be begged, followed by the note that a collection at the Council meeting had raised £25.

The next three years saw continued progress and growth. Ullyott resigned in October 1933 and Beauchamp became 'Naturalist-in-Charge and Assistant Secretary'; (he soon began to complain about administrative chores). P. A. Buxton became Hon. Secretary. Allen and Moon received research grants, E. B. Worthington worked as a visitor on the food of char, Marie Rosenberg, a refugee from Germany, was given free accommodation to work on algae and T. T. Macan and C. H. Mortimer held research studentships. In June 1935 Allen began research on salmon, on a special grant from the Ministry of Agriculture and Fisheries and the Scottish Department analogous to the 'Rothschild' Departmental commissions of today. W. H. Moore was appointed a laboratory assistant and is now the sole member of the pre-war staff still serving. The idea of publishing handbooks was first mooted and specimens began to be sold to universities. The next year, 1936, saw the connection to mains electricity.

Adolescence

In 1936, five years after the start of the laboratory, the Development Commission were persuaded to send a Visiting Group to inspect the laboratory and report whether longer-term support and further expansion were justified. The Visiting Group was led by Professor Graham Kerr and, while making some minor constructive criticisms, it recommended that the grant should be increased to allow the appointment of a director and a total of five full-time scientific staff, and that the grant should be guaranteed for five years ahead. This was a milestone as it showed that the scientific 'establishment' and the government had by now accepted the Association as a viable and effective research institute. In 1937, Dr E. B. Worthington was appointed Director from 1 June, a post he held until 1946. Beauchamp resigned and went to work in Africa, but Allen, Mortimer, Macan and Rosenberg constituted the scientific staff. It was decided that work on bacteriology should begin; the DSIR was persuaded to commission research and C. B. Taylor was appointed. The first assistant secretary was appointed - Miss Rosa Bullen, an indication of the increase in administrative work.

During the next two years there were three significant developments in the scientific programme. The University College of Southampton had combined with the Hampshire Fishery Board in 1934 to start a small biological station at Fordingbridge on the River Avon. This was called the 'Avon Biological Research' and J. Berry was appointed its 'superintendent'. Links were gradually built up between this project and the

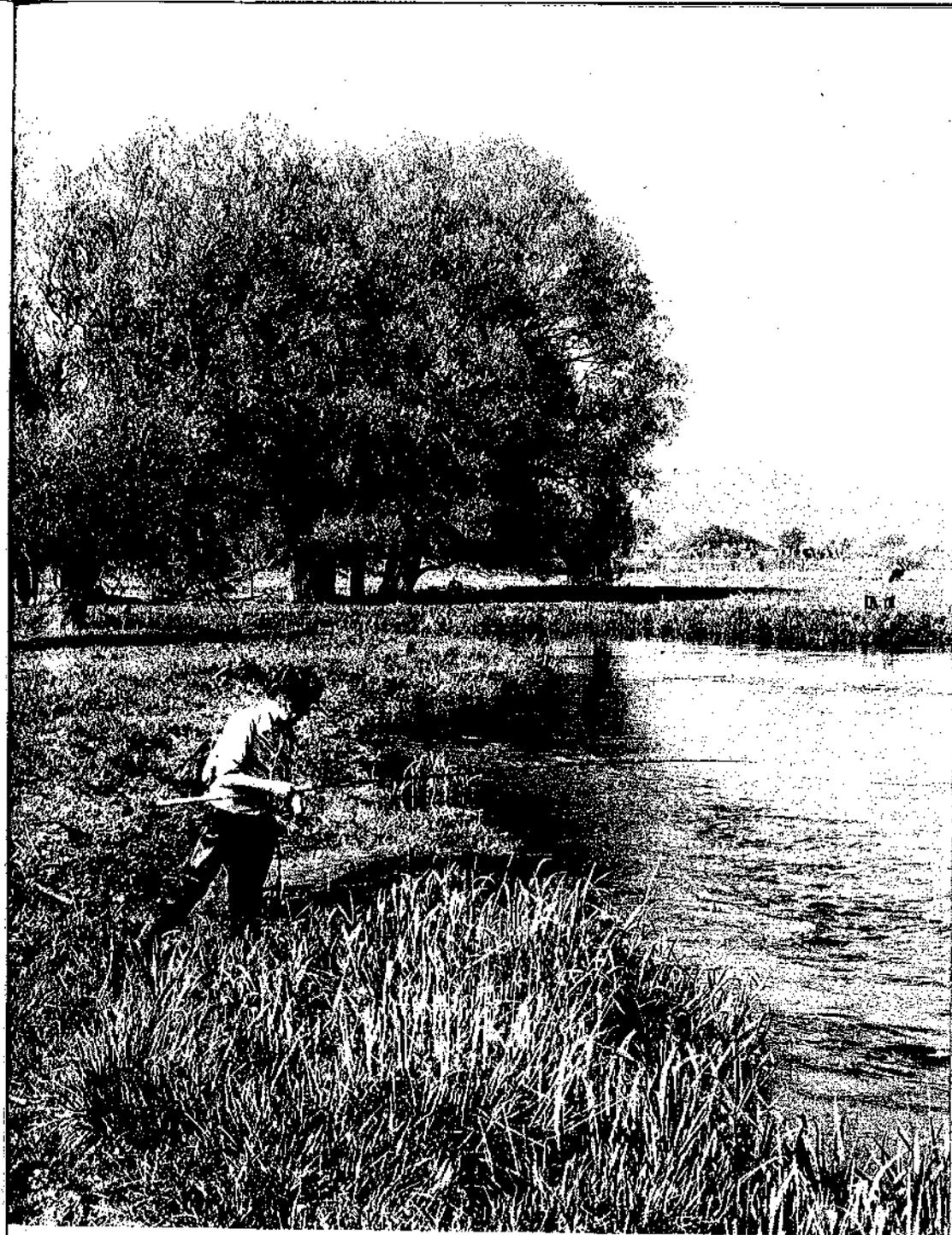


PLATE 1. The West Holme Fishery (River Frome).



PLATE 2. The new laboratories at Stoke Mill Farm.



FBA until on 1 April 1939 it became part of the FBA, as the 'University College, Southampton, Branch for Southern Rivers'. Moon joined its staff, and, later, J. W. Jones was in charge, but in 1940, as a result of the outbreak of the war, the project was abandoned. However, it was very much the forerunner of the present River Laboratory, and all its staff made names for themselves elsewhere later on.

It was also decided that the Association should carry out research into the biology of coarse fish. A committee was set up with the National Federation of Anglers and the National Association of Fishery Boards. Funds were raised from these organizations and P. H. T. Hartley was engaged to carry out the project. He based himself on Bulbeck Mill at Barrington, near Cambridge, and until 1940 investigated the food, age and growth of coarse fish in waters near Cambridge and in the Norfolk Broads. After the war he was to return to analyse his data and publish his findings. This was another example of commissioned research, though in this case financed largely by the contributions of many individual coarse-fish anglers.

This period also saw the realization by Pearsall and Mortimer of the potential value of studies of the history of the lakes, and how cores of lake sediments might provide ways in which this could be done. Mortimer drove drainpipes into the bottom of the lake at Low Wray Bay and later Mr B. M. Jenkin designed a corer that would take uncompressed cores. A young research student at Reading - Winifred Pennington - started to look at the diatoms preserved in these cores.

In 1938 Allen left to take up a post in New Zealand, and Winifred Frost was appointed in his place. The DSIR granted a research studentship to H. B. N. Hynes to work on Plecoptera. Wray Castle continued to provide facilities for visiting workers and during the year of 1938 sixty-six of them lodged in the Castle while working in the Laboratory.

The Association continued to be governed by a Council of appointed and elected members. By this time the Council was assisted by two committees: the Finance and General Purposes Committee, which was really the old Executive Committee renamed, and a Scientific Advisory Committee that was responsible for planning developments in the research programme and making appointments to the scientific staff. Beddington continued as President, Fritsch as Chairman, Atkey as Hon. Treasurer and Chairman of the Finance & General Purposes Committee, while Buxton and Pearsall were joint Hon. Secretaries. Saunders, Scourfield and Balfour-Browne continued to be active members of the Council and new members included H. C. Gilson and F. T. K. Pentelow.

Although there was now a Director, and some of the staff had become experienced researchers, the Council still maintained their close watch on the progress of the research, and their close contact with it, as a result of the annual meetings at Wray and frequent visits in between.

The war years.

Not long after the outbreak of the war, Macan, Mortimer, Taylor, Hartley and Moore all left to take up some form of war service, and Rosenberg was interned in the Isle of Man. Otherwise, the work of the Association went on. Worthington thought of ways in which freshwater fish might augment food supplies and the perch trapping project was begun in Windermere, to be followed in many other lakes and reservoirs. Pike were netted and silver eels trapped as they migrated downstream. Mortimer surveyed the continental literature on pond fish culture and a *Scientific Publication* on fish culture was produced. These projects led to vacation-student projects on diverting eels into traps by lights and seven more biologists were introduced to the FBA. Eventually three of these joined the staff as 'temporary war-time research assistants'. The Easter Class was continued without interruption and small numbers of biologists continued to visit Wray Castle. During 1940, when everyone was on the look-out for quislings and enemy agents, local suspicions about the Castle and some of its inmates were raised and efforts had to be made to restore the laboratory's local status, even though the male members of the staff were active in the Hawkshead Home Guard.

The Castle provided a safe refuge for some of the insect collections from the British Museum (Natural History) and some of the Museum's staff came with them. Similarly, the library of the Fisheries Laboratory at Lowestoft and two of the Lowestoft staff were evacuated to Wray Castle. These evacuees brought new activities and interests; Buchanan-Wollaston stimulated an interest in statistics and Kimmins increased knowledge of local Ephemeroptera and other insects.

In 1944 the Council drew up and published a plan for post-war development. This did not lay down details of the work to be done as it was still firmly the policy that this should be the task of the staff actually carrying out the work. Further development and expansion along the lines in progress in 1939 were envisaged, with the renewed development of a Southern station and also, interestingly, the appointment of two members of the staff who were to act as advisers to the water industry and fishery interests respectively and act as interpreters and liaison officers.

In 1944, Worthington was seconded to survey research needs in the Middle East and arrangements were made for China (of the Natural History Museum) to act as Director with regular visits from Fritsch, Saunders, Pearsall and Buxton to supervise the research in progress. S. P. Chu, who had been a 'Boxer research student', worked for a period on algal culture experiments, and algology received another boost with the appointment of J. W. G. Lund as algologist. This was really the beginning of post-war development.

During the period 1940-45 the momentum of research had been maintained. Regular sampling had been continued, new *Scientific*

Publications on invertebrate taxonomy had been published, algology had been kept going and past samples counted, a new experiment on fish populations in Windermere begun and work started, too, in the field of fish physiology. Several of the senior members of staff were able to publish work they had done in preceding years and the war years saw the appearance in print of much important work.

Post-war growth and maturity.

In 1946 Worthington resigned as Director to take up a new job coordinating research in Africa; H. C. Gilson was appointed in his place. Gilson had led a limnological expedition to Lake Titicaca just before the war and had been a member of the Council for some years. Macan, Mortimer, Hartley, Taylor and Moore all returned to Wray Castle, with new ideas and expertise gained by their war-time experiences. Although Government finances were still tight, it was the beginning of a period of public euphoria about the achievements of science, so money for research was not difficult to obtain. Smyly was appointed to work on perch and then on zooplankton, Le Cren returned from a year in America to a permanent post for fish ecology and Mackereth was appointed chemist. It was also the beginning of the age of electronics. Aided and abetted by Moore, Mortimer drove round the country picking up government-surplus equipment cheaply and Gilson set up a proper mechanical workshop. Especially was it a period of vigorous and stimulating intellectual activity, particularly in the field of open-water limnology with Lund, Mortimer and Mackereth engaging in lively discussions and cooperative ventures. The 1948 SIL Congress in Switzerland was the first one to be attended by a substantial British delegation, and the FBA was awarded an Einar Naumann Medal; British freshwater biology had arrived on the international scene.

The period 1946 to 1950 was one of continuous growth. The idea of research assistants ('experimental officers') was adopted and these as well as more assistants and other support staff were appointed. The latter included an instrument maker, a librarian and an accountant. Soon Wray Castle began to become crowded and the Council wondered from where more space was to come. An opportunity to buy Brockhole, across the lake from Wray, came too early to be taken up (in retrospect this may have proved unfortunate). However, in 1948 the Ferry Hotel came up for sale and Gilson and the Development Commission were able to move fast and buy it. Conversion took two years and cost more than anticipated, but the Director weathered some official disapproval and the laboratory moved to The Ferry House with remarkable smoothness in September 1950.

The next few years were to see steady growth and several changes in the staff; it does not seem necessary to deal with these in detail. Notable in this period was the departure of Mortimer to be Director of the SMBA

laboratory at Millport (which was shortly followed by his election to the Royal Society). In 1953 the SIL held its Congress in Britain and the post-congress excursions came to Windermere; the FBA played a large part in the organization of this Congress. In 1954 the Association celebrated its twenty-fifth anniversary with a dinner in Fishmongers' Hall. By then the membership was 725, the staff numbered forty-four and the annual expenditure had risen to £32,000.

The second twenty-five years.

Space will not allow such a detailed account of the second half of the Association's life so far, but the more notable events should be recorded. In the 1950s the Council turned their attention again to the idea of a 'Southern Station'. At first the site of the old Avon Biological Research station on the River Avon just upstream of Fordingbridge was explored again. Practical problems arising from the weirs, land and legal access were found to be insurmountable, but efforts were diverted to Bickton Mill not far downstream from Fordingbridge. Here land in the form of a small gravel pit adjacent to the river was actually bought, while negotiations were being carried out for the mill itself with its fishing and water rights. Again legal problems of ownership and rights could not be overcome, and the search was extended further afield.

Eventually, in 1957, fishing rights, a derelict mill and some five acres of land were bought on the River Frome at East Stoke in Dorset. More land was eventually bought and in 1961 a detailed scheme for a research programme and small laboratory was drawn up by Gilson, assisted by Le Cren, and submitted to the Development Commission, who gave their approval in principle. Building actually began in 1962, and at the same time T. Gledhill and then Le Cren moved from Windermere to Dorset. The new building was first occupied in December 1963 and the River Laboratory formally opened in June 1965.

The idea of this Laboratory was to enable work to be done on the ecology of 'chalk streams'; the hard-water and biologically productive rivers common in southern England, that are the ecological antithesis of the soft-water unproductive lakes of northern England. The philosophy of the work at the River Laboratory was to be that traditional in the FBA - to appoint a small number of creative scientists in a range of disciplines and then allow them considerable freedom to follow their own initiatives. However, from the outset they were given strong encouragement to involve themselves voluntarily in a team study of the river as an 'ecosystem', and to approach this system through an investigation of the production of its 'trophic components'. This approach received some encouragement from the contemporary International Biological Programme (in which FBA staff played a significant part).

At the same time as attempts were being made to start a river laboratory,

the FBA was involved in ventures into the field of applied freshwater biology. A small unit, staffed by D. F. Westlake and R. W. Edwards, was set up to study basic biological aspects of polluted rivers. This unit was based in a sewage works near Rickmansworth and, in conjunction with the freshwater fisheries laboratory of the Ministry of Agriculture, Fisheries & Food, carried out a detailed study of the nearby River Colne. Later, the unit was housed in the new Water Pollution Research Laboratory at Stevenage. Eventually, Edwards left the unit and joined the WPRL staff, while Westlake and the rest of the unit were absorbed into the River Laboratory. Another brief, and rather unsuccessful venture, was an attempt to study heated effluents in a tank in a power station in the middle of London.

In 1965 the Royal Society set up a team to investigate the biology and productivity of Lake George, on the equator in Uganda, as part of the IBP. The FBA undertook the administration, training and much of the supervision of this team on behalf of the Royal Society. In the eight years of its existence this team of young limnologists found out a great deal of interest about the ecology of Lake George, which thus became one of the best-studied lakes in the tropics.

At the same time the Nature Conservancy gave a grant to the Association to study the Shropshire and Cheshire meres, and C. S. Reynolds joined the staff as a research assistant. As the West Midlands Unit, later based at Preston Montford Field Centre, he did much to explore the functioning of the phytoplankton system in Crosemere and other nearby lakes. Plans to develop this unit into a larger centre for work in the West Midlands did not gain adequate financial support.

Meanwhile expansion was continuing at both Windermere and the River Laboratory. The first of a series of extensions to the laboratory was built at East Stoke and the fluvarium constructed on the site of the old mill. The Pearsall Building was designed, and after delays because of planning difficulties and the availability of funds it eventually came into use in 1973. D. T. Crisp moved from the River Laboratory to Moor House to begin a study of the changes in invertebrates and fish caused by the building of Cow Green reservoir. Eventually this small unit was to become the Teesdale Unit and broaden its interests.

In 1965 the Science and Technology Act brought about a fundamental change in the way in which the Association received its grant-in-aid from the Government. The Natural Environment Research Council came into existence and took over from the Development Commission the latter's responsibilities for fishery research. If anything, this tended to increase the availability of funds and allow greater flexibility in their application. Work on lake sediments and Quaternary studies that had been financed by grants could become part of the normal research programme and Dr Pennington (Mrs Tutin) joined the staff.

After the completion of the Pearsall Building, the Science Budget ceased to grow for a few years and the FBA's expansion also had to slow down. Another financial change took place with the White Paper on Government support for civil research. The Association then had to seek contracts from Government Departments for some of its research programme. By 1975 one-third of its income was derived from the Ministry of Agriculture, Fisheries and Food, the Department of the Environment, Regional Water Authorities and a number of smaller customers. In the event the Association was able to continue several of these contract projects along lines similar to those before 1973, but there

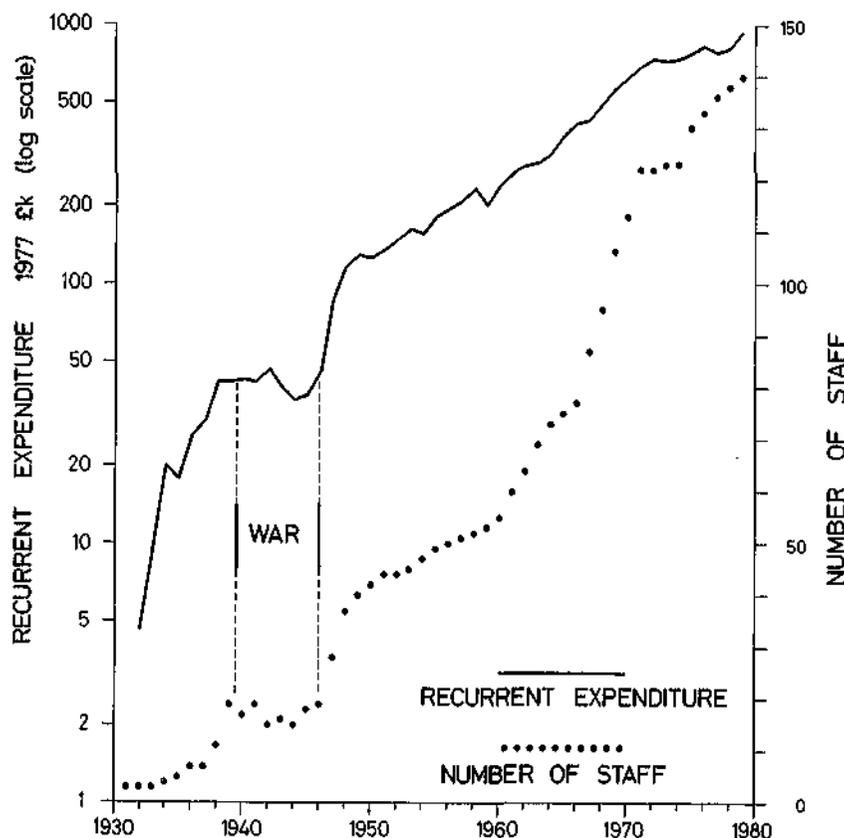


FIG. 1. Growth of the Freshwater Biological Association. Annual recurrent expenditure, adjusted to the value of the £ sterling in 1977, plotted on a logarithmic scale, and total number of staff plotted on an arithmetic scale for each financial year from 1931-32 to 1979-80.

was some increase in administration and changes in the emphasis of some projects.

H. C. Gilson, who had been Director since 1946, retired in 1973 and was succeeded by Le Cren, who had been in charge of the River Laboratory. A. D. Berrie was appointed the new Officer-in-Charge of the River Laboratory, and, after the retirement of Macan in 1976, T. B. Bagenal and D. J. J. Kinsman were appointed Assistant Directors to help deal with an increasing load of administration.

The FBA in 1979.

Over the past two years the Association has renewed its growth, largely through undertaking contracts for new work, but partly also from an increase in funds for basic research, especially in the field of chemistry. The NERC has also been able to provide funds for the purchase and conversion of Stoke Mill Farm at the River Lab, further fishing rights on the River Frome and a major improvement in the water supply for fish ponds and experimental purposes at Windermere. The Association now has a financial turn-over in excess of £M1 p.a. – compared to its initial £650 p.a.! The staff now number nearly 140 compared to three, and the membership is nearly 2,000 instead of 85.

However, much of the philosophy and general aims of the Association as set out in the paper published by the Council in 1930 still hold good today. Indeed, re-reading this document emphasises the far-sighted perception of its authors – Pearsall, Saunders and Fritsch. It is also a measure of the fundamental importance of most of the topics they suggested for research that several of them still form major parts of today's programme.

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APPENDIX I. OFFICERS OF THE ASSOCIATION: 1929-1979

Presidents:

1929-1931	Lord Rothschild
1931-1960	R. Beddington
1960-1977	Sir Edward Chadwyck-Healey
1977-	Sir Edwin Arrowsmith

Chairmen of Council:

1929-1954	F. E. Fritsch
1954-1964	W. H. Pearsall
1964-1966	F. T. K. Pentelow
1966-1974	C. T. Ingold
1974-	G. E. Fogg

Honorary Secretaries:

1929-1931	W. A. F. Balfour-Browne (acting)
1931-1934	J. T. Saunders
1935-1940	P. A. Buxton
1937-1948	W. H. Pearsall

} Joint from 1937-1940
(The post of Honorary Secretary ended in 1948)

Honorary Treasurers:

1929-1932	D. J. Scourfield (acting)
1932-1934	N. O. Walker
1934-1947	Sir Albert Atkey
1947-1950	W. H. Pearsall (acting)
1950-1962	N. F. S. Winter
1962-1966	J. McMillan
1966-1967	R. C. Whitehead (acting)
1967-1975	L. W. F. Millis
1975-	P. J. Liddell

Chairmen of the Scientific Advisory Committee:

1935-1940	H. T. Calvert
1940-1953	J. T. Saunders
1953-1954	W. H. Pearsall
1954-1956	F. T. K. Pentelow
1956-1962	J. E. Harris
1962-1964	F. T. K. Pentelow
1964-1965	R. J. H. Beverton
1965-1966	C. T. Ingold
1966-1974	G. E. Fogg
1974-	W. D. P. Stewart

Directors:

1931-1937	Prof. W. H. Pearsall (Honorary)
1937-1946	E. B. Worthington
1946-1973	H. C. Gilson
1973-	E. D. Le Cren

Naturalists-in-Charge:

1931-1933	P. Ullyott
1933-1937	R. S. A. Beauchamp

APPENDIX II. NOTABLE EVENTS IN THE HISTORY OF THE ASSOCIATION

1928. Joint discussion on 'The biological investigation of fresh waters' held by Sections D and K of the British Association for the Advancement of Science at Glasgow.
- December 1928. Committee appointed as a result of the above meeting met and decided to recommend to B.A. the foundation of a freshwater biological association on the lines of the Marine Biological Association of the U.K. The same people reformed themselves as a preparatory committee for this purpose.
- 11 June 1929. Foundation meeting of the Association.
- 21 Feb. 1930. Public meeting in Fishmongers' Hall to obtain support for a research station.
- 12 Dec. 1930. Council decided to establish a research station in Wray Castle.
- 19 March 1931. First grant of £450 sanctioned by Development Commission.
- 22-23 Sept. 1931. Work began in three rooms in Wray Castle.
- 3 March 1932. Association registered as a limited liability company.
- Autumn 1936. Visit of inspection by committee of the Development Commission.

- Sept. 1937. E. B. Worthington took up duties as first Director.
 April 1938. Coarse Fish Investigation began.
 April 1939. Avon Biological Research became the Association's 'University College, Southampton, Branch for Southern Rivers'.
 June 1940. Branch for Southern Rivers closed.
 June 1940. Part of the Fisheries Lab., Lowestoft, and British Museum (N.H.) evacuated to Wray Castle.
 November 1947. The Ferry House purchased.
 June 1948. Lease of Wraymires hatchery and tarns.
 August 1948. Award of Einar Naumann medal to the Association by Societas Internationalis Limnologiae.
 September 1950. Move from Wray Castle to The Ferry House.
 September 1953. Pollution Research Unit started work.
 April 1957. Purchase of fishing rights at East Stoke.
 December 1963. River Laboratory completed.
 1964. Association began to administer the Royal Society's Lake George IBP project.
 20 May 1965. Formal opening of River Laboratory.
 1 June 1965. Natural Environment Research Council took over from Development Commission responsibility for grant-aiding the Association.
 1 April 1967. Quaternary Research group joined Association's staff.
 March 1969. Work began at Cow Green.
 1969. Purchase of Waterston water-cress beds.
 1970. Midlands Unit established.
 23 July 1971. Formal opening of fluvarium and extension to River Laboratory.
 25 March 1972. Death of G. J. Thompson, Laboratory Steward.
 26 March 1972. Death of F. J. H. Mackereth, Chemist.
 1972. Publication of White Paper, Cmnd 5046, on organisation of government research.
 1 April 1973. Some research projects became commissioned by Department of the Environment and Ministry of Agriculture Fisheries and Food.
 14 April 1973. Formal opening of Pearsall Building.
 1973. End of Royal Society's IBP project on Lake George, Uganda.
 Summer 1977. Teesdale Unit established.
 September 1977. Formal opening of Meeting Room at River Laboratory.
 October 1978. Completion of purchase of West Holme fishing rights on River Frome.
 March 1979. Completion of conversion of Stoke Mill Farm House into laboratories.

FUNGAL AND PROTOZOAN PARASITES AND THEIR IMPORTANCE IN THE ECOLOGY OF THE PHYTOPLANKTON

HILDA M. CANTER (MRS J. W. G. LUND)

Fungi and protozoa responsible for the death of algae, more especially non-planktonic forms, were first described by the early European microscopists. Many excellent observations and illustrations were made by these workers in an era between the mid-19th and early 20th centuries.

During this period, there was no intensive work in Great Britain on these organisms although a few scattered papers do exist in the literature. The first real investigation in this country of the fungi classed as Aquatic Phycomycetes was carried out by the late Dr F. K. Sparrow during his visit to Cambridge in the years of 1932-1933. Even so, species living on the planktonic algae of large lakes received no attention.

It was in 1943 at an FBA botany class that the presence of fungi on the phytoplankton of Windermere was first noted by me and a very striking chytrid saprophyte was found attached to frustules of *Ceratium*. At that time, Professor C. T. Ingold was studying chytrids and so contact was made with him. The fungus on *Ceratium* proved to belong to a new genus which he named *Amphicypellus* Ingold (1944) (Plate 3a). This link with Professor Ingold was eventually to lead to the intensive survey carried out on the fungi which live on planktonic algae in the English Lake District and elsewhere.

Descriptive studies.

The main bulk of the fungal parasites (and saprophytes) associated with the phytoplankton belong to the Chytridiales or are simple biflagellate Phycomycetes. (See Sparrow 1960, Karling 1977). In each group there is a stage in the life-history when numerous minute free-swimming bodies called zoospores are formed. They are the main dispersive agents of these fungi and ultimately they find new algal cells upon which to grow. The chytrid zoospore (Fig. 1A,z) typically possesses a spherical body and contains a single bright refractive globule. The flagellum is posteriorly placed and propels the zoospore from behind. In contrast the zoospore of a simple biflagellate fungus (Fig. 1B,z) is often shaped like a bean or grape seed. It contains several small refractive globules and the two flagella are laterally inserted and oppositely directed when swimming.

Commonly in a chytrid, a fine thread from the adherent encysted zoospore penetrates the algal cell and internally forms a rhizoidal system (Plate 4D). Nourishment is conveyed back to the zoospore which enlarges and becomes a sporangium (Plate 3B). The sporangium matures and further zoospores are produced (Fig. 1A). Liberation of these zoospores takes place by diverse methods of sporangial dehiscence. A part of the wall may form a well-defined operculum (Plate 4C), a few or numerous small