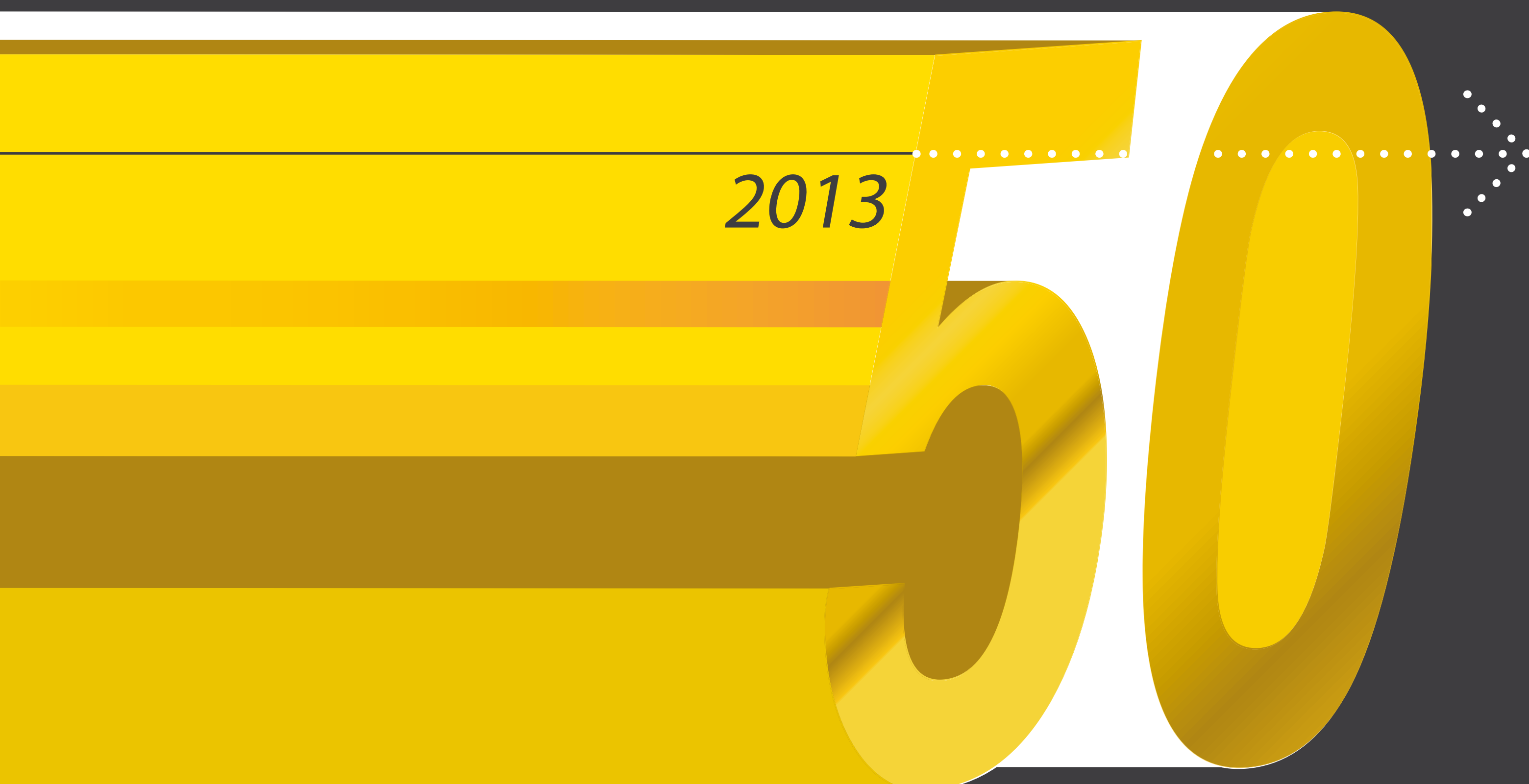
THE UNIVERSITY *of York*

Department of Biology



A History of the first fifty years of Biology at York

edited by Mark Williamson & David White

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Aerial view of the department taken in September 2003, looking across the lake to the east.

A: Teaching Laboratories; B: Old concourse and lecture theatres; D: Research Wing D; E: Services (Stores and Workshops) F: Research Wing F; H: original IFAB building being refurbished to make the first CII building (see Q); J: Research Laboratories, originally the Plant Laboratory and p53; K: Main administration (HoD & Finance) and Technology Facility; L and M; new Research Wings; P: Glasshouses and Preparation rooms; Q: approximate position of the new CII building completed and occupied in September 2010. Since then CII have occupied both H and Q; S: Suite of PortaKabins built for BioCode, now staff offices.

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Preface
by the editors

This book had its origins in an invitation from Dale Sanders a few years ago to the previous heads of the department to write reminiscences of their time in York. In January 2012 David White and Mark Williamson independently asked what has happened to those papers and the present head, Debbie Smith, suggested they could be enlarged to make a history of the department in time for the University's 50th Anniversary (of having undergraduates) in 2013. We agreed to edit a history, she provided the resources and this is the result with contributions from many members and former members of the department.

The original ideas, described in the first chapter, were for a department that was integrated in various ways. First, across biology with none of the barriers to cross-discipline working that beset the traditional separation of the subject into different departments. Second, by being a place in which, as Peter Humpherson expresses in Chapter 2, "all staff were respected, listened to and encouraged in various ways to feel that they were making a contribution. We had different functions to perform at varying levels of skill or importance but nevertheless one felt we were all equal". The physical structure of the building was designed to facilitate these ideas, with its wide corridors and shared facilities, as were such matters as the periods for coffee in the morning and tea in the afternoon; these were also timed to be after the first lecture of the morning so that students mingled with staff in an informal way. Inevitably, because of the way a University works, academic staff get more individual mentions in most of the accounts that follow, but that does not reflect a different view of the contributions made by all staff.

The original plans were to have over thirty academic staff with support staff to match, all housed in a building designed for this size. This concept was broadly realised by the mid-1970s. In sociological terms, we were of an ideal size for a community; everyone knew everyone else, and pretty well what they taught and researched. From the outset, it has been a goal that we should be excellent in both teaching and research. The early determination and philosophy were that in a university department, all academic staff should undertake both, and that undergraduates be taught by those at the forefront of developing their fields. It was also the case that we felt that not everything should be assessed, and that undergraduates should think broadly for themselves, and not be constrained only by a defined syllabus or what had been included in formal teaching. Tutorials were perhaps the clearest exposition of this, with the marine field course in Millport another example.

In those early days there were no objective measures of the quality of a department's teaching or research. Over the years, such measures have been introduced, first for research via the Research Selectivity Exercise and its successors, and a bit later for teaching via the Teaching Quality Assessment. It is very satisfying that those original goals of excellence have been maintained with the Department being recognised consistently for its high quality in all assessments, formal and informal, of teaching, research, student satisfaction, that are made.

The Department has grown immensely over the fifty years. After about ten years to reach thirty academic staff paid from University (funding council) funds, this plateau of numbers from the early 1970s was not significantly exceeded until the 1990s. As Debbie Smith points out in her account, there has been a major expansion of university-funded academics, starting in about 2000 and in part brought about by the creation of the Hull-York Medical School, although before that the expansion of taught postgraduate courses, in which the Department was a leader nationally, also brought in new posts. What did happen before this, though, is that department began to attract senior academics on external funds to research positions and this, combined with an increase in the size of research groups as Biology as a subject adapted to its 'big science' status and as funding for research became more generous, caused the number of staff in the department to increase in a major way from the 1990's onwards.

Annex 1 gives a list of academic staff who have been members of the department over these fifty years. Unfortunately, the available records do not allow a full catalogue of the department to be made. Figure 9-3 shows the changes described above of academic staff numbers in graphical form. There have been about 130 academic staff over the lifetime of the department; it is, to us, remarkable that as far as we can tell only six have died: Bob Reid, Ramsey Bronk, John Marsden, Richard Firn, Martin Davies & Roger Hall.

The number of students has also increased dramatically: undergraduates, those doing masters degrees and research students doing PhDs. These changes are detailed as far as we can in Chapter 8. Associated with the development of our teaching has been the introduction of Teaching Fellows from 1999 onwards, offering a properly structured career opportunity for, now, six staff, and these are included in Annex 1 and figure 9-3.

Another staff group that has greatly expanded is administrative staff. Originally these were mainly secretaries, but with the rise of word processing they have been largely replaced by staff taking on administrative roles originally played by academic staff, such as finance, safety and HR.

The expansion in numbers of staff and students has been matched by new building, to the extent that the original buildings, mostly still standing, are surrounded to the south, west and north by new laboratories, offices and lecture theatres. These developments are discussed in various chapters in Part 1.

Associated with this book, the Department has created a website for historical records, and amongst the papers there are the inputs made by the Department to the Research Selectivity Exercises and its successor, the Research Assessment Exercise. We would have liked to have included more photographs, and those with suitable photographic records, particularly from the early days are invited to submit images.

Acknowledgements

This book is a compilation of writings from many members and former members of the department. Some of these contributions appear as chapters or as major sections within chapters where the authors are named at the head. Some are included as attributed quotations within chapters, particularly in Chapters 2 and 8. We have not named these authors specifically here, but we are most grateful to all for their willingness to contribute their memories.

A major task in preparing this book has been to obtain accurate and consistent data of finances and funding, of student numbers, of the development of the undergraduate and post-graduate degree courses, of the dates of appointment and leaving of academic staff and other matters. Many people have helped find and collate these data, often at inconvenient times and at short notice. Within the department these were: Monica Bandeira, Adrian Harrison, Andrea Johnson, Julie Knox, Julie Lord, Nina Pirozek, Stefan Reidinger, Darren Spillett, Michelle Squires and Jenny White. Within the university we have been much helped by Charles Fonge and his staff in the Borthwick Institute for Archives, Gary Sheen, Heather Watson, Norma Wright. We thank them all for their help.

Many people have responded to questions, reminded us of distant memories, corrected our errors and had informal discussions on various issues. For that we thank Terry Crawford, Calvin Dytham, Peter Hogarth, Jim Hoggett, Lucy Hudson, Peter Humpherson, John Lawton, Henry Leese, Adrian Mountford, Geoff Oxford, Charles Perrings, Martin Rumsby, Sean Sweeney, Marjan van der Woude, Alan Wilson and Peter Young. We apologise if we have overlooked anybody.

Many people have contributed to the illustrations. Sue Sparrow devoted considerable skill in producing the diagrams of the layout of the original department in its first incarnation and then showing how it is today. Others found photographs from the distant past before 'digital' meant more than 'fingered'. The sources of illustrations are given elsewhere, but we are expecially grateful to Geoff Oxford for the photograph of the staff rugby team on the day of the fire, to Dave Thomson for images of the fire, to Peter Humpherson for a wonderful album of photographs from the early days and to James Merryweather for photographs from Millport and of the teaching laboratories.

During the time that he was a member of the department, Neville Astley, drew cartoons for the departmental magazine 'Scalpel!', our own Private Eye. His signature Nev!!! accompanies four of these cartoons. Nev!!! left the department in 1980 to follow a career in art, eventually becoming a highly successful professional animator, writer and director in London. We appreciate his willingness in allowing us to reproduce these cartoons, more of which can be found on the website.

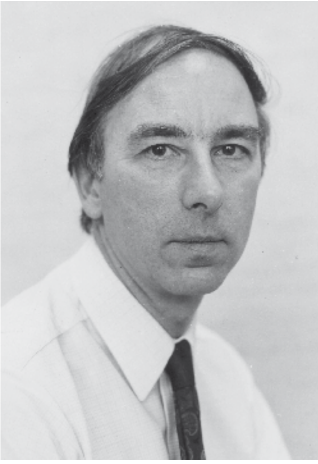
The book has been produced in the department, and for the high quality of the presentation we are very grateful to Phil Roberts, who has combined the many inputs into the whole you now see, and to Belinda Wade for helping the whole process.

None of this would have happened had Debbie Smith not supported this project with departmental resources, and we thank her for enabling the project.

Finally, we wish to thank Alastair Fitter who should perhaps have been named as an editor. He has provided invaluable advice, read all of the text, and suggested many improvements.

The early history of the Department of Biology at York 1963-1968

Mark Williamson



On 14 January 1990 I had occasion to write to the then vice-chancellor, Berrick Saul, about what I and other scientists had done for the university between 1963 and 1965. My description of my own work then was:

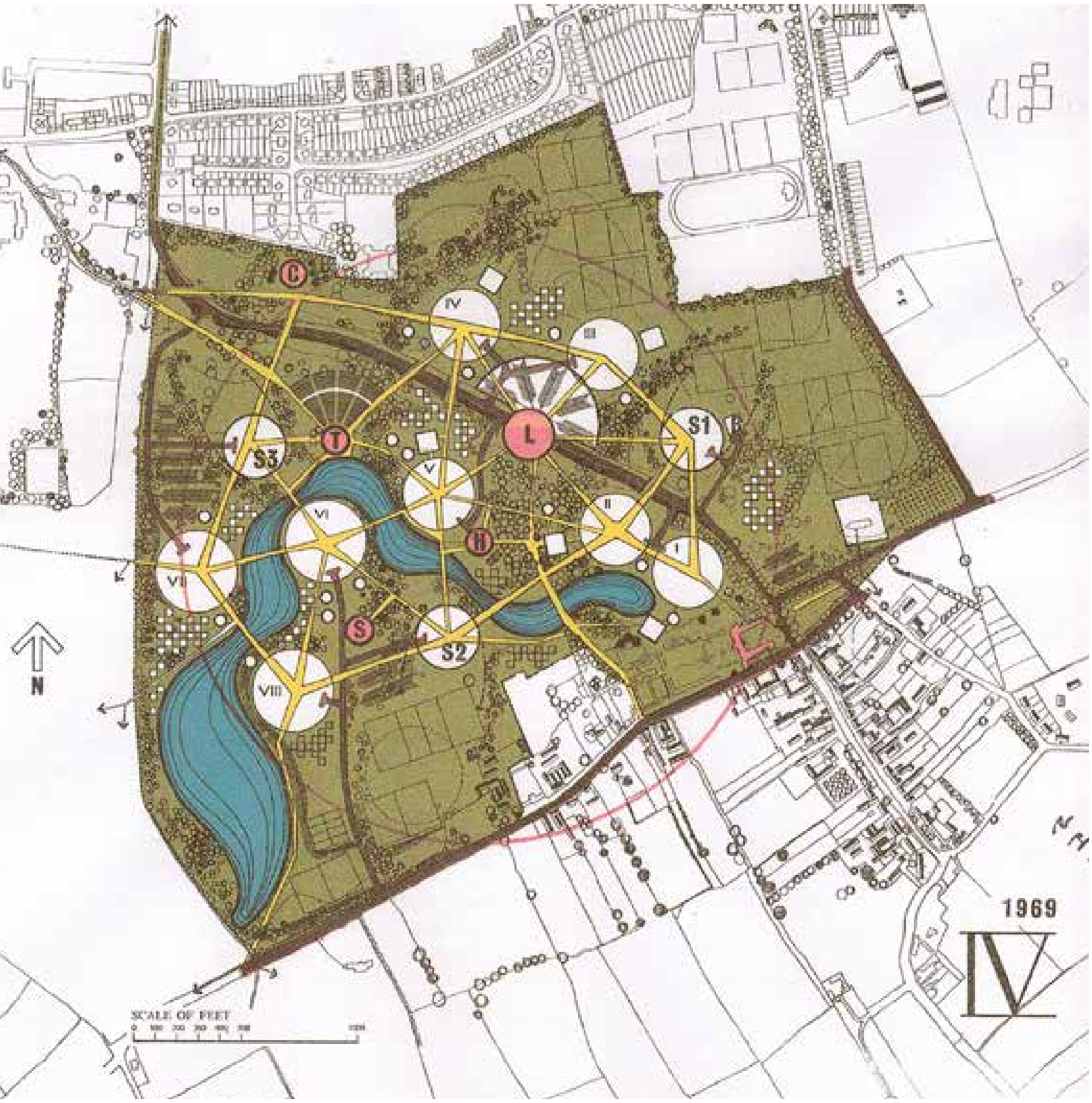
> From 1963, the University paid for a part-time secretary in Edinburgh for me, paid my travelling and subsistence, and paid fees to various people who helped me. In those years I planned the departmental structure, devised the undergraduate course and wrote the prospectus entry, helped John Currey select the first undergraduates, arranged research student quotas and allocated them to our first research students, got in our first research grants for myself and others, and designed the Biology building by writing the brief and discussing it with both the architects and my new staff. I arranged for the appointment of 10 academic staff, numerous technicians and secretaries, and got the post of Professor of Biochemistry approved by Professorial Board (PB). I put together the equipment list, negotiating it with the assessors, and arranging for the equipment to be ordered to be in York in time for our move into the Chemistry building (and earlier).
>
> I first met the architects on the 15th October 1963, and one of the equipment assessors on 17th October 1963, but I reckon I was working for the University from 25 September 1963, the date of my first business letter to Eric James.

This chapter enlarges on that and gives an account of the department up to and including moving into our own building in 1968.

History and background

The University of York was one of several new universities approved by the University Grants Committee (UGC) just before the Robbins report. The others were East Anglia, Essex, Kent, Lancaster, Sussex and Warwick, with Stirling a little later and there was much discussion of what they would become. East Anglia and York were approved together on 19 April 1960 and both took in their first undergraduates in October 1963, though just in arts, mathematics and social sciences. The case for York was put by a University Promotion Committee. An Academic Planning Board was appointed in September 1960 chaired by Lord Robbins, Professor of Economics at LSE. He also chaired the Robbins Committee set up in 1961 and reporting in 1963 [1]. It called for an immediate expansion of universities so that university places "should be available to all who were qualified for them by ability and attainment". The first Vice-Chancellor, Eric James (Lord James of Rusholme) was appointed in 1961, the first Registrar, John West-Taylor, had been secretary of the Promotion Committee and its predecessor the York Academic Trust and just moved over. The first academic was Pat Nuttgens, Director of the Institute of Architectural Study (later of Advanced Architectural Studies) who started in 1961 though not moving to York until January 1962. And the architects (see below) were appointed in 1961.

Also in 1961 The Royal Society issued a report on the development of research and teaching in biology in UK universities [2]. The Society had set up in 1960 a Committee of 15 Fellows, chaired by the President, Prof. H W Florey, to report "on possible developments in research in biology and related (borderline fields)". In March 1961 the Society circulated a memorandum from that committee (later published as Appendix 1 of the Report [2]) to all UK universities on the organisational structure of biological departments in universities "in the hope that it would be helpful especially to the new universities". After saying "the subdivision into traditional departments (usually botany, zoology, anatomy and physiology) has failed to accommodate the newer growth in the biological sciences"



biochemistry, genetics and animal behaviour." In those days, most biological departments had only one professor (e.g. in Edinburgh, Zoology, Botany, Forestry, Agriculture, Animal Genetics and various pre-clinical ones such as Biochemistry, Bacteriology) and one professor for eight staff was fairly standard, so the departments were often small.

All the new universities adopted more or less the structure recommended. While it seems that some senior biologists hoped that the new universities would help make British biology more competitive, others were more dismissive. For instance Dick Fifoot, Edinburgh University Librarian and my second cousin by marriage, who had lived in York when an Assistant Librarian at Leeds and who knew John West-Taylor (the first Registrar), said to me that York would never be anything except a liberal arts college. Rachel Leech (see below) was warned that moving to York in 1966 would be academic suicide and Prof Davidson of Glasgow (see below) clearly thought that new universities didn't deserve the best equipment. Fortunately, those senior biologists were right and some were very supportive.

Figure 1-1

The architects expectation of the development of the Heslington site by 1969. From the University of York Development Plan. The S1-S3 buildings are science laboratories, the roman numbered buildings, I-VIII, are colleges, C is a concert hall (never built), H the central hall, L the library, S the sports centre, T a theatre (never built). The red circle has a diameter of 10 minutes walk.

and "the present departmental or sectarian structure is faulty", the memorandum says the committee "suggests that an adaptable structure eliminating departmental divisions that now exist is desirable. Thus a school of biology might have some six to eight chairs uncommitted by title and a substantial number of non-professorial staff not divided into formal groups. Such a school should best be housed under one roof or in adjacent buildings with provision for expansion."

The main report said "The last few decades have ... seen great changes in the general balance of subjects within the field of biology. Certain of the older fields ... have become more fully worked over and consolidated, taking up a reduced proportion of the research effort ... many new fields ... have opened up. These newer developments have been particularly noteworthy in such fields as biophysics,

My appointment

The university held interviews for the first chair of biology in the Kings Manor on 30th July 1963. There had been thirty applicants, half a dozen interviewed. The interviewing committee were Eric James (V-C, chair) Michael Swan (professor of zoology, Edinburgh, external assessor), Gerald Aylmer (history, the first professor on site), Dick Norman (chemistry), Oliver Heavens (physics) with John West-Taylor (registrar) in attendance. Michael Swan was my professor in Edinburgh.

I expect the candidates were seen alphabetically. My interview was in the afternoon and I was given a cup of tea during it. I had a plan for the scope of the department. It envisaged, before that day, three parts, roughly biochemistry etc., physiology etc., ecology etc. with a strand of genetics connecting them. I picked up a copy of the prospectus at the reception desk in Kings Manor that morning (they had not been sent to candidates) and found that it envisaged half courses, as did the Development Plan, which I didn't see until later. So I modified my plan, sitting in the grounds of the Minster, into four bits to allow half courses. The structure of the course in 1965 is given below. Some of the discussion at interview, particularly with Dick Norman, was about an undergraduate course in biochemistry which I took to be half biology and half chemistry. Dick seemed doubtful that anybody could drop half of chemistry. Michael Swan asked about mathematical biology, to which I said I would like to be strong but doubted if I could get the staff. There was also some discussion of the nature of the university, and I mentioned conversations about that with Dick Fifoot (see above) and Murdo Mitchison (second professor of zoology in Edinburgh, who had been consulted in some way) and, I think, articles by Eric James in the *Listener*.

My chair was announced publicly, after a meeting of Council, on 20 September 1963. Michael Swan published an anonymous note about it in Nature for 26 October (**200**, 314).

By the time we had our first undergraduate entry, for 1965-6, all joint courses had become ⅔ : ⅓. We offered biology with education from 1965, biochemistry from 1966.

My letter of appointment was a hand-written letter from Eric James on Athenaeum Club paper. He told me soon after my appointment that I should appoint someone I knew, to be in York in 1964-65, to select our first undergraduates. I offered it to John Currey in Oxford on 10th December 1963 and he accepted on the 11th and he later saw Eric James who said something to the effect of just the sort of person we need in York. I don't think any references were taken up.

Nature of the university

The prospectus for 1965 puts it this way: "The University of York is being planned to encourage the growth of an academic community that is alive to the needs of society at large. It reflects some of the new ideas about university practice under discussion in this country and elsewhere. ... There is no rigid division into faculties ... There is equal emphasis on the twin functions of teaching and research with the fullest possible correlation of the two. A central role is given to the tutorial system, which provides an opportunity for the creation of those personal links between teachers and students that help to make a university a place of education rather than one simply of instruction."

Pat Nuttgens, in his autobiography (2000) *The Art of Learning* (The Book Guild Ltd, Sussex) describes the fairly informal planning of courses and buildings that went on in 1961 & '62, though he doesn't mention tutorials. He says: "The Vice-Chancellor's concept of the university was based on his experience as a student at Oxford" and hence the emphasis on colleges and personal contact.

In starting Biology, we gave (and still do) every student a supervisor for their whole time and a tutor, for a weekly tutorial, who changed each term in the first two years. David White in an inserted passage in my next chapter, describes the daily routine of lectures and practicals. I think some biology students find colleges very important, others of no importance at all. For all, there is a focus on the department.

The Development Plan [*University of York Development Plan 1962-1972*, published in 1962 by the York University Promotion Committee, 85pp.] envisaged three science buildings (S1, S2 and S3) which were thought of by Eric James (and probably by the Academic Planning Board), as Physics, Chemistry, Biology. The Development Plan also gave the size of the buildings and the numbers of undergraduates, postgraduates, teaching staff, technicians, other staff. Those numbers were the only brief I had; there was absolutely no academic advice or constraint. S3 became the Biology building (shown in the right place on a site plan, Figure 1), to be ready for the start of the 1968-69 academic year, with S1 (chemistry building) from 1965, S2 (physics building) from 1967, and the departments distributed accordingly. That was how I came to plan for an eventual size of 36 staff. Ramsey Bronk said that that was the figure he had thought we needed to cover the range of subjects.

Most of us appointed for 1965 moved to York in the summer of 1965 but, in order to have undergraduate admissions attended to and equipment ordered, John Currey, Wally Smithson (Chief Technician, the title Laboratory Superintendent came later) and a secretary worked from Micklegate House, John from December 1964, Wally from May 1965. David Waddington (senior lecturer in chemistry) and Oliver Heavens (professor of physics) were also there, with equivalents. I received no pay from the university before moving to York, on 1 July 1965, but the university paid my travelling and other expenses and for a part-time secretary in Edinburgh, Mrs Richardson.

So the department was in Micklegate House 1964-65, Chemistry 1965-67, split between Chemistry and Physics in 1967-68 and in our own building from just before the academic year 1968-69.

Academic staff and structure

My plan for biology required us to be strong in biochemistry. The procedure for new posts then was to bring proposals to the Professorial Board (PB). The General Academic Board (GAB) and Council also existed but Planning Committee didn't. I could attend PB but had no vote (so didn't vote in the contest between Alan Peacock (Economics) & Philip Brockbank (English) to be the first Deputy V-C, which Alan won). I was at PB on 19th December 1963, 20th February, 19th March 1964 and later. My proposal for a chair in Biochemistry was on the agenda of the meeting of 20th February. There were also proposals for chairs in Physical Chemistry and Theoretical Physics. All were approved without difficulty. I was relieved that Dick Norman, who was there, made no adverse comment. My copies of the advertisement (Times, Guardian, Nature) and the further particulars are not dated.

I had to get an external assessor and discussed possible names with some colleagues in Edinburgh (Murdo Mitchison, Peter Walker). Michael Swan then told me he had approached Professor Neuberger who had agreed. I had never heard of Neuberger. My first letter to him is 26th March 1964 saying "Michael Swan tells me that you would probably like to be the Assessor for the next Chair of Biology at York. I would be delighted if you would." and, after discussing timing, "York will have three Science departments: Physics, Chemistry and Biology, each with four Professors, and each with an eventual annual intake of 120. .... I hope to have the department centred on Genetics and strong in both Biochemistry and in population studies (my own interest). So, for this Chair, I am looking for a man who is a good Biochemist, but also interested in, and sympathetic to, Biochemical Genetics."

Neuberger was Professor A. Neuberger FRS of the Department of Chemical Pathology, St Mary's Hospital. He was an excellent assessor, very helpful with much good advice. I think Swan knew him through the MRC. He accepted in a letter to me dated 3rd April 1964. The chair was advertised and I sent him the further particulars on 27th May. Presumably those are in the university archive but I need to quote the first two points:

1. The Biology Department is expected to grow to a staff of 36, including 4 professors, an annual intake of 120 undergraduates, and over 100 post-graduates by 1970.
2. It is hoped to appoint to the second chair someone whose interests lie in the general field of Biochemistry, Biochemical Genetics, Molecular Biology and Microbiology.

The interviews were held on 14th August 1964 by James, Neuberger, Alan Peacock and me; West-Taylor in attendance. Dick Norman couldn't make it but sent comments on the candidates. Ramsey Bronk, who was appointed, was on sabbatical in Oxford. He was an associate professor of zoology at Columbia, becoming a full professor before coming to York for 1st October 1966. That meant he was readily available in 1964-65 for interviews, discussing equipment lists etc. I remember discussing UCCA (undergraduate application) forms with him and John Currey in a bedroom in the Abbey Park Hotel, Blossom Street. On 10th September 1964 the Bronks and RB Fisher (equipment assessor, see below) came on a social visit to our house in Edinburgh.

Other appointments. We advertised for Readers, Senior Lecturers, Lecturers and Assistant Lecturers. All the best candidates were young and in 1965, of those in York, five of us were in our twenties, only John Currey and I were in our thirties. We appointed to come:

- in 1965: John Marsden, Ken Murray, Robert Reid, John Turner, Alan Winter, Alan Wilson (the only Assistant Lecturer and that for only one year).
- in 1966: Jane Baxendale, Mike Chadwick, and Rachel Leech.
- in 1967: David Kirby and Michael Usher.

Whatever their appointment date, all were invited to the planning meetings I held in York. Of those eleven, six had unusual interviews. Ken Murray was interviewed by Neuberger in New York at the end of July 1963. He resigned just before our first term (probably in September) 1965 to stay with Sanger in Cambridge, though he came up to give his lectures in the autumn term. He is now Sir Kenneth Murray FRS, founder of Biogen and emeritus Professor of Molecular Biology, Edinburgh. John Turner was in Trinidad working for his DPhil with EB Ford of Oxford and having been an undergraduate under Philip Sheppard, Professor of Genetics in Liverpool (an old friend of mine from Oxford and a cousin of my wife), so we relied on Philip's reference, which was most accurate. Alan Winter was at Harvard and interviewed by Dick Norman who toured America interviewing in several places for all three science departments. Jane Baxendale, an electron microscopist, came through Edinburgh recommendations. She visited York on 10th September 1965 but later resigned to stay in USA and was replaced from 1st October 1966 by Tony Robards (who had a normal interview). Rachel Leech was already a lecturer at Imperial; I interviewed her in my office in Edinburgh. Michael Usher had taken maths at A level but then went to Edinburgh to read forestry. When I was teaching statistics to Zoology III, I was asked if I would add him to my class where he impressed me. I took him as an instructor to Malham Tarn with Edinburgh Zoology undergraduates 23rd-30th September 1964. I drove him back to Edinburgh at the end of the course, stopping at my family Cumbrian cottage, Swineside, to mend a window pane. On the lawn there I offered him a lectureship from 1967, when he should have finished his PhD (which he did, having also taken a Nuffield funded course in mathematics for biologists). The Registrar later took up references.

David Kirby, a developmental-mammalian biologist, was the third one of those who never came to York. He resigned for a post in Oxford (where he already was). He was in York on 16th November 1965. That may be the day when he and I had a meeting with Oliver Heavens and Michael Woolfson (theoretical physics, their second professor) about converting enough rooms in the physics building for a second animal house. We had some animal rooms in Chemistry, with Wladek Wloch in charge, from October 1965. The upshot of the meeting is that we had a portakabin structure tagged on to the physics building, used again as an animal house after the fire and later moved to the walled garden where it housed our Environmental Archaeology Unit (EAU, see the account pp 106). David Kirby died in 1969 having broken his neck in a car accident in Seattle.

The various interviews in York were all done by Eric James, John Currey and me, with Ramsey Bronk sometimes there; West-Taylor in attendance. The first interviews seem to have been on 13th August 1964, the day before the interviews for the second chair. John Currey and I interviewed, by ourselves with nobody in attendance, for a Chief Technician on 19th August 1964. Other interviews for technicians were all done by John Currey and Wally Smithson without me.

With sufficient staff appointed and available in Britain we held the first (unofficial) Board of Studies in Imperial on 11th February 1965. The arrangements were made by Rachel Leech. I sent a copy of the minutes to Eric James, the only minutes of a Board of Studies that was ever sent to Heslington Hall. We had another staff meeting in York on 2nd September 1965 which was, I think, mostly about our new building.

Building

The university's architects were Robert Matthew, Johnson-Marshall and Partners (RMJM or rum-jum). It was in effect two firms. Sir Robert Matthew was professor of architecture in Edinburgh and Pat Nuttgens' previous chief. I never met him and we had no dealings with the Edinburgh office. Stirrat Johnson-Marshall ran the office we dealt with from Welwyn Garden City. He had been chief architect to the Ministry of Education and before that county architect for Hertfordshire and had been involved in the CLASP (Consortium of Local Authorities Special Programme) system for local authority schools. The Development Plan has no named authors but I think was largely written by Johnson-Marshall and Andrew Derbyshire ("Project Architect"), both knighted later, with advice from Eric James.

My first meeting with the architects was in Slough at the offices of LJ Fowler, the heating and ventilation engineers, on 20th September 1963. I had been contacted by Dick Norman or David Waddington to go to a meeting there to consider design for service turrets and benching for the chemistry teaching laboratories, so I telephoned the architects to arrange it. They (I think actually Andrew Derbyshire) said they had been asking the university to tell them who had the chair in biology and the university had refused to tell them as it hadn't been publicly announced (see above). Fowler's gave us a large lunch at a fashionable restaurant in Maidenhead, Skindles. After lunch, Andrew Derbyshire discussed my needs in the chemistry building with me in a small and very hot office. A few days later, I was telephoned and asked to put those in writing 'as Andrew can't read his notes'.

I seem to have first met the architects to discuss our building plans properly, in Edinburgh, 15th-16th October 1963. We had to plan suitable modifications to the chemistry and physics buildings as well as plan our own building for occupation in 1968. The first architect we had was Ralph Baldwin. He was later shifted (autumn 1965 ?) and replaced by Philip Hodgkinson and Dick Howard. We also had to consult with the electrical engineers (Pinto, from near Warwick), the heating and ventilation engineers and maybe others.

My first job was to write the brief. I can't find it and don't remember much about it. I can say that it called for a building that couldn't

Figure 1-2

The steel CLASP frame of the base of the research wings, F on the left, D on the right, connected by E.

be split into sub-departments to ensure that biology stayed integrated. One first sketch by Ralph had a star of wings with research on one floor and teaching on another in each wing. The eventual plan, with separate teaching and research blocks joined by lecture theatres, administrative offices, stores and workshops fitted the no-split requirement. There were originally six sets of research corridors and teaching labs. In the autumn of 1965 the UGC revised the money available to the university for building starts, forcing us to reduce six to five, and so making the biology building smaller than both physics and chemistry.

In the chemistry building, all offices were internal, without windows, except for a luxurious office for Dick Norman and one for David Waddington. Oliver Heavens and I had to have changes made to get offices for ourselves and our secretaries; second rate accommodation. The fault was partly with the Development Plan which says for S1 (p. 48) Practical Teaching Acommodation1 (Science Departments) ...Suites for 3 professors .. (2 to be temporary)" and for S2 and S3 "Similar to practical teaching accommodation 1 with 1 professor's suite ...". Clearly the authors had no knowledge of senior/junior academic staff ratios, as they also had "50 individual staff laboratories" (p 48) and no distinct staff offices. In the physics department there were four professorial offices, each with a window looking onto an inner courtyard. For our own building John Currey and I were determined to have external offices mostly looking outwards and good daylight in the research laboratories.

The final result is shown below. The A corridor, the teaching laboratories, and G, part of the workshops, were single story, B, C, D and E two stories, with corridors labelled B0, B1, etc., and F was three stories. They are all still there except for the north end of G though with some changes to the internal layout of D & F, part of the refurbishment that went with the new (K,L,M) building in 2002 (see Figure p 1-4). We were told the building had a life of thirty years.

Our planning was constrained by a UGC pamphlet known as the red book. It laid down standards for most things: e.g. 120, 180 & 240 sq ft offices for lecturers, senior-lecturers/readers and professors. I visited the UGC offices in London with Ralph Baldwin to get clarification on animal houses, glasshouses and a few other points which gained us a little. The research wings followed to a great extent the recommendations of a Nuffield Foundation report, which had also influenced Murdo

Figure 1-3

The Department during construction from across the lake. The steel frame of F-wing can be seen above D-wing before the cladding is attached.

Mitchison's annex in Edinburgh zoology. That report suggested staff offices and laboratories on the outside, with wide corridors for shared equipment and 'ancillary rooms' in the centre. The red book standards required us to plan research laboratories with so many square feet per inhabitant, but specified 120 sq ft each for up to three research people, 80 sq ft each for groups of four or more. Arithmetic lead to most labs being built for threes. The wide corridors came from two notional graduate students (adding 240 sq ft to that allowed for corridors by formula). The ancillary rooms were five constant temperature and one cold room (always the southernmost) per corridor. Each corridor had one large office, with adjoining secretarial office, 2 medium, 3 small, six in all which, with five corridors (D0, D1, F0, F1, F2) implied 30 academic staff.

Equipment

We needed equipment from 1965 while we were in the chemistry building. The UGC procedure was for a university to ask for two equipment assessors for any new building and for the UGC to appoint them. I asked the Bursar (Cannon) to do that and he reported that the UGC didn't have a list of biology assessors but did have lists for botany, zoology, etc. So I asked for one in biochemistry and one in zoology. The UGC appointed Prof RB Fisher, Biochemistry Edinburgh, and Prof CFA Pantin, Zoology Cambridge. I think both had done the job several times before. Fisher clearly regarded it as his job to see that buildings were fully equipped. Pantin's attitude could perhaps be described as ensuring correct equipment. Fisher had been Ramsey Bronk's DPhil supervisor in Oxford and also, it turned out, a friend of my parents. John Currey asked for a Land Rover and a calculating machine for when

Figure 1-4

The Department as is was in 1968 apart from four glasshouses in the walled garden (see Figure 7-1).

he was in Micklegate House. Pantin said he would have to see the complete list but Fisher said 'of course, buy them'. One piece of advice from Fisher was to budget for more calculating machines; he discussed possible models.

The official procedure was that I made a list and sent it to the assessors. When they approved it they sent it to the UGC. In practice, I made a preliminary list and discussed it at various stages with the assessors, particularly Fisher, though I discussed equipment with Pantin in York on 4th September 1964. Where I felt out of my depth, the university agreed to pay a fee to others to help me. I asked two colleagues in zoology in Edinburgh, Alan Maddy, a biochemist who had worked for a while in ICI equipment accessions and Henry Bennet-Clark, an animal physiologist whose father was a founding biologist at East Anglia. There was time for Ramsey Bronk to have full input; he added some expensive pieces we had no intention of buying (see the next paragraph). I spent some time talking to company people and visiting. I remember one visit to the Vickers microscope factory in York (up the road from Rowntrees). Wally Smithson introduced me to Chapman of Northern Media in Hull. I also visited university departments. Fisher arranged a full tour of his with discussions on the equipment used. That included my introduction to the Spinco E ultra-centrifuge which got onto the list and was eventually bought. Various people advised me about electron microscopes. Pantin said I should go for the top of the range, others were just a waste of money. That advice came from his assessing equipment for the BM(NH), now the Natural History Museum.

One person I visited, to discuss both equipment and building, was Professor Davidson, Biochemistry Glasgow. He said he wouldn't approve a Spinco-E for a new university. His university had been pedantic about interpreting his list, insisting on referral to London if he wanted to change 100 ml beakers to 200 ml beakers. At York we had no constraints at all, it was all treated as a sum of money to be spent on what we wished, though there was pressure to spend slowly, at least after the initial equipping of our space in the chemistry building. That lead to a crisis in 1967 when the government suddenly decided to cancel all unspent equipment balances in all universities. James made a speech in the House of Lords and with other pressure the decision was cancelled. The pressure not to spend was no doubt partly to protect the university's bank balances but also because there was no proper system for renewing equipment once a building had been occupied. All universities but one, I believe, had the same attitude. Alan Williams (economics) said at a board meeting (GAB probably, he was a senior lecturer then) that it was a mistaken view; grants should be spent as soon as possible. I did a calculation for James of the sums needed for replacement. The numbers were so high he didn't believe them but in any case nothing could be done until the system was changed and we got annual equipment grants.

The outcome of all that was an equipment list approved by the UGC for about half the value of the building. The chemistry and physics lists came to very similar totals, no doubt reflecting that the three departments were planned to be the same size and all of us intended to be strong in research.

We went strongly for research grants from the start, as did chemistry and physics, an attitude that surprised some administrators. Mike Chadwick got a grant from Nuffield for plant growth chambers and other things. There were some plant growth chambers included as part of the building but there were none on the equipment list. Mike established a small ancillary lab with his chambers in the walled garden. We also had four reasonable size glasshouses put up there as part of our building spend. Mike commented that the York attitude to getting grants was very different from the indifference he had met in Agriculture at Cambridge.

Rachel Leech writes:

> The decision to buy appropriate and top of the range equipment was critical. If we hadn't been able to do this I'm sure our research credibility (& departmental reputation) would have suffered badly. Going strongly for research grants was another critical decision. With your support I was able to come to York in September 1966 with a good Agricultural Research Council grant which provided a full technician and I also brought a SRC funded fellow (Dr Chris Bucke)

and a Salter's Company funded mature graduate student (Stuart Ridley). With Wendy Crosby (departmental Junior Technician) & new plant growth rooms (initially in Chemistry and moved in 1968) & lots of new equipment, no wonder we were able to get off to a flying start!

The course in 1965

Our entry in the university's 1965 prospectus, so written in 1964, is given in Chapter 8 (p. 68) and shows a three part Part I and a four part Part II.

The latter reflects the half-course joint courses I was expecting. So the syllabus was soon changed to a three part structure with course 4 absorbed into the other courses (Biochemistry and cell biology, physiology and development, ecology and evolution). However it shows the range I was aiming for and the central role of genetics in the scheme. As mentioned above in 'Nature of the university', every undergraduate had a supervisor and a series of tutors. 'We had to plan a proper third year fairly soon and the Board of Studies decided to have no practicals, only a project with a single supervisor. That was becoming common in British universities. We also decided to have no practical exams, only continuous assessment, in the earlier years.

We also took graduate education seriously from early on. Even though we had rather few research students initially, only five in 1965-66 and 22 full time in 1968-69, we decided:

- that as far as possible all research students would attend and be assessed on formal courses
- that the supervisor could not be the internal examiner, and
- that theses could consist of chapters written as papers for publication.

The rate of growth

Not only was our first building only 5/6 of the size envisaged in the Development Plan, our growth was slower. This was largely from a lack of good enough undergraduates, though we were much more successful than physics and chemistry, exceeding their combined size in a few years. It was also because of repeated financial crises with deteriorating staff/student ratios. In 1965 we had 7 academics, 7 biology technicians + a share of 'university' technicians (4 fte, workshops, photo, stores) = 11 technicians, 2 secretaries and 41undergraduates (29 biology and 12 biol/ed), necessarily all in their first year. In 1968 we had 17 academics, 38 technicians, 5 secretaries, 73 first year undergraduates (64 biology, 2 biochemistry & 7 biol/ed), and of course our own building. By then we had a well established department, the largest science department in the university.

Notes

1 Committee on Higher Education (23 September 1963) *Higher education: report of the Committee appointed by the Prime Minister under the Chairmanship of Lord Robbins 1961-1963,* Cmnd 2154, London HMSO.

2 Report of the *ad hoc* biological research committee. A report presented by the Council of the Royal Society to the Chairman of the Advisory Council on Scientific Policy in November 1961. London, The Royal Society. with Appendix 1: Memorandum on the organisation of biological subjects in universities in the United Kingdom.

3 Ken Murray died on 7 April 2013.

The Department from 1968-1984

Mark Williamson

with contributions by Simon Hardy, Jim Hoggett, Peter Humpherson, Brian Johnson, Rupert Ormond, Gary Smith, Barry Thomas, Dave Thompson, David White, Alan Wilson

Life in the department in the '70s

In 1968 the department could be said to be established. We had our own building, we had grown to seventeen academics, a little over half way to the plateau of thirty in the later seventies, we had increasing numbers of undergraduate and graduate students and research grants, and we were pretty well equipped and had a good staff of secretaries and technicians. We had established procedures for admissions, teaching and examining. I wanted us to be as good as possible in both teaching and research. For teaching, it was a matter of university finance and that meant keeping student numbers up, as most of the money was capitation, and fighting our corner on university committees. Some research too was supported by the university, but excellence required external grants. In our new building we had a pool of secretaries in the general office overseen by Joan Chambers. She asked me for a list of priorities to help her. I put grant applications at the top of the list.

From 1968 until I stood down as Head of Department in 1984 it was principally a matter of growth and consolidation apart from the major interruption of the fire of March 1973. Eventually we were pulling in half the grant money coming to science in the university. It was my intention that, as far as possible, everyone should be happy to be a member of the department if not happy in other ways. I think that happened pretty well throughout my headship, though the fire, naturally, made many people very unhappy. It was what Dale Sanders often called collegiality. One instance is flexitime for technicians. Peter Humpherson, thinking about the resentment of some technicians at having to work fixed hours while academics were more flexible, suggested introducing the scheme we still have. With my support, we got it approved by all the relevant university committees.

To describe this period I have therefore drawn on the reminiscences of various people.

First ***Peter Humpherson*** comments on what I've just written:

> I would like to support the points you made about the department as a place to work in e.g. 'everyone should be happy to be a member of the department…'. I agree strongly that it was a happy department to work in and it was easy to feel, as David White puts it (below), 'being part of an exciting development'. An important point is that it was true for all sections of the department and it was to a large extent due to how you set the whole thing up, even to concept of the shared research corridors (with a senior technician in charge) and committee structure.
>
> From the beginning all staff were respected, listened to and encouraged in various ways to feel that they were making a contribution. We had different functions to perform at varying levels of skill or importance but nevertheless one felt we were all equal. Flexitime was a good development too in that it blurred the distinction between different groups. Not only were we about 20 years ahead of the rest (the first in any university by miles), but the system was unique in that it was based on trust and didn't state a core time (your insistence for the ecologists!). We should also remember the Laboratory Committee. We may have wasted some time discussing the price of tea and biscuits but it did also involve staff at all levels on issues important to them. Another structural mechanism to say we are all in this together.

Rupert Ormond came as a lecturer in 1974. He writes:

> My first impressions of Biology at York were of the packed coffee /tea-times, the wonderful expanses of glass windows in every office and laboratory, and the clever big corridors where shared equipment and benches were placed. All this was such a change from the ancient and venerable Cambridge department where I had spent seven years, where the doors were so thick and solid you hardly knew who was in the next room, and tea-time in a tiny enclave, though replete with Nobel prize winners and FRSs, a stilted affair, in which PhD students ventured to participate only with trepidation, and undergraduates never. Biology at York by contrast was a huge breath of fresh air, with in those days a crowded coffee time at which almost all staff and students gathered on a daily basis, much it seemed to me to the benefit of both.

David White gives a fuller description:

> When I joined the Department in April 1971, we occupied what was essentially the finished Biology Department building as conceived by Mark Williamson. This was a CLASP building, in keeping with the other buildings around the campus: principally the five colleges and Chemistry and Physics Departments.

Figure 2-1
David White by Nev!!!

> All academic staff were given an office adjacent to a research laboratory. There were five research corridors, each with space for six staff, that is a capacity for 30 academics. The design was such that there were in effect three sizes of laboratories. We were also provided with a technician and sufficient research funds to do research with a group of this size and a research student. I asked for, and was given, sufficient equipment to get on with the research I was doing, and there were funds annually for equipment allocated by Mark [in consultation as necessary with others, not a matter for the Board of Studies (see below) MW]. Part of the equipment I requested was a computer to control my experiments, and I was allocated the Departmental computer, a Hewlett Packard with 8k of memory, not the PDP 8 with which I was more familiar. There were no other computers in the Department at that time, and of course no e-mail, no word processing, but very good staff to do typing in a central office. I had my own typewriter and carbon paper.
>
> I came during the initial growth phase of the Department. I was the nineteenth member of staff [23rd appointment MW], and over the next two or three years the numbers increased to the mid twenties, and became stable at thirty from 1976 to 1983. There were three 'established' chairs, and there were no other professors in the Department in the early days; the rest of us were all too junior. These chairs were in ecology, held by Mark Williamson as Head of Department, whole-organism studies (physiology) held by John Currey and biochemistry (held by Ramsey Bronk). Academics mostly fell into one of these categories, geneticists the main exception, so I was within the physiology compartment. Despite the fact that there were three areas, the Department felt coherent and integrated. Before the wave of new Universities founded in the early 1960s, of which York was one, most biology in Universities was in distinct departments of zoology, botany and more recently biochemistry and so on. York was 'biology' (emphatically not 'biological sciences' which would have

allowed the separation to continue), and achieving this coherence in reality was part of Mark Williamson's vision.

Part of this coherence was enabled by the emphasis given to staff meeting twice a day for coffee/tea in the concourse. This was the hub of the department. It was used for coffee in the morning and tea in the afternoon. Lectures were at 9:15 and students poured out of the lectures at 10:15 for coffee. Technicians, of whom there were many, and the academic staff met at 10:30. We were expected to limit this to 15 minutes, and broadly we did. We sat in the seminar room or went outside if it was sunny. Almost all staff did come down, and the few that seldom came stood out for this fact; the social pressure to arrange your day around these two slots was strong.

Part of this coherence too was because of the way that the Board of Studies worked. The Board of Studies met at the start and end of each term and was supreme and effective, and everything of importance was discussed and decided there. It was very rare for an academic member of staff to miss a BoS meeting. The Chair of the BoS felt second only to the HoD in the scheme of things, and it was just about small enough to be functional and take things forward. Mark Williamson as HoD developed the Department and the BoS ran the teaching of both graduates and undergraduates.

Not only was the building simple and structured, so was the teaching. The first and second-year teaching day had lectures at 9:15 and 14:15, with practical classes from 10:15 to 13:15 and from 15:15 to 17:15. Wednesday afternoons were for sports, with a research talk late in the afternoon. Two half days did not have practicals; these were for the tutorial slots, and the norm was that all academic staff had one first-year and one second-year tutorial per week with four students. Biology was taught very much as an experimental science. The course was common for all students in their first and second years. Third-year teaching was based on 'options' and there were roughly as many options as there were academic staff. Third-year students had to choose nine options and undertake a two-term project, and we each had about four project students. There was a separate Biochemistry degree which shared the biochemistry and physiology components of the biology course, but had teaching in the Chemistry Department rather than doing the ecology.

All very orderly, but for me all very exhilarating. I felt as though I were part of an exciting development; it was my first proper job and I had a very young family, so it felt breathtaking. Nearly all the staff were young, in our late twenties or early thirties. We had administrative responsibilities. I agreed to be the Departmental Safety Officer pretty early on, and wrote a booklet which was in a small ring-binder with a bright yellow cover and given to everyone. Looking back, it was a good booklet. However, it didn't prevent the Biology fire – 14 March 1973 – see below.

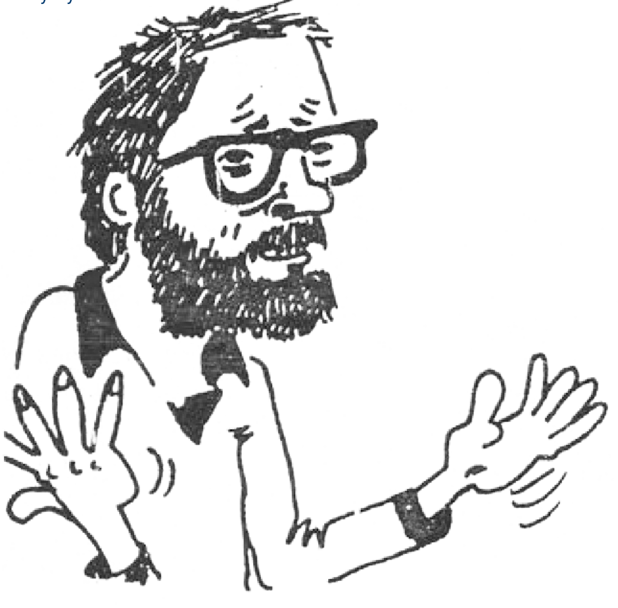
Brian Johnson (undergraduate 71-74 and later a graduate student) said, in the Alumni Newsletter in 2008, what it was like to be an undergraduate:

> After spending six years as an analytical chemist in local government I arrived at York in 1971 to read Chemistry. I was a 'mature' (if 26 is mature) student with a VW bus and some money in the bank. As I lay on my small hard bed in Alcuin that night I thought: "What on earth have I done? I've given up a well paid (but boring) career, left all my friends in Cambridge, to study yet more Chemistry – and then what?" I did some hard thinking that night and realised that I really wanted to study Biology, my passion in life (besides the usual pastimes of music, drinking and trying to get laid). Trotted off next day to Chemistry, just in time to hear the 'welcoming lecture'. This confirmed my worst fears - the theme was: "You are here to work, work, work - so get used to it right now!" I turned to the chap sitting beside me and said: "This sounds grim!

I'm off to Biology because I've heard it's a lively department and it has to be better than this!" He said: " I'll come along as well, just to have a look." The Biology Department welcomed us both into the fold, and the person sitting beside me in that lecture is now an FRS heading up an international research institute!

The Biology course at York in the 70s was great - with young, enthusiastic lecturers who inspired everyone to think deeply about all aspects of Biology, and then organised departmental parties to obliterate any conclusions (no Health and Safety stuff in those days!). I enjoyed my three years as an undergrad; not only the Biology course and university life, but also the freedom to roam through different departments (enjoying sociology and philosophy lectures as well), not forgetting the beautiful northern countryside with rich botany and wonderful trout fishing. Field trips to Wales and Scotland were pure pleasure; good company, inspirational teaching from the likes of Chris Rees, Geoff Oxford, Andy Hodges and John Lawton, and hazy evenings. I was student union chairman of Entertainments for a year and even shared a house with Greg Dyke and his dog at Escrick. To balance all the fun and work, we found the time to protest in our thousands (well OK - hundreds) about grants (remember them?), wars and Northern Ireland - today's students take note!

Figure 2-2
Simon Hardy by Nev!!!



Simon Hardy, writing in 2008 in the Alumni Newsletter on his retirement said:

In 1971 the new academic staff in the Biology Department besides me, were John Beddington (now Sir John and chief scientific advisor to HMG), George Kellett (now Professor), John Lawton (now Sir John and retired head of NERC) and David White (onetime HoD and lately Director of Research at BBSRC), all but one now very distinguished. It was a time of academic growth as in the following year we obtained Terry Crawford, Alastair Fitter, Geoff Oxford with Richard Firn, and John Sparrow the following year, though I think we also lost a couple who left for pastures new [Terry, Geoff & John were replacements, MW]. There were only three professors and about 20 previously appointed academics. To keep all these talented people busy teaching, there were about 70 biology and 20 biochemistry undergraduates in each year. Now with approximately 50 academics the Department has about 100 biology and between 40 and 50 biochemistry undergraduates.

In those early days there was an experimental feeling about our teaching which seemed to me rather different from that at Leicester where I had been a post doc, and where I had given some lectures in a molecular biology course. As a new department with a substantial number of students and staff we had a lot of freedom and not much tradition, and we had just lived through the 60s when 'to be young was very heaven'. It was wonderful to find that tutorials were taken very seriously, occurred weekly throughout the first two years, and were not assessed. At Leicester they had just been for the first year and occurred sporadically. I was very lucky in my very first second year group who were talented, enthusiastic and friendly. I became convinced and have remained convinced that tutorials are the most educational thing we do, in that students are more or less forced to participate, learn that they can understand quite difficult concepts without help and gain the confidence to solve new problems.

This is even more important today when A level teaching has become much more like spoon-feeding. (I am blaming the exam culture and the attitude to it of the media and not schoolteachers for this.) It is therefore with considerable concern that I view the reduction in number of tutorials per term from 8 to 6, that recently occurred when we started teaching a new course in 2006. Yesterday's man speaks! (I append to this article a 'debate' about tutorials between me and Barry Thomas from the Chemistry Department on the different philosophies behind them in the two departments.) Now, although I am a big fan of tutorials I do not claim that I have always been successful with my own. More often than not the students gave me a very good tutorial report but some have been critical. One group of second years who had chosen me without knowing me (I had had a sabbatical during their first year) ended their report with the sentence 'Sorry to be so negative but there was nothing good to say.' But overall I believe that both staff and students enjoy as well as learn from their tutorials, and that they help to maintain interest in the subject. Another consequence is the good relationship that exists between staff and students within the department and a high departmental morale. My most treasured tutorial compliment came from a supervisee of John Sparrow, 'Dr. Hardy's tutorials made my brain ache!'.

When I was an undergraduate I was a disaster in practicals and felt that I never learned very much from them. As I started my Ph.D. I was therefore surprised and delighted to discover that I was really rather good at doing experiments and I realized that that was because I had designed them myself and pretty much knew what I needed to do and why. So I always tried to incorporate some design aspects into practicals. A practical that I was asked to run almost from the earliest days, and became known for, was the Interrupted Mating (of bacteria). This allowed me annually to make a few ribald jokes but required the long suffering and very reliable teaching technicians to pour more that 1,000 plates! Amazingly it always was interpretable so that by 2006 I had more than 30 years of results to show students in the post mortem, but strangely the numbers of recombinants decreased over the years as though the two strains were becoming less excited by each other! Students liked this practical not just because of the ribald jokes but because they could clearly show the order of the genes on the DNA as it was passed from one strain to the other. I always asked them at the end if they thought it was a valuable practical and whether it should be run for the following year, and both answers were overwhelmingly Yes.

Now you, dear readers, will want me to stop rabbitting on and get to the important question. Are students today the same as you were ten, twenty and thirty years ago? (Subtext – were we smarter than them? The answer I'm afraid is No but they are no smarter than you were.) There are however differences. They are in my opinion more dedicated to their work but at the same time less independent, perhaps because of the exam culture they come from. They want to be taught more (they do after all pay more than you did). They do get better degrees on average, but whether this is because of modularization where less of the degree marks come from final exams, or because they work harder, or because of a slippage of standards, I do not know. I also believe it is significant that students make less fun of us today. No longer do we hunt desperately through Scalpel [the Biology students magazine] to make sure that our idiosyncrasies are there to be laughed at, because there has been no Scalpel now for at least 20 years. One incident that I think could never happen now was the Great Departmental Shaving, of about 1985, when for the first Children in Need Appeal (Red Nose Day), students contributed money for various members of the technical and academic staff to have their facial hair removed. It was a remarkable event, almost like a public execution, with undergraduates lining the balcony of the concourse and cheering as various faces never seen before or since emerged from their whiskery cover. When I got home that night our twelve-year old daughter wept over the transformation of her father.

Nevertheless our students have remained cheerful, supportive, tolerant and the same age. They continue to be on our side, perhaps because they recognize that we are doing our best for them despite some glitches and some nonsensical traditions. Their tolerance stretches to yesterday's people. When a recent first year tutorial group of Terry Crawford's was asked whether they didn't think that use of Powerpoint by all lecturers should be compulsory they said, 'Oh no. It would spoil the magic of Dr. Rumsby's and Dr. Hardy's lectures.' My most precious possession has been the lab coat given to me by the first year class of 88-89 when I was about to leave on a year's sabbatical. They presented it to me I think, because I had spent so much time with them in the summer of 89. It was signed indelibly by many of that class. And the best card I have ever received was from the second year of 2006-2007 who presented it after my last undergraduate lecture, one of a difficult series. I have had a wonderful time in the Department of Biology and to a large extent our undergraduates are responsible.

A discussion on tutorials between ***Simon Hardy*** and ***Barry Thomas*** of Chemistry

Simon: I recently read on the Unitarian Wayside Pulpit: "A student is not a vessel to be filled, but a candle to be lit" - and I thought YES! On reflection, I realised that both activities are important, but that the vessel-filling is much more difficult if the flames are not burning. In Biology, weekly tutorials are primarily for lighting and maintaining those flames. We are by no means always successful, but we try to do this by allowing students considerable choice in selecting their tutor for the term on the basis of his/her stated interests, by encouraging the tutorial group of four students to choose the topic to be studied (although often they prefer to leave that to the tutor), and by using a wide diversity of tutorial formats for illuminating the chosen topics.

When asked: "What was the best feature of the first two years of your course?", final year Biology students nearly always answer: "Tutorials".

Barry: In Chemistry, we try to ensure that each of the ten or so lecture courses each term has an associated tutorial, so that a second perspective is provided on content. Tutorial groups of three to four students are college-based, with the same tutor team being retained throughout the programme. We hope this approach improves student-staff relationships, with those tutors also being used informally as necessary. An unintended advantage is that tutors are used as supplementary supervisors when need arises.

The assigned work is returned and annotated in tutorials so that students can quickly seek further clarification. Our structure may seem somewhat rigid, but with small, balanced groups, topics can be developed further with the more able, whilst with others, fundamentals are reinforced.

Simon: Your tutorials sound very focused, and must be helpful for students in assessments. Indeed this explains why at the end of the first year, Biochemistry students, who have had four Chemistry and four Biology tutorials in each term, praise the Chemistry tutorials for their usefulness, with the implied question: "What are the Biology tutorials for?" With the current educational philosophy, where, alas, the tail of assessment wags the dog of education from age seven onwards, this is a fair question. However, we ignore it and fix our standard to an earlier model: that education is an empowerment gained from an enthusiasm for, and a critical examination of, an important human interest or activity. Thus for Biology tutorials, students conduct searches on the chosen topic, prepare presentations to be delivered to the group, write essays, or just formulate questions and ideas for in-depth discussion. In tutorials, assumptions are examined, dogma is questioned, evidence is scrutinised, scepticism is encouraged, critical thinking is practised and often some knowledge and understanding is gained, but only rarely is it helpful in assessments.

Barry: On the face of it, Chemistry and Biology would appear to use tutorials in very different ways. In practice, the differences are not major ones. Whilst Chemistry students do not choose the general topic of each tutorial, they have ample opportunity to direct discussion to aspects of the topic which interest them, or which they find confusing. Isn't there a danger in your approach that students will avoid areas of Biology they find less interesting, but in which a well-founded biologist might be expected to have some expertise? Incidentally, we hope we develop presentation and group-working skills in workshop activities and in group exercises, although that's not to say such skills are not reinforced within the tutorial environment.

What is clear from these two different approaches is that small groups are essential if all students are to benefit, and that both Departments have found four to be the optimum number.

Figure 2-3
Nev!!! in Scalpel, the Departmental Magazine, after the fire.

The Fire

The fire on Thursday 15 March 1973 was a major catastrophe. It disrupted the department for the best part of two years and destroyed much of the research area, which had to be rebuilt. So what happened, why did it happen and what were the consequences and aftermath?

What happened was that the incinerator that served the animal house set fire to the ceiling, and the roof over it, of the animal house on corridor E1 and from there spread to destroy the ceiling and roof of corridor F2. The alarm went just before the normal end of the working day, so the evacuation went generally smoothly and quickly. Kevin Brear, a technician who tried to fight the fire in the animal house, suffered from smoke and made a short visit to the hospital (and see Gary Smith below). The fire brigade could only contain the fire, they failed to extinguish it in either area so that E1 and F2 were totally unusable, and there was extensive water damage to E0, F0 and F1 corridors. Much equipment was damaged and had to be replaced.

It happened just before the end of term, so staff and research students could be relocated to the teaching laboratories. I took over the Chief Technicians office on C0, moving him to a smaller one. The Physics department had failed to grow, so the floor of the teaching laboratories in their tower that we had occupied in 1967-68 was still empty, and we moved much teaching back to there. Equipment in the mechanical workshop on E0 not damaged by water was moved to the nearby lock-up garages. All the workshop staff continued to work in the garage in G0. Lathes etc. in

Figure 2-4

The rear of E block with smoke billowing from the plant room [P] over the F-corridor staircase. John Lawton's office is behind the ladder, with his laboratory [L] to the left of that. The incinerator whose overheated chimney was the origin of the fire was within the building [I]. The chimney passed through the plant growth chamber area [G] from which smoke is also billowing. The building behind the fire-engine [W] housed a mechanical workshop and the electronics and glassblowing technicians (Block G in Figure 1-4).

both the Chemistry and Physics mechanical workshops were used as appropriate and when available. The electronic and glassblowing workshops on G0 were unaffected by the fire.

The heat had buckled the steel work of F2, so that that corridor was removed entirely, with the outside concrete panels laid on the ground until reinstalled on new steel. It was the time of the first oil crisis, so it was difficult and expensive to get the parts we needed for rebuilding. I remember a quantity surveyor looking at a bill and saying 'it's about twice what it should be so it must be right' and when we came to order pvc flooring being told 'any colour you like as long as it's brown'.

Throughout it all, most people stayed remarkably cheerful and got on with their work as best they could. Research studentships and grants were extended, typically for one year. Dealing with the effects, rebuilding and re-equipping took the major part of my time, and that of others involved in administration, for two years, but eventually we got back to normal and told the world by having an open day, the first in the university and Martin Rumsby's idea.

We had offers of help from Bangor, Cardiff, Leeds, Liverpool, Oxford and St John's York which we didn't need to take up. We had excellent support from the other science departments, the university library and the bursary.

Why it happened was that the animal house incinerator chimney should have been in a brick lined void, but was installed touching the building. It was a two skinned metal chimney, designed to be cooled by air

Figure 2-5

The Staff Team for the Staff-Students Rugby Match on the day of the fire

Back Row: Peter Barnes technician, Keith Webster RS, Andy Tasker RS, Brian Wright technician, John Broughall lecturer, Alastair Fitter lecturer, Simon Hardy lecturer, Tony Robards lecturer, John Beddington lecturer.

Front row: Gary Smith RS, Geoff Oxford lecturer, Peter Ingham RF, Peter Williams RF, Barry Longstaff RS

John Lawton (Lecturer) also played but was absent from the photograph.

Figure 2-6
F wing during the fire

Figure 2-7
Peter Humpherson by Nev!!!

circulating between the skins, but negated by a flange welded across the gap half way up. The chimney ran naked up through the animal house. Wladek Wloch, the chief animal technician, found it too hot to touch and it was boxed in by the Maintenance department, concentrating the heat further. On the day of the fire, a set of rabbit corpses, used by a project student of Mike Chadwick's to study lead pollution, were being burnt, a process that took many hours. When the ceiling spaces above E1 and F2 caught fire, the spread should have been limited by fire stops, shown on the plans but never installed.Others have written reminiscences: Peter Humpherson, then a senior technician working with Ramsey Bronk, Gary Smith, then a research student with Alan Wilson (who adds a comment) and now a professor at the University of Pennsylvania, Dave Thompson, then a research student with John Lawton (JHL), now a professor in Liverpool University, and David White. I've added those below. John Lawton writes about the consequences for him and how it lead to a fruitful collaboration with John Beddington in his research account, chapter 10 p 88.

First, ***Dave Thompson***:

> There had been an intradepartmental rugby football match early that afternoon, so all my sport kit was in the lab on E2

and was ruined. I was sitting at my desk which faced over the car park. I pointed out to JHL that there were wisps of smoke coming up through the ventilator grills in front of my desk. (It is possible that he noticed them in his office and came to check in the lab.) He went next door and found that similar wisps of smoke were coming up through the floor adjacent to the sides of the incinerator pipe that passed through that room. He went down in the lift to investigate. I walked down the corridor to tell Andy Hodges that the Department was on fire. At this time it seemed not at all serious as there was no smoke in the corridors. By the time I returned to the Lawton lab there was smoke and it was clear that we should evacuate the building. I still left my jacket, including wallet, on the back of my chair and went downstairs to the car park. I still did not believe that this was a serious problem. That all changed in an instant when the animal house ceiling collapsed and all of us in the car park saw flames for the first time.

The consequences academically for me were that the one result I had obtained to date (I was 6 months into my PhD) was destroyed and there is nothing in my PhD that I did during the first 18 months of my Studentship. I did become very familiar with the literature and by the time I was able to get back to experimental work I had a pretty clear idea of what I wanted to include in my thesis. JHL kept me busy, by among other things, getting me to review a book for Journal of Animal Ecology (my first publication). Financially I lost a year and that is now coming home to roost as I am having to pay extra AVCs in order to get a full pension if I retire at 65.

Gary Smith, who had been playing in that rugby game, writes:

I have never forgotten the fire. My colleagues at Penn scoff at the seriousness with which I take fire practices, but I can still remember trying to find the exit doors at the end of a smoked filled corridor (F1) that just five minutes earlier was completely clear. I also keep copies of my work in different locations.

Alan Wilson comments:

Now you make me feel responsible as I got out quickly, and I don't remember Gary getting left behind. I stood outside and watched the whole fiasco. The fire on the floor above stopped at my office wall where I had all my books, so very few were ruined, apart from those on my desk. I still have one smoke-blackened and smelly book on The Liver Fluke that I was unable to replace.

Peter Humpherson writes:

The fire was the result of a faulty design in both the construction and location of the animal house incinerator. For aesthetic reasons and against the advice of Wally Smithson, Chief Technician, the architects decided to site the incinerator in the entrance passage between the stores and the mechanical workshop with the chimney passing through the inside of the building at the mid-point of the animal house.

The fire started in the suspended ceiling of the animal house. Kevin Brear (John Currey's technician) reported to John Hogarth (chief technician in the workshop) that there were fumes on E2. Kevin, John and Dave Cooper (another workshop technician) went upstairs to investigate. In addition to smoke they found flames coming from the gap round the chimney pipe. They saw it was too serious to attack with fire extinguishers and left the floor. On the way Kevin broke the glass of the fire alarm, setting it off.

By the time the first fire appliances arrived I could see flames appearing along the several windows of the animal house. The fire fighters were unable to access the fire quickly at this early stage. The fire soon spread in both directions along E wing towards the junctions of D wing and F wing. Crucially the fire soon 'jumped' floors, which I believe was due to the igniting of solvents in the base of a fume hood in John

Lawton's lab on E2. The fire was then able to move through the hood into the ceiling void of F2. At this point the fire stopped advancing down D1 corridor. An additional factor in the fire stopping at this point may have been due the seals in the void space above the toilets, a useful though incomplete fire break. (The whole of D1 corridor was badly affected by smoke. Most of the chemicals had to be replaced and some equipment damaged, for example, the mirrors and lenses of all the spectrophotometers of which there were many.)

Over the next hours the fire simply worked its way along the ceiling void of F2. During this period many fire tenders were pouring water on the roof, through some of the windows and from inside up through removed tiles. Because of all the water, falling debris from the ceiling didn't ignite lab furniture, equipment or books. Extensive water damage and smoke damage resulted to F2 labs/offices and to a lesser extent to F1 and F0 floors below. The heat distorted the metal frame of F2.

Later that evening I became the first member of the Department to inspect the damage to the animal house and F2 corridor. I was carried around (piggy backed style) on the back of a fireman. A few mice and rats were found downed, their boxes having filled with water. [Most were rescued the following morning and moved to our old animal house next to Physics. MW] Thankfully, I was able to reassure colleagues, notably John Lawton, that although important papers and books were water or smoke damaged they had not gone up in flames. Nonetheless things were bad.

David White writes:

The fire was detected more or less simultaneously in John Lawton's laboratory on E2 and the animal house on E1. It developed quite rapidly. It was Kevin Brear, a technician, who broke the glass of the fire alarm, and we vacated in pretty good order. It was fortunate we did. F2 rapidly filled with dense black smoke. Although the fire brigade came promptly, there was little they could do, despite there being 13 fire engines pumping water from the lake into the building. The fire spread agonisingly slowly along F2, lab after lab being filled with flames along the corridor. My lab, at almost the far end, went up in flames, clearly visible from outside, about three hours after the fire started. Water poured into the first floor and to a lesser extent into the ground floor. The water level in the lake fell by eleven inches I believe – I never worked out what volume that represented.

It took about eighteen months before the building was rebuilt and reoccupied. We were well insured and could replace all the equipment we had lost. My HP computer was replaced; nonetheless the old one still worked with 4k of memory and I used it for many further years as a controller of some of my equipment. We camped out for all that time, mainly in the teaching laboratories (using some of the teaching laboratories in Physics for undergraduate practicals). Looking back, this was traumatic. Chris Rees lost a mass of electrical recording of experiments from insect sensillae that were on tape, and never returned to experimental neurophysiology. Surprisingly little paper was burned. Papers on my desk were still legible even though I had seen flames through the windows for an extended period. I was offered space in laboratories in University College London after the fire and spent six months doing research there, giving lectures and tutorials in York one or two days a week and working in London the rest of the week. I also used the time to write up my physics lecture booklet into a published book.

After the fire

Some aspects of the aftermath are covered above. Only one member of staff seemed unable to cope initially, but he recovered after a few years and went on to become successful both in York and internationally. Others changed paths, David White and John Lawton giving examples. Mostly we carried on much as before. For instance I had started an informal workshop on population dynamics in 1971. There was a second meeting at Imperial in '72 and I had organised the third to be back in York in '73. Despite the fire, we held it in the departmental library on C1 on 17-18 July, with 16 from York and 8 from Imperial but also with Bob May (now Lord May of Oxford), then at Princeton, Joel Cohen from Rockefeller (temporarily at Oxford) and 15 others from 8 other places. Michael Usher was just back in York having been in Africa for two years (and missing the fire) and he suggested quick publication of as many of the talks as possible. That came out as Usher & Williamson (eds) 1974 *Ecological Stability*, Chapman & Hall.

We held an Open Day on 7th & 8th May 1976. The programme says "In March 1973 a fire severely damaged parts of the research area ... The move back was completed in the summer of 1974 and reinstatement was completed in the middle of 1975. One of the reasons for holding an Open Day is to demonstrate that the department has fully recovered and is again functioning normally." The Open Day had been proposed by Martin Rumsby at the Board of Studies of 31st March 1975. After, in the usual academic way, setting up a committee to consider the proposal, the Board agreed to it on 26th June by 14 to 3 with 11 abstentions. On Friday 7th, we had invited-visitors in the morning, including our two local MPs, Alex Lyon for York and Sir Paul Bryan for Howden, which included the Heslington campus. We had school parties in the afternoon and a free for all on Saturday. There were about 50 research displays including those by the Cancer Research and Environmental Archaeology Units, 12 on our teaching and facilities and 8 on biological careers and student societies. A fine effort by all the department. What its external impact was is anyone's guess but it was certainly good for the department's morale and spirits.

After that, until I retired as HoD in 1984, the department changed little but became older, more successful and more widely known. When we first took in undergraduates, in 1965, the academic staff were between 24 and 37 years old (Alan Wilson & me). When I retired from being HoD in 1984, they were between 31 and 56 (Dale Sanders and me again), of the order of 40% older with twice the spread. We became financially much the largest department in the university though Economics and English had similar numbers of staff and students. I first realised this when Berrick Saul, having papers prepared for a visit by the UGC, showed that we were bringing in about half the university's science research money. That was true for my last ten years despite the rapid growth of computer science, electronics and psychology and was about 30% of the university's total research money.

We had no new academic appointments between 1976 (Sue Bougourd and Jim Hoggett) and the two New Blood appointments of 1983. Most universities and departments were similarly stationary at that time which is one reason why the New Blood scheme, to get new academic staff into worthy departments, was approved and run by the UGC and the research councils. We could apply, as a department, to any research council, with a research programme for the new lecturer, and so we applied to AFRC, MRC, NERC and SERC. We were successful with the first and third, appointing Dale Sanders (c.f. his account of his research work p. 89) and Richard Law.

On that high note, I decided that it was time to hand over and told the Vice-Chancellor I would step down.

Looking ahead

I end with a comparison of my time with now, by ***Jim Hoggett***, a revised version of a piece for the *Alumni Newsletter*. He was appointed Deputy Head of Department in October 2006.

> When I was asked to write a piece for the newsletter my first thought was that the very idea of a 'Deputy' Head of Department would be strange to much of the alumni readership. This made me reflect on the changed landscape of the Department, indeed of the University and of the HE sector generally, since I arrived in York at the beginning of 1974. The then Head of Department (HoD), Mark Williamson, was the founding head, and although the Department was not quite 10 years old, it still had the atmosphere of a new enterprise, despite a devastating fire and other challenges. At that time, the headship of

a department was for an indeterminate period, so questions about succession did not really arise. The Department was run by him, assisted by Margaret Britton, a very capable secretary who seemed to have her finger on every significant departmental pulse, and the academic structure was the responsibility of the Chairman of the Board of Studies.

It must be said that life was simpler then for most members of the Department, but maybe not for the person at the top. I remember the somewhat wistful note on Mark's door 'No morning calls'. I gathered from him later that many members of staff thought that this did not (of course) refer to them specifically. Managerially, the atmosphere was one of competent amateurism. The HoD was helped in finance by an academic member of staff, safety was the responsibility of another, personnel matters somehow got sorted, the Research Assessment Exercise (RAE) didn't exist, nor did student feedback, and University funding, if not particularly generous, was at least secure for five-year periods. The idea of a Deputy HoD would have seemed - at best - superfluous then.

So what has changed? One answer which will be obvious to any returning alumnus or alumna is size: the original building spawned a range of additions and satellites, many temporary and not particularly attractive, but these were dwarfed by the new building which was opened in 2002. This can't be described as an extension, being larger than the original, and dominating it. The building expansion reflects expansion in numbers of students, staff and researchers, and of course - turnover. In 1974 there were just under 30 academic staff, about 280 undergraduates, and 63 graduate students. The corresponding figures in 2006 are 58, 488 and 165. Even greater is the increase in research staff from a solid but comparatively modest 21 in 1974 to 159 at present. The financial changes over the period are in some senses even more dramatic, although the major changes in how the dual support system operated make it difficult to compare like with like. However, looking though figures for a presentation made last year to a returning 'Class of 76-79' alumni, I noted that research grant income in 1976/7 was about £306k, compared with £9.7M in 2005/6. The landscape has changed in other ways that have less to do with size, and more with accountability, regulatory requirements, competition for resources and, most recently, the student as customer.

It became clear, probably most obviously in the mid to late 90s, that the previous departmental structures that had served us well in a different climate, would not be able to cope with the increasing requirements of number, size and the demands made on the Department both internally and externally. In response to this, various vital support activities have been professionalised, most notably finance, personnel, and management of the Department's infrastructure.

Around the same time, the first Deputy HoD, Terry Crawford, was appointed. He will be known to alumni over the last 30 years or more as the source of the most expert statistical advice, willingly given to students and colleagues alike. He developed some of the roles for the Deputy, and set the standards. I did not need to be reminded that his would be a hard act to follow, and fortunately for me, even if colleagues have felt this, they have on the whole not voiced this - at least to me!

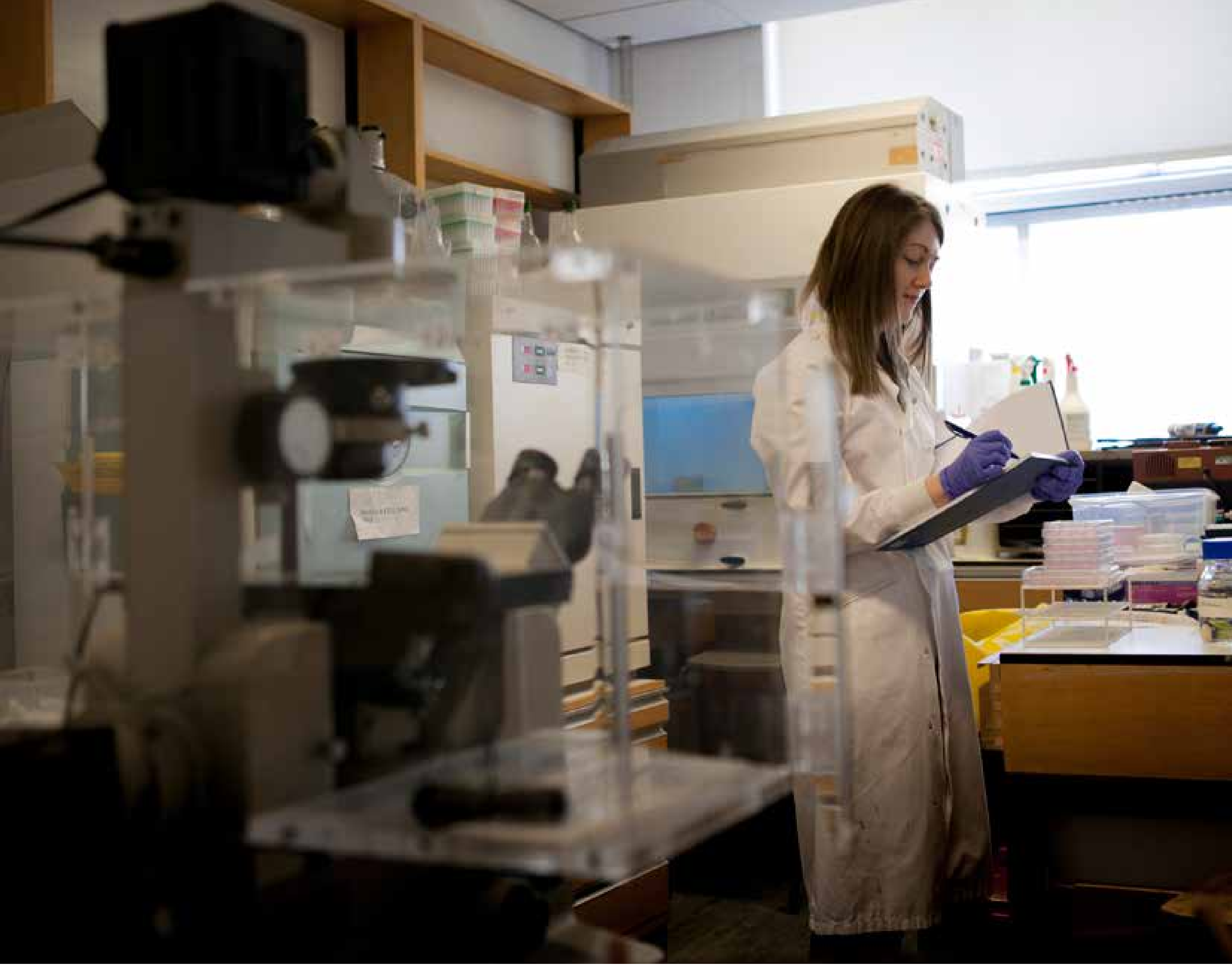
The challenge for the current HoD, Dale Sanders, in managing an operation as large and complex as the Department is a demanding one, particularly if the HoD (as they always have done, to the great benefit of the Department) maintains high-profile research activity and hands-on involvement in teaching.

So what do I do? Well, for this aspect of my work I do have a job description - interestingly, for the first time ever. The obvious ones are to stand in for the HoD at meetings, internal and external, and other events, such as some alumni occasions, degree days etc., and to deal with urgent matters in the HoD's absence. Through membership of Senate and University Teaching Committee, I can assist in being aware of University level issues and advising about Departmental developments and responses to them. As Chair of the Undergraduate Studies Committee, I have an element of shared responsibility for teaching with the Chair of the Board of Studies. A new development for the Department is the growing body of teaching fellows whose contribution to the Department is much valued. The intention is not to have short-term contract staff (as is more usually the case), but to build a proper and satisfying career structure. The overview of this will be an interesting challenge for me, as we are moving into somewhat uncharted territory. My focus in the job generally is on internal matters, 'internal governance' as it was put to me. That said, it is interesting to take part in external HoD meetings, where one can see the extent to which our concerns are shared (or not) with others - the competition! Thinking of competition and markets reminds me that we do have aspirations to develop new undergraduate programmes; not too many, and above all ones that play to our strengths, such as microbiology and biomedicine. I hope to be able to contribute in the development of these and seeing them come to fruition.

One aspect of the job that that I haven't yet mentioned, and one that I know Terry carried out very effectively and with great sensitivity, is being a confidential listener and sounding board to the HoD. In this, personnel issues figure quite heavily, and these can be particularly tricky for a HoD to deal with, especially in a University environment where there are complex tensions between individual freedom of action, collegiality and simply managing the whole operation. Collegiality, above all, is a quality that successive HoDs have worked hard to sustain and encourage. I would be happy to think that I could contribute to supporting this vital aspiration. In that respect we are lucky in our history; the original concept, quite unusual at the time, of a broad biology department insulated us from the factionalism that beset many other institutions, and provided us with a solid base for development.

Compared with US universities, British universities have been slow to nurture their contacts with former students. It is increasingly recognised that the benefits of closer association can be mutual, and they do not simply revolve around the idea of a fast buck to deal with university needs that can't readily be met elsewhere. That said, the introduction of Postgraduate Alumni studentships, funded through the generosity of its alumni, is an example of important support in an area where funding opportunities are limited. Recently, we have had several visits of groups of alumni to us in Biology, and we are very keen to develop this further. This newsletter is part of the jigsaw in keeping in touch with you as important (and continuing) stakeholders of the Department and the University. Dale and I would be very pleased to hear from you about what we can do to make these links more effective.

In the next chapter we go back to 1984.



One of the research laboratories in the original building, in corridor D1 (2013).

1984-1990

John Currey

I was head of Department from 1984 till 1990, taking over after Mark's long and very successful reign. My first job, and the most unpleasant I had in the whole time in the job, was to tell Ramsey Bronk, who wanted the Headship, that I was to be Head. He was very good about it, and never in my six years was my life as Head made uncomfortable by him. Of course, we had our differences, but his disappointment never showed.

There were, though I cannot remember the details, a few hard times. I remember going to see David Foster, the University Registrar, and saying that I didn't see how we could make the savings required of us. He said 'Well, what I think about the Biology Department is this...' and then went on to show how we could make the savings relatively painlessly. What was so splendid about his performance was that, of course, there was nothing special about Biology, and he must have had similar deep thoughts about all the other departments. Anyhow, for most of the time we lived in relatively benign times. The overwhelming majority of staff taught, and there were no thoughts of anything like Teaching Fellows. Appointments were still made in teaching areas. So we muddled on, and I handed over a rather quiet, though quite efficient Department with quite good morale to David White, who moved it firmly into the late 20th Century. I remember thinking, and saying, that if the numbers of Academic Staff rose significantly above 35, the Department would lose cohesion. David White thought that it was important to grow. He was right about the need to grow, and I was wrong. On the other hand the Department did, as David recognises, begin to lose cohesiveness.

I went on to be Deputy Vice-Chancellor (much less grand than it sounds, then). There was a weekly 'Prayer Meeting' in which the University's top brass agonised about how to stop the University going down the plughole. I thought that, as Biology accounted for say 20% of the University's income at that time, we would occupy about 5-10% of the Prayer Meeting's time. Not a bit of it. We were barely mentioned, and when we were it was in terms of 'Oh they're all right, just let them get on with it.'

Another thing I remember shows how important it is to keep friendly with people who have the money. Because of an ill-advised commitment we found ourselves owing the finance people £15k, which was a lot of money in those days. I went along to Heslington Hall feeling pretty downcast. There, the person who dealt with us said: 'Oh, don't worry John, I'll put it under a carpet somewhere.' Which he did. I am sure that he was only willing to do this because Mark, and then I, had been straightforward in our dealings with Heslington Hall.

Anyhow, rather than give a numerical account of what went on in my time in office, I thought I would mention a few things that are often, rightly, left out of official histories, but which often affect people's lives quite a lot.

Changing role of secretaries

In the old days secretaries functioned almost entirely as re-typers of handwritten or poorly typed manuscripts, position papers etc. Then PC's came along in the 80s, and the world changed for secretaries, and for everybody else. Paper writing and manuscripts are now done mainly by the Academic Staff, post docs or graduate students, themselves. The secretaries have in general moved on to what I hope are more interesting things like general or special administration. The role of secretaries has changed from being more or less typists to much more being administrators. This is because both of the increase in student numbers, and the enormous increase in form-filling required these days. No doubt some of the form-filling is useful. One administrator said to me the other day: 'In the old days, the Staff would do the admin, and call on us only when things got tricky. Now we do the admin and call on the Staff, very occasionally, when things get tricky.'

IFAB

The Institute for Applied Biology was an idea that came just before its time. We won some money from the University to develop an Institute for Applied Biology. This seemed to us at the time to be a good idea, and we thought that applying the biological insights and knowledge we were getting would enable us to build bridges to the wider world (and also improve funding for ourselves). Unfortunately, although we had a good leader in Tony Robards it never really got off the ground, in that it never generated enough income to be self-sustaining. Many Academic Staff turned out to be lukewarm or even actively hostile to the idea. I was particularly dismayed when one member of Staff said he didn't want anything he did for IFAB to get in the way of his 'real work'.

[See also Bernard Betts' account of his Microbiology Research Unit, p. 113]

Coffee (and tea)

In Mark's second part, several people mention coffee in the concourse as being an important meeting place where ideas were discussed and deals done. Even so, there were always a couple of groups, right from the start, that did not come to coffee, but rather had coffee in their labs. By the time I became head of department coffee was rapidly losing its place as a 'must-go-to' event. In fact Ramsey Bronk and I had fruitless discussions about how to get things better. These discussions never turned up anything very useful. Nowadays essentially all groups have their own coffee, though the structural chemists still have a lively chat at coffee time in the main concourse.

It is interesting how trivial external events can sometimes have a much longer-lasting effect than one would imagine. It used to be the case that at tea time the Academic Staff would have their tea in the 'Staff Common Room'. Technicians occasionally came in. Then, in the '80s we had a long hot summer, and the common room was deserted. As summer came to an end the Technicians moved back into the Common room first, and the Academic Staff felt inhibited from following when they moved inside, a couple of weeks later, so stayed in the concourse. This state of affairs continued for many years until tea was essentially abandoned by the Academic Staff.

Work habits

When the University first started most Academic Staff came in on Saturday mornings. Nowadays the place is almost deserted at that time. (We early ones never went as far as Peter Medawar and his group, who used to go in on Christmas morning while their wives (of course) prepared the Christmas dinner.) There were lots of reasons for this change in behaviour. One is the fact that it is so simple to do much work at home, because of PCs. On the other hand, I suspect that people take much less long tea breaks, because once one is settled in a reasonably comfortable chair there often seems no good reasons for getting up.

Lecture plans

Just to give an idea of how things have changed in lecturing, apart from everything being on Powerpoint, and students expecting handouts for everything. First, a very early memory, in 1965, when I was giving almost the first lecture in the Department, on genetics, someone lit up a cigarette. Fortunately I was able metaphorically to stub this out without causing a riot, but it was a close-run thing.

Next, and this relates to the way that nowadays everything has to be more or less pre-ordained. One day I came into the lecture room in B006 and said to the second years: 'I am not going to tell you about X (something about genetics) I am going to tell you about Lysenko, who has just died.' (Lysenko was a fairly stupid Russian who perverted the whole course of Russian genetics for about 30 years.) So I did just that. I think it would be pretty difficult to do such a thing nowadays, and if one did you would get people coming up afterwards and asking 'Are we going to be tested on Lysenko?' O tempora, O mores!

1990-1997

David White

The Biology Department in 1990

I was very fortunate in my time as Head of Department. The Department was in good order, active and with high morale in 1990, and, not primarily through my doing, we were offered significant resources to invest in new staff, building and capital enabling us to expand very considerably for the next seven years whilst I was head.

John Currey had ensured that we had appointed staff to keep us at the forefront of biological developments, especially the very rapidly developing molecular genetics, and this percolated through both our teaching and research. We offered a number of undergraduate degrees, but in an efficient way in that we had a common core of teaching in the first years, with specialisms being introduced, primarily, in the third year.

We had a very good base of staff who were committed to the Department. Research and teaching were both high quality, with a number of high-flying researchers, although no FRS's at that time. There was a genuine ethos that both research and teaching were important, and that university teaching was only done properly if it was taught within an active research environment. Everyone did some teaching. There was a strong graduate programme, with a highly successful MSc in Biological Computation, run by Michael Usher, and an active cohort of D.Phil students.

Whilst John Currey was head, the base of the Department had broadened, with a number of important units/centres focussed around individuals. John, with Tony Robards, had created the Institute for Applied Biology (IFAB) to exploit the Department's activities, with funding to build a new building alongside the original Department. Mike Chadwick had established an outpost of the Stockholm Environment Institute in York (SEIY), with funding for a significant group. Colin Garner and Carl Martin ran a small company, Microtest, not a formal part of the University but with University investment, housed in Portakabins adjacent to Department.

There had been two Research Assessment Exercises (RAE), in 1986 and 1989, in both of which we had achieved a rating of 4, which was quite good. Only a few University Biology Departments had scored 5 (there was no 5* then).

In short, the Department was in good shape when I took over.

The 1990s

The political climate for higher education was changing rapidly. The expansion of access to Higher Education, giving polytechnics University status, meant that the government could not afford to treat all Universities as equals for funding, and the RAE was introduced in order to enable the the UGC (as it then was, later UFC and now HEFCE) to fund Universities differentially. The outcome of the RAE was a score for each 'Unit of Assessment (UoA)', which in our case meant the Department. The research funding received by a University from the funding council depended heavily on that score which was used to determine a multiplying factor for the funds allocated for each member of 'research-active' staff.

Further, the University was itself becoming much more open about how its internal funding was distributed, and introduced a 'Resource Allocation Model [RAM]' in which both the income earned from all sources and the expenditure spent by a Department was shown, with the intended and obvious follow up that departments worked towards self sufficiency.

An important income component of the RAM was that accruing from a significant change to the dual-support system: the introduction of 'indirect costs'. Until the late 1980s research councils only paid the direct marginal costs of research. This created a significant burden on Universities particularly with growth in Research Council (RC) expenditure, who had to find the indirect costs, the additional infrastructure needs, the heating, lighting and so on, from their funding council funds. This was recognised, and RCs started paying for such items, including salary contributions for departmental technical input. This too became a driver for staff to obtain external income.

Some Universities took their funding models further than we did, charging Departments (and staff within those departments) for space; although in my time this did not happen in York, it lurked in the background. I received monthly Departmental accounts from the University Finance Department, and gradually detailed financial information was provided to individual staff. The computer programme behind the RAM was changed from time-to-time, following one instance of which the Departmental accounts had no information (all entries were zero) for about six months. Such is the efficiency of programming. I'm sure that Mark Williamson and John Currey knew the state-of-play financially in their time, but I don't think the pressures were so open or so formal.

One of the first things I did when I started was to build a set of databases, of membership of the department, of funding, of publications and of space allocation. The state of development of computing (Microsoft was hardly more than a gleam in the eye then) meant that these were in a more rudimentary form before I started. My ignorance of detail when I took over was palpable, and I spent considerable effort in understanding these issues. This was essential, both for discussions internally ("Dear David, I need more space – X has much more than me, and I'm much better than him/her, Yours Y") and within the University (Dear David, Planning Committee has allocated you the following… Don't be offended that the Department of Z has R resource. Yours, Finance Officer). I got elected to the University's Planning and Policy & Resources Committees, and thereby to the University Council; significant University policies were developed by these. Associated discussions with officers in Heslington Hall were easier with some facts at one's fingertips.

John and Mark had maintained their offices in the research corridors, alongside their research groups. Wisely or not, I decided to have an office in what was broadly the administration part of the Department. Avril Harrison worked with me as my secretary and we had our offices between the General Office and that of the Laboratory Superintendent (then Wally Smithson) and Martin Ellis who maintained the accounts. This meant I was more remote from my research but this did allow me to more easily keep my finger on the detail of the Department. As far as research was concerned, I relied heavily on John Sparrow and Justin Molloy who developed a new line of research with me in single-molecule mechanics via optical tweezers.

All this is by way of explanation to say that what we were going to be able to achieve was vitally dependent on what resources we had to work with, and that we could influence this. Funding for under¬graduate teaching was dependent on student numbers, allocated by funding councils, and with little opportunity to influence these in a major way. Funding for masters courses was in part via awards from Research Councils and in part from them finding other sponsors plus fees from those who were able to fund themselves (often from abroad) and this mix applied to D.Phil. students also.

It seemed to me that much would be determined on the basis of a Department's RAE score – more than simply the funding council funds, and that expectancy has proved correct. Different subjects were assessed independently, and each subject area in each University chose which staff to enter – its 'research-active' staff. Research funding was only given for those staff. The RAE introduced an inherent instability: a high RAE score generated more funds, and the greater funds were major enablers for further achievement. Further, it was apparent that the funding differential between scores was likely to increase, making it even more important to obtain the highest ratings.

Of all of the above drivers, the RAE was new, was very significant, and the major influence on my thinking throughout my time as HoD, as it was with many others.

I was very fortunate also in the considerable help given me by Alastair Fitter. I asked him to be Associate Head, and his support was very important in many, often behind-the-scenes, ways. This was a very different role to that played later by the Deputy Heads.

Research Assessment Exercises

So, the development of the RAE dominated my tenure as HoD. The consequences suited my nature and inclination. What was clear to me was that being a top research department was essential for many reasons, perhaps obvious but not universally agreed in the Department. The earlier RAEs, when John Currey was HoD had shown how the criteria were applied in practice; this was an assessment of individual performance and the state and ambitions of the Department. Again obvious perhaps, but not universally understood or accepted. Whilst the ethos of the Department was that all academics undertook research, a significant part of that research was of low impact, and what mattered was impact – in publications, in peer acceptance and so on. The criteria were clear, and to my mind correct.

The view of the Vice Chancellor, Berrick Saul, shared by Council, was that York would only survive effectively in the evolving climate if it remained a top-quality research University, and he understood the importance of the RAE for the University to achieving and maintaining this status. Relatively early during my tenure he persuaded Planning Committee and Council to release funds for a number of senior appointments (Professorships and associated posts) to be offered to those Departments judged to be capable of becoming RAE 5 (before the days of 5* - grade drift). The Biology Department was a potential recipient of that investment, and we were given about a week to come up with proposals as to how we would spend the money/posts we were being offered.

I challenged three members of staff to come up with a written proposal in two days as to how we would do this, thinking that strengthening one area was the way to go – strength in depth. Of these, that produced by Dale Sanders was the most visionary and exciting. We were already strong in plant science with Rachel Leech, Dale, Alistair Fitter, Richard Firn and John Digby. Further, we had a realistic chance of becoming the leading centre for plant science in a UK University (it was unlikely that any University would take that accolade for academic centres more broadly from John Innes), whereas we were unlikely to attain that position in the other subjects (too medical), so we chose to move plant science forward. Berrick Saul bought into this vision, and the search started for the leading person to appoint.

The RAE submission

As far as the submission to the RAE was concerned, the issue as I saw it was that we had a game to play, in which it was essential that we achieved the highest rating (5 at that time) but within that priority maximising our income. Research funding was now only given for "research-active" staff, so the game (in the game theory sense) was to maximise the number of staff entered as research active whilst ensuring that those entered would ensure an overall score of 5. This required us to analyse each individual's performance in detail to make this judgement, and this had a knock-on effect in the future behaviour of staff.

This had an inherently divisive effect, not least because of the terminology 'research active'. Nearly all the academic staff in the Department were active in research at some level, yet we were internally about to assess the research quality of everyone, using the criteria we expected to be used by the RAE, and to have a dividing line above which those were entered in the RAE and below which they were not – the latter were by implication being judged, as far as the RAE was concerned, as 'research inactive'. Some members of staff understood the game, and some did not and were scarred by the experience. I don't remember the exact numbers, but we had about 43 staff eligible for entry, and in the end we included about 35 in the first of the two RAEs during my tenure.

What was made clear was what was expected from research.

The outcome was good in that we achieved the desired ranking, and good in that the QR funding received by the University attributable to the Department increased by over £1m, and was by far the largest increase of any Department.

New Staff

Berrick Saul's initiative had provided resource to attract new staff to the Department, very much with an emphasis on their research, and as indicated above, we decided to concentrate on plant science with this resource. However, two other organisations also chose to put significant funds to establish research in the Department, and we also took other initiative to build up the research strength and postgraduate input.

Plant Science

Our first task with the RAE-initiative funding was to appoint the senior scientist. We invited a number of potential candidates to York for a day or so, and narrowed the preferences down to two. Of these, the less conventional but the more exciting was Dianna Bowles. At the time we were looking for someone to lead the new initiative, she was at the University of Leeds. She came over to York at our invitation. I think that she was only moderately interested at the beginning, but prepared to see what was really on offer. She showed what imagination and ambition and outstanding discussion can achieve, because the offer, originally for two academic staff ended up with her initiative as two full academic staff, research fellows, more junior staff and a new building which was built as The Plant Laboratory to the south of D wing. We were then able to interview for two new lecturers, and from an excellent field were fortunate to persuade Ottoline Leyser and Jurgen Denecke to join us. Simon McQueen Mason came on a Royal Society Fellowship.

Yorkshire Cancer Research Campaign – Chair(s) in Cancer Research

The then Yorkshire Cancer Research Campaign (YCRC) decided that it would fund a chair in cancer research in the Department following their policy of using their extensive funds to build up significant groups in Yorkshire's Universities, and I'm sure that we were awarded their next tranche on our research quality and success in obtaining project funding from them. We had an excellent field of applicants, and excellent external assessor in Robin Weiss. The Chairman of YCRC, Douglas Shortridge, was a tanner by background, but had devoted his retirement to making YCRC a success. He was adept at raising funds; YCRC was the most successful of the regional cancer charities. He was always determined to do things his way – somewhat autocratic. He sat in on the interviews, but was not part of the decision body. The interviews were chaired by Berrick Saul, and we opted to appoint candidate A. That person was not Douglas Shortridge's preferred choice from two outstanding applicants, but we stood firm. The outcome was that we were offered a second chair for the second candidate, and Berrick Saul, to his total credit, refused this unless it came with the same funding as the first chair, which included additional building to house the group, research staff, technicians and top-quality equipment. So, we acquired two professors, a new single story building to house Norman Maitland working on prostate cancer, and additional space within the Plant Laboratory to house Jo Milner's p53 group.

After he retired from being chairman of YCRC, the University awarded Douglas Shortridge an honorary degree. In his early, tanning, days he had worked at a tanning factory in Italy next door to the Ferrari headquarters, and despite a good relationship with them, had never achieved his ambition to drive a Ferrari. The main Yorkshire Ferrari dealer agreed to drive him from his home the other side of Leeds to York on that day, and he was thrilled.

Smith & Nephew Chair in Tissue Engineering

When the University opted to develop a Science Park, they persuaded Smith & Nephew to become the lead tenant. How much of S&N's decision to come to York was because of the academic environment I don't know, but presumably having an outstanding Department of Biology was genuinely important. At any rate they funded a new Chair in Tissue Engineering and this funding included a research team, capital equipment and the building costs used to adapt the department for a new sizeable group. This brought in Tim Skerry to continue his work on bone growth and remodelling and in effect got us an updated animal house, since it was decided that the place to position this new development was where the then animal house was located.

Chair in Molecular Ecology

We were also able to recruit a new 'established' chair when Mark Williamson retired, and opted to make this be in Molecular Ecology. The outcome was the arrival of Peter Young from the John Innes Centre.

EEEM

When the University was canvassed by the University Grants Committee for suggestions for the development of new departments, on the initiative of Mike Chadwick, and with SEIY as a pull, the University agreed to start a new department, initially known as EEEM, the Department of Environmental Economics and Environmental Management. This was in effect a joint sponsorship between the Departments of Biology and Economics. The Department was envisaged as a multi-disciplinary one with its focus on research into and teaching of operational aspects of the contemporary moves to sustainable, environmentally-based development .

The task of finding someone to lead this development did not prove an easy one and after an abortive attempt to identify a head through interviews, Mike Chadwick and David Pearce (the external assessor for the post) suggested Charles Perrings and he was telephoned in Riverside in California. He flew in from sunny California for interview on one of the foggiest days that York could offer. Fortunately this did not deter him and he became the Department's first head. A significant fraction of the undergraduate multi-disciplinary course was common to that of Biology undergraduates with a balance from economics and courses by newly appointed lecturers. Although they were a new and independent department we were closely associated and they were initially housed in some of our Portakabins. This development had a significant impact on us and broadened the outlook of many biologists, both undergraduates and graduates.

Research Fellows

It might seem that we simply recruited professors. Not so. We saw it important to attract more junior teaching staff and also research fellows, and had a policy of persuading people with prestigious fellowships (e.g. RS URFs) to come here with a proleptic appointment. At the time of the RAE submission in 1996 we had six RS URFs: Angela Douglas, Jeremy Searle, Simon McQueen Mason, Justin Molloy, Julia Davies and Eva Johannes.

Growth

All that shows that the Department grew significantly during the 1990s. In part this was due to the infusion of funds to create new research groups around key individuals, but longer-standing members of staff were also successful at obtaining grants thereby introducing more research staff. Between the 1991/2 and the 1994/5 academic years our research income increased 2.5 times, and within that the contribution from Research Council grants increased by a factor of three.

Accommodation for this increase was made available in part by building The Plant Laboratory, but in part it was made possible by the addition of Portakabins. These were acquired piecemeal. Colin Garner had already housed his company Microtest in a set on the west of the department, and these were taken over by us when Microtest was sold. David Pegg's cryogenic unit required more, then the Jack Birch Unit was accompanied by another set to the north. We somehow acquired the presence of Biocode, a small company providing biologically based authentication techniques for industry, entirely external but housed immediately adjacent to the Department, and with its head, Tim Wilkinson, a visible presence. This had a two-storey Portakabin development that was transferred to departmental use when Biocode moved on. A few more were placed between the two main research wings to accommodate an expansion in the administration. Portakabins were the short-term, answer to rapid expansion. They became a long-term solution too, and crucial to our being able to expand, although the site of the department became messy. Much credit goes to the University Bursar, Roger McMeeking, for his determination to find solutions to our space problems. At one stage I was invited to Portakabin Ltd for lunch with Roger and counted 114 units around the Department; it was a good lunch.

Master of Research Degrees (MRes)

A major, and highly influential government White Paper was published in 1990 titled *Realising our Potential*. Its most significant and adopted recommendation was a reorganisation of the Research Councils, creating the BBSRC from the old AFRC and the biological and biotechnological components of SERC. However, another recommendation concerned the creation of masters' degrees in research – the MRes. One consequence of the expansion of education, the development and increasing sophistication of research and changes in funding for teaching, was that undergraduates were less equipped to start research than in previous times. Further, it was felt that it was important that there were a cohort of people who left University with a good understanding of research, and of topics associated with research – funding, presentational skills, commercial drivers and so on – and that this could be delivered by a one-year Masters degree; this might be particularly relevant for those entering industry.

Accordingly, the new Research Councils were required to introduce funding for MRes courses in the 1990s, and we felt this was an opportunity to take. Our success in acquiring this funding was in large part due to Dianna Bowles. The upshot was a new style of course, and we were able to acquire funding for two, one joint with Chemistry and the other joint with EEEM, and use the generic teaching in common. We were one of only two Departments in the country to acquire funding for two such courses. The nature of the design required all students to undertake two or three placements, one of which had to be external to the University. We acquired a number of external placements for projects, and these made great interactions with a number of relevant industries.

Evolving ethos of the Department

Much of the way we went about this was controversial within the Department. It was essential that we recruited top people to these new posts, and to help this we provided start-up packages that enabled new staff to concentrate on research in their early years, with equipment and recurrent funding above, sometimes well above, that which longstanding members of the Department received.

I'm sure that a significant part of the Department felt that I concentrated on research at the expense of teaching. That was not my own view. I took the view that we did excellent teaching, but that what mattered above all at this time was to raise the game of our research; to be, and importantly to be seen to be, one of the elite research departments.

There were many reasons for this. Perhaps most important was that it was exhilarating and fun to be in a department that buzzed. But the future of the Department was more secure, the rewards in terms of funding, of studentships, of attracting research fellows, of external perception, of interest from the brightest prospective students, the ability to get funding for masters courses, of ability in later years to get JIF funding were all improved immeasurably by being tagged a '5-Department'.

Developments in strategic and applied research. Stakeholder interactions.

As described on page 35, Tony Robards and John Currey had started the Institute for Applied Biology (IFAB) in the late 1980s. This was an important venture and showed a determination to be keen to invest in our applied and strategic outputs and our interactions with industry. I now think that we did not make the most of these opportunities, particularly those provided by IFAB.

One of Dianna Bowles' initiatives was to woo industry in a highly organised and high-visibility way. Together we (largely she – I agreed the budget) wrote two booklets to describe the Department, its ambitions, its capabilities and resources and its desires. We made presentations to relevant industrialists, always senior, in Heslington Hall, and the Vice Chancellor spent time with them to show the University commitment. The one I remember most vividly was a day's visit by Tom Little and Peter Lillford from Unilever. They came, they listened, they departed. We now know that at York station on the way home they decided that would place a contract with Dianna to isolate proteins from plant tissue to act as freezing protectants – biological anti-freeze. This was not part of our presentation. The contract was awarded and well funded, but with zero rights to any returns from the findings, which they held. Peter Lillford now has an honorary position in the University and has maintained links, many years after that contract ended. The outcome is now part of their ice-cream repertoire, and Peter boasted to me very recently how many hundreds of millions of pounds that investment had made for Unilever in the last financial year. Could we have fought and achieved say a 1% or even 0.01% return - I don't know.

Change

Then: the 1970s

Mark Williamson's 1960s vision for the Department, within a University thirsty for excellence, was highly successful, and that vision was probably most simply and cleanly seen towards the end of the 1970s. It laid the foundation for successful evolution.

My perception of Mark's vision was to create a department of biology based on the understanding that living organisms had common principles, particularly at the biochemical and the ecological ends of the biological spectrum. It was to be a department in which undergraduate students were taught by inquisitive staff themselves active and at the forefront of research, in which teaching and research were a seamless continuum. The presence of research students was an essential part of this vision, this continuum. Small group teaching in tutorials was part of this growth, as was the supervisory system making a close bond between the academic staff and the new wave.

Perhaps lower priority in those early days was the drive towards applied science. When I arrived I suspect a stakeholder was only what I was when my father banged posts into the ground on our farm.

Later: the 1990s

Some of the features described above and on pages 20-21 in Chapter 2 have been diluted, and that dilution was gradual but I think identifiable throughout the 1990s. Whilst the various actions taken to raise the research profile of the Department had massive and crucial positive outcomes, tended to reduce the alignment of teaching and research, to reduce the co-operativity, maybe, I'm not sure, to reduce the perception of the cohesiveness of biology.

There was a strong undercurrent in the Department that felt that everyone should have the same treatment, that everyone should do an equal share of all that had to be done. Whilst I was prepared to over-ride this for the RAE, I was, with hindsight, not sufficiently able to sell the notion that as a large, successful, department we should let people excel at what they were best at, at the expense of that ethos. There was too much vocal dissent from an important minority who felt that they were denied the opportunities given to others, and that they bore the brunt of the teaching and running the department, whilst others gained promotion and other tangible signs of success at their expense. Again with hindsight, I believe that I should have found ways to encourage those who were not part of these exciting new initiatives, but did perform the bread-and-butter work of all the administration and background work that made the department such a successful teaching environment – the willingness to take on those extra duties that make such a difference – running Millport, taking on the impossible student for a third-year project (indeed thinking up new third-year projects), taking a greater share of tutorials, ensuring that we had a continuously updated and modern set of bachelor's degrees and so on.

SCIENCE

So what did all this deliver?

Importantly, between 1990 and 1997 we graduated over 700 students with bachelor degrees and perhaps 150 or so with master's degrees and a further 150 with doctorates.

In terms of science output we contributed high-quality input to the scientific base, and this is well documented for a four-year snapshot in the submission to the RAE. The final parts to that submission, RA5 and RA6, are a short summary of the achievements and ambitions of that period, and are available on a departmental web site associated with this history.

One of the research laboratories in the new Biosciences Building, corridor L0 (2013).

1997-2004

Alastair Fitter

I guess I was the luckiest HoD, except perhaps for Mark Williamson who seized so effectively the opportunity to create a distinctive Biology department in 1963. I held the role at a time when government eventually recognised the need for substantial investment in universities, in the research that they do and in the skilled people that they train. We were able to capitalise on that change of policy, especially after 1999.

New Buildings

The department in 1997 was in a very good state, with a strong RAE performance the year before and an excellent teaching programme, not yet assessed under the new Teaching Quality Assessment. What was not good was the state of the buildings: the original buildings had been well designed to make best use of the available resources, but the CLASP building system (which stood for Consortium of Local Authorities Special Programme) was hardly state-of-the-art. Apart from the new Plant Lab building, almost all the remarkable development of the department in the previous decade had been accommodated in Portakabins – again useful, but not always ideal for scientific research. There had been some money available for refurbishment under a programme called KDK (I have no idea what that stood for) under which we had 'improved' D wing for a total cost of £400k.

My first opportunity as HoD was to bid to the funding council (HEFCE) for over £1M to refurbish the remaining labs, for which we had to find (as I recall) about £250k as matching funds. Some unspent money from the KDK programme was used for the matching monies, and the bid was submitted with about a dozen senior staff as co-investigators. Meanwhile serious pressure was being put on a government that had come to power determined to demonstrate its financial prudence and had committed itself to maintaining the restrictive spending plans of its predecessor for at least 2 years. In particular, the Wellcome Trust threatened to start spending its largesse outside the UK if the government was unwilling to invest to make UK research facilities suitable to receive Wellcome funds and the result was the surprise (to most of us – I was on holiday at the time) announcement of the JIF programme in July 1999.

JIF was a £600M competitive programme: Universities had to submit bids which would be judged on familiar criteria of scientific excellence. The problem was that the cost of preparing a bid was large, with architects and QS fees needed. We made a very strong case to the University that they should back a Biology bid and though several other cases were also developed, ours was submitted in round 2 of JIF. Within the department there had been very active debate as to what we should go for. The most vociferous advocates for an ambitious and radical bid were Norman Maitland, Tim Skerry and especially Dianna Bowles. We held a departmental awayday at the new CSL (now FERA) labs in September 1999 and from that arose the concept of what we then termed (rather infelicitously) an 'equipment park', a lab where communal equipment could be held, properly maintained and available to all, ensuring better access to the most modern technologies. This idea eventually became the Technology Facility (TF).

We realised the scale of effort that would be needed to deliver an effective bid and Dianna took on the role of leading that, with Peter Crosby providing the technical and building expertise. The eventual bid listed all the members of staff with research income of over £1M – then quite a substantial sum, pre-FEC – as co-investigators and Dianna as the PI, and included some of the staff of the Structural Biology Laboratory (YSBL) from Chemistry, after protracted negotiations in which we initially considered a bid to re-house both departments *in toto*. Even at this scale, it rapidly became clear that the size of the bid would dwarf anything that we or the University had previously considered – it ended up at £22.6M, overshadowing the £1M HEFCE bid which we had now heard was successful and which was part of the necessary matching funds. Additional matching came from the University, which agreed – and was required – to pay all the fees, and from Yorkshire Cancer Research (YCR) who agreed to pay for new labs for Norman Maitland's group as part of the new development.

Preparing the bid took us into new territory. We held a competition for architects to see who could deliver the vision of an integrated biology department with the innovative TF concept. Some were remarkably prosaic and the easy winner was Anshen Dyer, whose plan also envisaged future expansion. We were less fortunate with our quantity surveyors who seriously under-costed the development, causing us real problems when the grant was awarded. The University covered all these quite substantial costs at risk, demonstrating real confidence in us, and the then Vice-Chancellor, Ron Cooke, was very supportive.

The scale of the investment was not lost on Graham Gilbert (Director of Finance) who provided two accountants from pwc to work with me to develop a business plan for the department, the first time the University had done what is now commonplace. Developing the plan was not straightforward, since many of the things we needed to know, such as our indirect costs, had effectively to be guessed. The first version assumed that they were in the same proportion to the University's total costs as our student numbers were to the total. Doing that made our plan look unreasonably strong as many of our costs were linked to research rather than student numbers. As the plan evolved over time, the changes tended to reduce the initial rather illusory future surpluses but the University centrally generally stood by us – the main exception that I can remember being when I described, perhaps rather rashly, one set of University financial figures as 'effectively meaningless' to the incoming Vice-Chancellor. Judging by the reaction, this was the wrong thing to say.

Meanwhile, Dianna Bowles was plotting her big coup: as the possibilities of genetic modification of crops became clear and before Monsanto, Friends of the Earth and the Daily Mail had, perhaps rather oddly, combined to terrify the public about Frankenfoods, she envisaged a research group focussed on developing new agricultural products, such as pharmaceuticals or industrial precursor chemicals, thus promoting agricultural livelihoods and UK plc. She persuaded the Garfield Weston Foundation to provide a grant of £5m to create the Centre for Novel Agricultural Products (CNAP), and part of the JIF bid was to provide accommodation and facilities for this new group which comprised 5 research professors and their groups. This grant and that from YCR were undoubtedly influential in the bid's success.

The bid preparations went up to the wire. It was eventually completed in the early hours of the morning of the deadline day thanks to a dedicated team who stayed up most of the night. To be sure of submission, two staff went by train to London carrying the necessary bound copies and delivered them by hand. The bid went out to referees, one of whom we could have hugged; he or she wrote along the lines of 'I have visited the University of York and I am amazed that research of such quality is carried out in such poor conditions'. We eventually heard the result just before Christmas 2000. It was the second largest JIF award (only Oxford Chemistry got more) and transformed not just the way the department thought about itself but also, I believe, the University's own self-image: the physical change across the campus since then has been stunning.

The building contract was let to a firm called HBG, again after a competitive process, and was on a shared risk basis. Our initial problem was that the quantity surveyors had under-estimated the costs by ~£5m and we had to go through a painful 'value engineering' process, in which we insisted that the scientific facilities were protected, but in which many other valuable parts of the original building design were lost. The planned social areas largely went (though the atrium was protected and has served that purpose); the worst decisions were to abandon the efficient but expensive air-handling system, which will undoubtedly have cost the University dear in running costs over the subsequent years, and to not seize the opportunity to replace all the windows in D block, again with serious impact on the energy costs of the building. Another issue was

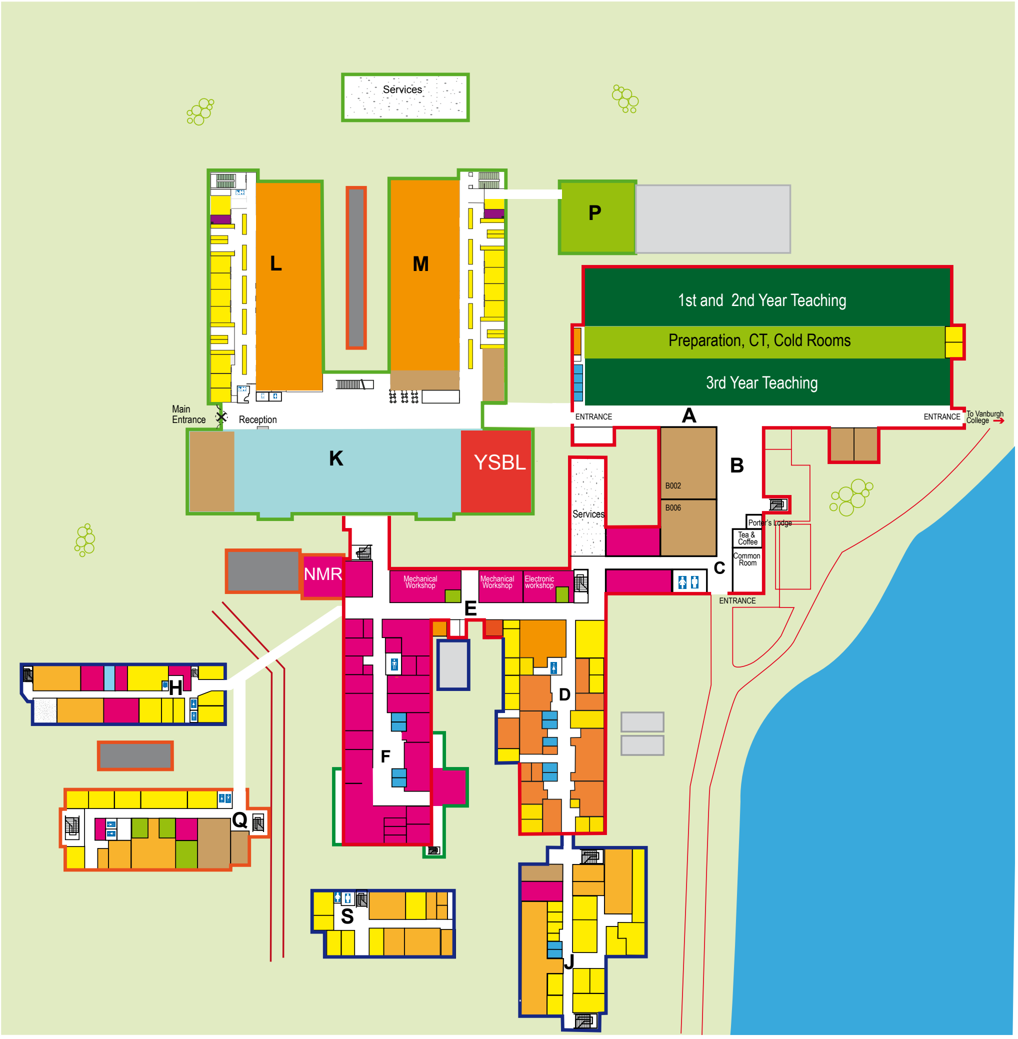


Figure 5-1

The department in 2013. The key to the building identification is in the caption to the Frontispiece.

that the Chemistry department agreed at this stage to transfer the entire YSBL group and the University put in another £2M to extend one block of the building; the re-design issues were inevitably complex.

Peter Crosby was in charge of the building programme from our end and, other than one or two excitements caused by the proximity of the new buildings to the existing ones, it went very smoothly, and was eventually completed in 2002 and opened by Lord Sainsbury - then Science Minister and the most successful holder of that office. There were some interesting departmental debates as to who went where, because only one small part (G block, part of the workshops and the animal house) had been demolished and some groups had to occupy the barely refurbished D wing; in the end that short straw went to some of the biochemists on D1 and some of the ecologists on D0.

One especially exciting part of the process was the equipping of the new Technology Facility. It's rare to have a £5m cheque to spend on equipment and we had a very thorough process to work out what was needed, and generally got it right. Managing the TF was the big challenge and we were fortunate to be able to appoint as the Director, John Pillmoor, who had worked in an industrial research lab previously, and an impressive set of lab managers. The TF has worked brilliantly and has been a major driver of the department's success.

The building works did not stop there. We got substantial funding to start the much-needed refurbishment of the teaching labs and also won competitive grants from the Wolfson/ Royal Society lab refurbishment scheme to convert the old library and associated rooms into a new bioinformatics suite, and to equip it with good quality computing equipment. I began to realise that the department was a bit like the Forth Bridge – there was always some part in need of attention.

New Staff

The department had grown rapidly in its first 10 years but then the 70s and 80s had been tough times. Consequently a department in which almost everyone was under 40 when I joined in 1972 had become one in which most were over 40. A few staff were coming up to retirement – notably three of the founders in Ramsey Bronk, John Currey and Rachel Leech - and new opportunities for Masters' training also created appointment opportunities in bioinformatics (Sandie Baldauf) and biomathematics (Jon Pitchford). A planned expansion of student numbers on the biochemistry course also allowed us to make three new appointments, and Dianna Bowles' transfer to the Garfield Weston Chair opened possibilities in plant biology. In fact by the end of my tenure in the role, half of the academic staff were new appointments and the age structure was rather more healthy.

The development of CNAP allowed us to make four further professorial appointments, including Ian Graham, now CNAP Director, from Glasgow, Neil Bruce from Cambridge and Simon McQueen-Mason, who was already in the Plant Lab on a Royal Society URF. We were also able to make a number of other appointments in plant biology, including Louise Jones, Michael Schultze and Richard Waites. Together with the Dale Sanders' election to Fellowship of the Royal Society we could lay claim to being the leading UK university centre for plant science.

The expansion of biochemistry and the need to replace Ramsey Bronk brought us Colin Kleanthous from UEA as the new Professor of Biochemistry, followed by James Moir and Gavin Thomas, with Christoph Baumann plugging the hole in biophysics left by the departure of Justin Molloy. We also identified other areas that needed strengthening in the department, given the emerging scientific opportunities, including development (Betsy Pownall and Harv Isaacs) and cell biology (Dawn Coverley and Paul Genever, who was appointed after a period in Tim Skerry's lab, when Tim moved to the Royal Veterinary College).

Evolving from Mark Williamson's original vision of a department with particular strengths in biochemistry, genetics and population biology, we now saw our three poles as molecular biology, plant science and ecology. Having built up biochemistry and plant science, logically the next set of appointments needed then to be in ecology. We were able to make an early appointment (Peter Mayhew) but after that the opportunities were fewer. In 2002, the new Vice-Chancellor initiated a programme of Anniversary Chairs to celebrate the University's 40th anniversary in 2003. The University would underwrite the early costs of each post but they then had to be absorbed onto the departmental business plan. That suited us well for we were starting to see the benefits of the new facilities and knew that we had a number of retirements and other opportunities coming. We were able to make two excellent appointments in Chris Thomas from Leeds and Phil Ineson from ITE Merlewood (now CEH Lancaster). Backing these with appointments of Jane Hill and Angela Hodge ensured the vitality of ecology in the department.

A few other strategic appointments were possible, including one in microbiology (James Chong) and one in bioinformatics (Leo Caves), and another opportunity arose when Colin Garner resigned from his post as a Professor to run his accelerator mass spectrometry company. York Against Cancer, the local charity that funded his group, agreed to fund the post and so Jenny Southgate was appointed as professor of Molecular Carcinogenesis.

The final major staffing development was momentous. In late 1990s the new Labour government issued a call for new medical

Figure 5-2
The new JIF building from the north-west.

schools. Initially Biology was barely involved, although as a member of Council, I was aware of what was planned. The strong health sciences groups put forward a proposal to offer their expertise to another University (Bangor was suggested at one stage) but there was no suggestion for a York medical school, largely because the catchment was too small and the clinical facilities too limited. In the event, the panel offered (or even instructed) York and Hull to get together and create a joint school.

There was some initial scepticism about this offer but there was an obvious opportunity, especially for Biology because one of our problems was being taken seriously in the biomedical research world. I therefore urged that we offer to this school what Hull could not, which was our research excellence in biology. In a series of meetings at the Londesborough Arms in Market Weighton, midway between York and Hull, the mainly clinical representatives from Hull and the mainly academic folk from York sniffed around each other but eventually decided we could make it work. Fortunately the (I think) serious proposal to call it the Wolds Medical School was not taken up.

The biggest problem for us was that the new medical school was funded for teaching but not for research: there would be no QR and no set-up funds. The only solution therefore was to embed new staff in an environment where the research facilities were ready made and Biology, with its new labs and its TF, was ideally placed for that. We consulted and agreed on Infection and Immunity as being a research area of huge clinical significance that fitted well with our expertise and facilities and persuaded the new HYMS board and Dean to allocate 5 posts to this area over a 4-year period, starting with a Professorial Director of a new Unit of Immunology and Infection. In addition, the department agreed to use the forthcoming retirement of Alan Wilson – almost the last survivor of the original group of staff – to create a parallel post to strengthen the unit. The appointments of Paul Kaye from the London School of Hygiene and Tropical Medicine as the HYMS-funded IIU Director and Deborah Smith from Imperial as a Professor in the department created one of the world's leading groups for the study of the devastating tropical disease leishmaniasis. The IIU (which has now expanded substantially and become the Centre for Infection and Immunity (CII)) is a successful joint venture of Biology and HYMS; most of the other appointments were made after 2004, but Marjan van der Woude was appointed before the new building was ready and actually arrived before the two professors.

Such a substantial new research grouping clearly required new accommodation, and we had a solution for that. The IFAB building, an idea perhaps developed before its time, no longer housed spin-outs as first envisaged; indeed the Science Park had been developed precisely for that purpose. It was the right size but needed nearly £2M spending on it to bring it up to scratch, which we were able to obtain from the University's SRIF allocation. SRIF (Science Research Infrastructure Fund) was the formula-based son-of-JIF, and a recognition of the success of JIF in making government realise the need for sustained investment in science.

Not all the appointments were academic though. I had been Associate HoD for 2 years when David White was HoD and had been astonished and alarmed by both the workload that he shouldered and the range of skills in which he was expected to be expert. When he announced in May 1997 that he was leaving to take up the Director of Science role at BBSRC, I found myself HoD with only a couple of months' notice. One of my early vows was to find ways of appointing proper professional support in a range of areas. The first and most important, given the new business planning that was going on, was finance. Fortunately, the University had drafted one of its central management accountants, Duncan Rotherham, to help me cope with the JIF process. When that was over, we agreed that he would stay on in the department, officially on secondment, but paid from departmental funds. Again there was an interesting debate in the department as to the wisdom of, in effect, commuting academic posts into administrative ones, but one of the great strengths of having a proper business plan was that it freed us from thinking of posts as quanta and regarding them instead as sums of money that could be used as best fitted our needs. Duncan was immensely helpful to me personally and to the department generally, both because he actually understood all the financial transactions and flows and because he knew what was going on in the University Finance Office: on several occasions I went to meetings of Planning or Policy and Resources Committee well briefed by Duncan and got what I wanted that way.

Other 'support' roles were created too: the department already had an effective IT support office in Ian Jennings, a post created imaginatively by my predecessor, and we were able to strengthen that team and to appoint a professionally qualified safety officer and eventually – after some debate with the University – an HR specialist. The HR appointment was perhaps the most radical. Traditionally, academic staff issues were directly handled by the HoD, which was fine when there were 10-20 staff in a department, but we now had around 50 and no-one can manage that number of staff. That number did not take into account the whole department, which had around 400 employees. The conventional view was that they should be managed hierarchically, in the teams in which they worked, but one consequence of this was a serious limitation on career development opportunities for many, especially the technical staff. Peter Humpherson, who had acted as Laboratory Manager prior to Jim Murison's appointment, now took on the role of personnel champion for all the non-academic staff, and did so with insight, vision and great commitment. He certainly opened my eyes to a range of challenges about which I had not been well informed. In time we agreed that his task had become impossibly large, and agreed with the University on the appointment of a dedicated HR professional, Nina Pirozek, to take forward all those developments. Nina was formally a member of the central HR team, as Duncan was of Finance, though paid for by the department, and this model has been adopted in several other departments since, giving many of the advantages of a faculty system without the well-known drawbacks. Another innovation was to have a research office, with staff who could assist in the preparation of research grants; this was especially important because the business plan to justify our magnificent new building and facilities had some challenging research income targets. Indeed there were many who said they were unrealistic, though in fact the department has met every one of them.

What this all meant was that the old model of the academic who did everything had been replaced by a new one in which we tried to recognise people's strengths. Although we had a number of staff who were appointed on research-only contracts – some research professors and quite a few research fellows, such as RS URFs – almost all academic staff played a role in our teaching programmes, but the amount they did varied and especially the amount of administrative work they did varied greatly. I ran a workload model which was available to all to see and amend – one innovation was to make the previous holder of a role responsible for assessing its severity - and tried to ensure that workloads were not unreasonable. In practice this meant dealing with the outliers rather than making all equal.

One new development was the appointment of several teaching fellows. These were usually early career staff and often appointed with an explicit programme in mind. Emma Rand initially supported the MSc in Biological Computation, but Adrian Harrison and Setareh Chong both had a broader remit. We recognised that teaching fellows needed a proper career structure and early on took the decision that they could be appointed on one of two models: either as a fixed-term appointment to cover the absence of another member of staff (e.g. on a Leverhulme Fellowship), with no expectation of reappointment, or as a permanent (or open) contract. In the latter case, there needed to be opportunities for serious career development and promotion, and the University has now put those in place, at least partly thanks to pressure from Biology.

The other key appointment for me was of a deputy HoD and I was delighted when Terry Crawford agreed to take on that role. Terry and I had both been appointed in 1972 and we worked well together. He has an exceptional eye for detail and could be relied on to ensure that we got things right, particularly in matters of quality assurance. He rose to every challenge, even when a vexatious series of complaints by an ex-student required him to go back meticulously through ancient files to demonstrate the falseness of the charges. The new building had an administrative area where both the HoD's and the Deputy HoD's offices were, though I also had an office on D0 where I tried to be at least on Fridays. Prior to 2002 my office and lab were both on F0, now where the IT and facilities management teams work.

New – and old – hurdles

Early on in my time as HoD, we learned what we had been expecting, that our turn had come for a visit from the TQA (Teaching Quality Assessment) team. This short-lived and unsustainable system was actually a great boost to the University because we almost invariably did well in it, except for the poor Chemistry department who in the early stages had been given a wholly unjustified 'satisfactory' (as opposed to 'excellent') grade. As a result, for a long time the University was able to brand itself as equal top with Cambridge in national teaching league tables. By the time our turn came round, the scoring was different, with 6 elements scored out of 4, so that the maximum possible was 24. Most departments seemed to get 21 or 22 as it was easy for assessors to find something somewhere to quibble about.

Terry Crawford readily agreed to lead our preparations for the TQA visit which was several days long. The amount of paperwork that had to be prepared for them was staggering and we eventually kitted out one of the larger rooms in the department as the inspectors' base and lined it with filing cabinets. A large team swung into operation to get the material together and to ensure that all bases were covered, including Annette Lamb, Julie Lord and Jenny Brown, who returned from maternity leave just in time (for us, possibly not for her). Several academic staff also played big roles here, including Peter Hogarth who was then admissions tutor, Sue Bougourd and Martin Rumsby who ran the two year-in-industry schemes, and Jim Hoggett and Simon Hardy, because the visit covered the Biochemistry degrees as well. Behind all this, there was the extremely reassuring presence of Alison Kennell, the Assistant Registrar whose track record in ensuring good outcomes from TQA visits was remarkable.

The visit itself was tense and it was obvious that one or two members of the team were determined to find points of criticism (and that others were genuinely convinced we were doing a good job), but they were not terribly effective in their questioning. One weakness I knew we had was that we had failed to ensure that all postdocs who were doing tutorials had been properly trained; in one of the sessions I was asked whether we did this and I said that yes, we had a policy that all postdocs who teach be trained. They never asked the follow-up question as to whether that policy had been implemented.

In the end we were given the maximum score of 24 and there was great celebration. The credit for that goes partly to the department as a whole for I believe that we genuinely did (and do) offer a top quality degree and that staff take their teaching very seriously and approach it enthusiastically; and also to Terry and his team, for the nature of these inspection processes is that if you are not thoroughly prepared, it is easy for an unjustified criticism to go unchallenged.

Shortly after TQA, we experienced RAE again, but at least that was predictable and we knew the rules. In the 1996 RAE, under David White's leadership, the department had made the critical jump from 4 to 5, the highest category. For the 2001 RAE the scale was extended by the introduction of 5* and the question was whether we could achieve that – a hugely desirable prize - and should make the attempt given the undoubted costs of success. There is no doubt that a broad-spectrum department as we are is at a disadvantage in the RAE; the top places are almost invariably taken by specialist departments and institutes, including some such as the Institute for Cancer Research that do no teaching and in my view have no place on a level playing field. We also had to pay real attention to the departmental ethos: ours is still a department where almost all academic staff teach and where all are encouraged and supported to do high quality research. We were keen to avoid the idea that we had 'research-inactive' staff and never used that term.

Dale Sanders was the very effective Chair of the Departmental Research Committee and took on the task of preparing the RAE submission. We deliberated at length over who to include and ended up with about a 90% submission rate. In the event, we stayed at 5 and did not achieve the 5* that I still think we deserved. Probably, had we omitted two more staff, we would have achieved that goal, for informal feedback suggested that the line was drawn just above us. Not only would that have brought in to the University around £250k p.a. for the next 7 years in additional QR, but it would have brought us more international visibility. In the end, we made a wrong judgement call, but the fact that including or omitting the publications of one or two staff can have such a large impact demonstrates the big failing of the old RAE system. At least the 2008 RAE, which I oversaw as PVC for Research, did away with those steps and put in place a continuous scale. It is ironic that Universities have still not seen the logic of that for the classification of degrees, where we routinely condemn students to career problems on the strength of a few tenths of a percentage point in their marks with the ludicrous degree classification system.

Other events and changes

An enormous amount happened in the seven years that I was HoD and it would be difficult to decide which should be picked out. We increased our outreach work substantially, were fortunate in support from some generous donors, notably the Burgess family who supported a programme of PhD studentships in memory of their son James, and experienced three royal visits, so we must have been on someone's radar. I managed to be overseas at a conference for the first of these (Anne) which Terry Crawford handled, but I was around for both Philip and Andrew, the latter to open the Yorkshire Cancer Research laboratories. My main recollection is of the extraordinary amount of time spent by special branch officers in advance of each visit, crawling over the department looking for bombs or whatever. I remember asking one of them if this was what he did all the time (answer, yes) and whether he had ever found anything (answer, no).

All the time, events in the outside world were having impacts on us. The introduction of student fees seems very modest now given what is being proposed. Many of the big changes (higher fees, the introduction of full economic costing for research) were planned during this period and introduced later, but advance planning to cope with them was always going on.

In 2004, the department was physically very different from how it had been in 1997, there were more staff (nearly 500 employees) and most of them were recent appointments, and we had become much more electronic in our operations. Importantly, however, I don't think that the ethos of the place did change, at least in terms of the critical elements. We were still an integrated biology department, teaching and researching biology, and not an artificial collection of separate units. We still had an expectation that we would pull together: I cannot recall any occasion when I asked a colleague to take on a role or a task and was refused. That combination of collegiality and intellectual coherence is unusual if not unique. On several occasions I was asked by prospective staff to whom I had just offered an appointment for a guarantee as to what they would be expected to do in the way of teaching and admin; I never obliged, pointing out to them that the guarantee was worthless were the HoDship to change hands and that our goals were anyway the same, to ensure that they could achieve their best when they moved to us. In only one case did that result in the person refusing the job, probably wisely.

Biology at York is to me a remarkable department. I came here in 1972, aged 24 and fresh from my PhD, expecting to stay 4 or 5 years and move on. I haven't done because I couldn't find anywhere better to do science and develop an academic career.

2004-2010

Dale Sanders

As an incoming Head of the Biology Department in 2004 I found the prospect of leading a department of such repute truly daunting. All four previous incumbents had been my lecturers in my undergraduate years, and in my view each had done a remarkable job as HoD. Although I had had an opportunity to be involved at a senior level in administration in the Department since David White suggested that I chair the newly-formed Research Committee in 1992, at the time I felt that this would be about as close as I wanted to get to management and leadership outside the scientific environment of my own research group. So HoD was a job that initially I did not want, and given the quality of the previous incumbents, believed that I could not aspire to.

Even so, I accepted the HoD position in the knowledge that I would give it my best and that this was "payback time": I had been treated extremely well by the Department as a junior academic, and this was the chance to give something back. To my surprise, I loved almost every minute of the six years of my HoD tenure. I saw a different dimension of life, and it was a delight to help solve problems, to celebrate successes and to work with others – both scientists and non-scientific professionals – to continue to develop a better working place for all.

Infrastructural inheritance

This sounds like a boring place to start, but previous decisions made by David White and Alastair Fitter in the areas of finance and HR had a critical impact on the direction of the Department during my term as HoD. My predecessors had recognised the need for local support in these areas – systems that could support science in ways that a central university administration could not. Duncan Rotherham had been appointed as our Finance Advisor and Nina Pirozek the Head of Biology HR. I relied on them both heavily for advice in their areas. I learned a tremendous amount from both Duncan and Nina about finance and HR, and how these areas underpin the output of a first-rate science department.

In recognition of the high-quality professional support I was receiving, I expanded the membership of Strategy Committee that had been established in David White's time to include significant non-academic input. In addition to Duncan and Nina, John Pillmoor joined as Director of the Technology Facility, and Dawn Cartwright as the appointee of the newly-created Director of Infrastructure and Facilities (DIF).

Dawn's appointment came at a time of HoD transition. The retirement of Jim Murison as Departmental Superintendant gave us the scope to redefine a relatively traditional position to something far more imaginative. Alastair and I discussed this over dinner as he briefed me on the HoD transition, and we both agreed that essential areas of departmental activity that were not strictly academic could be overseen by a single person. The result, after much consultation with Nina, was the DIF position. Importantly, Health & Safety and IT would now report directly to the DIF rather than to the HoD. The job description I developed with Nina was demanding, and we failed to recruit a suitable candidate in the first instance. Probably for the first time in the Department's history, we then went in desperation to head-hunters, who duly delivered Dawn. I have been a firm believer in head-hunters ever since.

Research Assessment Exercise 2008

We had moved into the magnificent new Biosciences Building in 2002 and had created the Technology Facility (TF) that was the envy of many institutions, nationally and internationally. The challenge for the forthcoming period as I took on the job of HoD would be one in which we would be expected to deliver on the promises of the excellent science proposed to result from the funding of the new building and the TF. Delivering on this promise meant that it was essential to obtain an outstanding result in the Research Assessment Exercise (RAE) in 2008. We had already been awarded a top "5" rating in the 2001 RAE, but in 2008 the results would be based on a more complex Grade Point Average that took into account not only high quality papers (still the major factor) but also research environment, esteem and other more formulaic factors such as graduate student numbers.

Ottoline Leyser had taken over from me as Chair of our Research Committee and threw herself with verve into crafting our submission. We appointed an external Science Advisory Board (SAB) drawn from across the spectrum of our research activity to give feedback on drafts of our submission and our overall long-term research strategy. We asked John Lawton to Chair this, and he readily agreed; the composition of the initial SAB was:

Professor Steve Halford FRS (Bristol University): Biochemistry

Professor Jonathan Jones FRS (Sainsbury Laboratory, Norwich): Plant Biology

Professor Sir John Lawton FRS (Chair, Royal Commission on Environmental Pollution): Ecology and the Environment

Professor Cheryll Tickle CBE FRS (Dundee University, then Bath University): Developmental Biology

Professor Robin Weiss FRS (UCL): Biomedicine

Ottoline assembled a small team comprising Colin Kleanthous, Chris Thomas and me to develop our RAE proposal in the light of SAB comments, feedback from the individual academic research reviews that I had instituted some years earlier when I was Chair of the Research Committee, and our general assessment of where our strengths lay and where they needed to be bolstered.

It is worth recapitulating our major achievements for the review period (2001-07) in the RAE document:

- Three staff elected Fellows of the Royal Society and two to the European Molecular Biology Organisation (EMBO)
- Annual Research Spend increased from £6.1M in 99/00 to £11.5M in 2006-07
- PhD student number increased from 87 at 2001 census to 117 at 2007 census
- PDRA number increased from 79 at 2001 census to 116 at 2007 census
- Joint appointments with academically adjacent departments increased from 1 to 6
- Top in UK for citations per paper in Plant and Animal Science 2001-2005 (Thomson Scientific UK)

A full version of what we formally submitted can be found at the HEFCE website [1], and on the departmental web page associated with this history.

We were proud of our submission, and when the results came through, we were both disappointed and excited. The disappointment arose from our "quality profile". The quality profile went from 4* to 1* (4* World-leading, 3* Internationally Excellent, 2* Internationally Recognised, 1* Nationally Recognised). Our grade as percentages was 25-35-30-10, and we had thought we had submitted nothing in the 1* category. It quickly became apparent that the panel had marked very hard. When reported as Grade Point Averages, we realised that we had beaten University of Cambridge and Imperial College in our submission and had lost to a number of other HEIs that had been much less inclusive in their staff submissions. Despite the absolute score we received, overall, we felt we had got the balance right. The full results tables are given in [2].

You will need to go to the Biological Sciences section on page 32 of the PDF to see how we matched against others. On the basis that we scored 25% in the 4* category, we were able to announce justifiably that we were equal first (with Manchester and Dundee) among UK broad-spectrum biological sciences departments for the quality of our research that was described as "world-leading".

Undergraduate teaching

It was pointed out to me early on by our Finance Advisor, Duncan Rotherham, that in strict financial terms, research in HEIs was generally supported by teaching. At an early stage of my HoD tenure, I asked Duncan to give a detailed analysis of his conclusions at an Awayday for staff. His results had shocked me, and were a surprise to many staff members: a large part of the financial health of the Department rested on our ability to recruit students (see page 19, 80) and therefore indirectly on teaching quality and delivery an exceptional undergraduate experience. Through service on the Executive Committee of the Heads of University of Biological Sciences departments (HUBS: now incorporated as a sub-group of the Society of Biology), I discovered that many other HEIs that were prominent in research were simply leaving it to Teaching Assistants to deliver the majority of first and second year programmes (especially practical classes), while letting the "elite" academics get on with their research.

I campaigned vigorously against this philosophy, secure in the knowledge that this was part of our departmental ethos. All first year undergraduates should be exposed to all the best minds – be they a conventional academic or a teaching fellow – and no academic in a HEI should put themselves above that task. Many of our biggest research grant holders had full teaching loads. They led by example.

The position of Teaching Fellow (TFel) had originally been established at York in the late 1990s as a means of support for the Masters Degree in Ecology and Environmental Management (EEM), and Emma Rand developed the position very successfully, particularly in the area of statistics teaching. Just before I became HoD, the TF concept was extended to give support for the Biochemistry undergraduate degree and for microbiology. Set Chong and Adrian Harrison, the respective appointees, rapidly developed challenging programmes for undergraduates in a way that was highly complementary and sympathetic with existing lecture courses. The success of these appointments led to other appointments during my time: in ecology and population genetics (Olivier Missa, Mike Thom). We were very keen to ensure that these positions were monitored to enable appropriate career progression. Teaching Fellows were not to be regarded as Teaching Slaves, but given the freedom to be innovative with respect to pedagogical approaches and to spread good practice.

York Biology has found itself persistently in the top three to five of UK Biosciences Departments in the newspaper league tables with respect to undergraduate experience and outcomes. This is not least because of the quality of the Department's teaching administration, with Julie Lord leading the Undergraduate Office in its handling of the undergraduate experience from cradle (admissions) to grave (i.e. a great destination after leaving York). The National Student Survey[3] (in which final year students were invited to rate the quality of our teaching) also placed the Biology and Biochemistry degrees very high nationally, with well in excess of 90% of our students routinely proclaiming themselves satisfied with the courses. This positioning was valuable in one very important respect: it enabled us to enhance the quality of our undergraduate intake progressively. We therefore were able to contribute to the development of the most able students, take them in our labs to do valuable research projects, and deliver some of the best minds to the job market or to further training.

Associate HoDs

Our prominent positioning in the undergraduate league tables was the result not only of highly efficient administration, but also forward strategic thinking by key academics. First among these were the Associate Heads of Department during my time. I overlapped during my first year as HoD with Terry Crawford, who had been appointed as Deputy HoD by Alastair Fitter. Terry was a fount of knowledge in the area of undergraduate education, having served on numerous University committees in this area. Terry retired after I had been in post for only a year, and I worried that I would not find a replacement who would cover adequately for the numerous teaching-related issues that constantly emerged in the Department.

I should not have worried! Jim Hoggett agreed to take on this position after Terry left. Jim had Terry's eye for detail, and like Terry, was also able to see the big picture. Jim oversaw substantial change in the way the undergraduate modules were constructed. Driven by the University, we were asked to construct short fat modules and long thin ones, to build in reading periods and generally to change the structure of the undergraduate curriculum. I would become exasperated when we discussed these things: this seemed to me to be the result of so-called educationalists making a career for themselves by generating lots of work for others and changing a successful formula. A major departure from previous practice was the proposal that all student assessments needed to be related to credits, which in turn translated to study hours. This undermined a general view in the Department that summative assessments such as finals papers should be just that: an examination of students' ability to synthesise what they had learned as an undergraduate. In this and other matters, Jim always tried and nearly always succeeded to find a middle way. He and Terry were both voices of reason in the Department, and I owe them a huge debt not only for their secure handling of many contentious teaching-related matters, but also for the wisdom that they imparted to university-wide decision-making on undergraduate educational issues.

Graduate teaching and training

The years 2004-2010 saw an increasing emphasis placed by Government and the Research Councils on a skills agenda for graduate students. The "SET for Success" report by Sir Gareth Roberts published in 2002 that looked in-depth at graduate and post-doctoral career development had been responded to positively by Government. The benefit to Biology was some tens of thousands of pounds to invest in skills development for junior researchers. In consultation with Nina, we developed a role of Skills Development Coordinator, a position paid for by the so-called Roberts Funds. We appointed Hilary Jones, who has a PhD in biological sciences, and who crucially was able to construct a training agenda that was tailored for biologists. Hilary facilitated imaginative thinking among PhD students, building on John Sparrow's foresight in earlier years that a training agenda would be an essential element in a graduate curriculum. Not everyone graduating with a PhD will become an academic, even though many graduands would like to believe they could be. Hilary's job was to convince graduate students and post-docs alike that there are very many worthwhile things one can do with a PhD in biology.

As with our undergraduate programme, we received tremendous administrative support from a professional graduate office led by Julie Knox. Peter Young and Debbie Smith as successive Chairs of Biology Graduate Studies Board provided academic leadership. These combined roles amounted to much more than overseeing PhD studentships. The Department was running numerous Masters courses, mostly jointly with other departments, and ensuring that these maintained highest standards was critical to receiving renewed Research Council support for core places. This success was measured by the fact that we were recipients of around 10% of BBSRC MRes. studentships (see also pages 40-41).

Such achievement was internationally recognised. We were deemed to be in the "Excellence Group" by the European Centre for Higher Education Development (CHE) based on their results in research and internationalisation indicators. In 2010, York was ranked 5th in Europe in this survey.

Academic Developments

There were a number of major academic developments during the years 2004-2010 and I highlight here some of those with which I was most closely associated. Note that there are accounts of the Units in Part 3.

Immunology and Infection Unit (IIU)/Centre for Immunology and Infection (CII)

The IIU was a joint venture between the Hull/York Medical School (HYMS) and Biology. Alastair Fitter and others had argued that York-based research at the newly-founded HYMS should be both embedded in Departments, and have focus since starting a new venture that covered all areas of medical research would spread efforts too thinly. Paul Kaye (a HYMS appointment), who was based at the London School of Hygiene and Tropical Medicine, had already been appointed as Director of the IIU. His position was complemented by our ability to attract Debbie Smith (a Biology appointment) from Imperial College: Both Paul and Debbie work on Leishmaniasis, Paul from an immunological perspective and Debbie from that of the parasitic protist. The old IFAB building was extensively remodelled to include Category 3 containment facilities for

Figure 6-1
View of the Centre for Immunology and Infection (Q block) from the main department. To the right is what was built in the 1980s as the Institute for Applied Biology, and now H block (CII). To the left, the new clinical and other laboratories.

pathogens, a £2M project that Paul oversaw with meticulous attention to detail. As a part of the overall IIU project, four HYMS senior lecturers/lecturers were hired: Mark Coles, Marika Kullberg, Natalie Signoret, Marjan van der Woude.

The success of the IIU was dramatic. Within the first two years Paul and Debbie held between them two Wellcome programme grants, an MRC programme grant and much other external funding. The more junior appointments also began to draw in external support. This success enabled Paul Kaye to bid successfully for a Leverhulme grant to develop a more translational facility with a new building that included facilities for Phase I clinical trials. With this new build, the IIU morphed into the CII.

Besides their evident research success, the CII proved a boon to the Biology Department in many other ways. These stemmed from the fact that all academics in the CII became fully engaged with the Biology Department. In essence, although all the new staff above but Debbie were HYMS-affiliated, they were in every other respect simply regarded as Department members. They contributed actively to decision-making (Paul, as Director, was a member of our Strategy Committee), and to the intellectual vibrancy of the Department through seminars, membership of graduate training committees, supervision of undergraduate projects and much else. This spirit of integration emerged through vision and leadership from Alastair, Paul and Debbie and is a credit to York. At least two other universities with which I am familiar and which had new medical schools founded at the same time as York's failed to capitalise on the research opportunities, in one case through lack of strategic research vision and in another because of overt antagonism between the biological sciences department and the new medical school.

Centre for Novel Agricultural Products (CNAP)

As I assumed the HoD-ship, CNAP, which had been generously funded by the Garfield Weston Foundation, was nearing the end of its initial £5M grant. This paid not only laboratory expenses, but also salaries of the five professors. It had been agreed that once the initial funding expired, academic salaries would be covered by the University, although effectively with devolved budgeting the cost would fall on the Biology Department. In line with thoughts that all HEFCE-funded academics should be involved in teaching, I was able to reach an accord with the CNAP professors that they should teach at undergraduate level, but with a reduced load. This took account of the outstandingly diverse portfolio of external funding that they had mustered.

CNAP grew from strength to strength. Dianna Bowles had established a strong Advisory Board chaired by Sir Dai Rees FRS and which included Peter Lillford who was ex-Unilever. Significantly, CNAP gained a $14M research grant over three years from the Bill and Melinda Gates Foundation (BMGF) to enhance production of the antimalarial compound artemisinin in the plant *Artemisia annua*. This was the largest research grant in the University's history, and was a success not only from a translational perspective, but also from a scientific one: the first genetic map of Artemisia was published in Science as a result of this grant (Graham et al. (2010) Science 327: 328) and further funding of $12.5M from the BMGF enabled germplasm developed at the University of York to be distributed to developing countries. A wealth of other projects, some commercial, some public good, saw CNAP lead the way to new funding streams and new ways of doing science.

At the end of the first BMGF grant, Dianna Bowles stepped down as Director of CNAP, and handed over to Ian Graham. The transition was seamless. It was a pleasure during my tenure as HoD to see CNAP becoming increasingly integrated within mainstream biological research and CNAP colleagues viewed as full members of the Department.

York Centre for Complex Systems Analysis (YCCSA)

The growing realisation that genetic and genomic analyses of biological organisms could enable development of predictive mathematical models to support further biological investigations led to the formation of the YCCSA. Ottoline Leyser pioneered this concept, and out of it we were successful in bidding for two RCUK Academic Fellowships: one with the Computer Science Department for Dan Franks, and the other with the Mathematics Department for Jamie Wood. Reidun Twarock, in a joint appointment with Biology and Mathematics, had already joined YCCSA as an EPSRC Advanced Research Fellow with interests in viral capsid assembly: she provided inspirational leadership to the YCCSA in terms of formulating a fertile culture for wide-ranging discussion of mathematical biology.

The whole YCCSA concept went beyond biological sciences into interdisciplinary fields involving the application of systems theory to Chemistry, Electronics and more. Until around the time I left the Department the YCCSA were housed in a Portakabin. The atmosphere there was both electric and chaotic: Brian Cantor, the Vice Chancellor, in his efforts to get them to provide a business plan, described dealings with YCCSA as tantamount to managing a hippie colony. There were murals on the Portakabin walls and a severe refusal to bow to simple administrative demands. Brian saw this as creative thinking, much to his credit.

Around the time I left the Department, YCCSA moved to the new campus on Heslington East. One hopes that the IIU/CII model of integration will be maintained, despite the geographical constraints.

Links with the Chemistry Department

Just before I assumed my position, the prospective HoD Chemistry, Paul Walton, contacted me. He pointed out that relations between our two departments were not always as harmonious as they should have been, and that it was important to get good relationships, especially since we jointly ran the Biochemistry undergraduate degree. I had not known Paul at all before this contact, but we hit it off the moment we met. We decided to set up a joint Biology-Chemistry Planning Group, and this met every other month to discuss issues of mutual concern in all areas from undergraduate teaching through technology platforms. Through the BCPG we were able to combine the power of the University's two biggest spending departments to make representations centrally for new appointments and new facilities. One productive outcome was the joint appointment of Jen Potts to an Anniversary Readership, specialising in structural studies on proteins using NMR. She was promoted to a Professorship in 2012.

Another more low-key activity came out of this. Paul and I had lunch together every other month on a "Chatham House Rules" basis. We swapped thinking on many issues and saw in these meetings as a strength in aligning our Departments with respect to vision and strategy. I respected confidentiality in dealing with Biology Department matters, but it was incredibly useful to know how Chemistry were thinking. Paul has remained a firm friend as a result of this.

York Environmental Sustainability Initiative (YESI). When Alastair Fitter stood down as HoD, he was gracious in not breathing down my back. But as Pro-Vice Chancellor for Research he did have a new agenda of his own. The RAE was of course a major part of that, but Alastair also conceived YESI in which York

Figure 6-2

View from the south-east of the new clinical and other laboratories of the Centre for Immunology and Infection. The main department is off to the right.

had strengths not only through the Biology, Environment and Chemistry Departments, but also through the Stockholm Environment Institute - York (SEIY) that was part of the Biology Department. The plan was to develop a sustainability agenda that built on York's historic and current academic reputation. We were fortunate to recruit Sue Hartley from Sussex to the position of Director.

Wider developments.

I alluded above to the close professional relationship I had with our HR Manager, Nina Pirozek. Nina has no background in science, though she does have a First Class degree in Politics. But she was extremely willing to learn about the issues relating to scientific career development, and then to apply her creative thoughts as to how to improve things.

Nina and Natalie Signoret (as academic lead) played a major part in our submitting for an Athena Swan Silver award for progression of women in science. We were the first biological sciences department in the country to gain such an award. We were able to demonstrate that despite female attrition throughout the academic pipeline from undergraduate to professor, once one had an academic position in York Biology, one's chances of promotion to full professor as a female were equivalent to those of a male.

Nina also locked into the science agenda by suggesting that we have a "Research Fellows Recruitment Day". I had been complaining about our inability to attract independent research fellows, and Nina within days came up with a creative formula that enabled us within all the bounds of HR law to generate positions for prospective research fellows, with a view to taking these scientists onto tenure-track positions. The formula Nina developed has since been copied by a number of other institutions. An "early win" was our ability to attract Daniela Barilla to York: she already possessed an MRC New Investigator Award to work on bacterial chromosome segregation, and we were able to promise her a proleptic lectureship.

The dedication and success of Nina and of Duncan Rotherham and his successor as Financial Advisor, Michelle Squires, indicates the importance of retaining outstanding professional advice in an atmosphere of rapid scientific evolution. As a scientist I was not able to interrogate fully balance sheets or to assimilate the complexities of HR legislation. By embedding such support within the Department, my HoD precedents paved the way for new thinking about the way science is managed and performed.

Hellos and Goodbyes

In the nine years I had spent away from the Department from 1974-1983, there had been almost no change in academic staff. The years in which I was HoD saw huge change – partly because many of the 1960s and 1970s appointments were retiring, but also because as our business plan became more secure, we were able to make new appointments. I gave more farewell talks than I would have liked. The retirements included Sue Bougourd, Terry Crawford, Angela Douglas, Simon Hardy, Peter Hogarth, Jim Hoggett, George Kellett, Henry Leese, Geoff Oxford, Martin Rumsby, Jeremy Searle, Alan Wilson – all great stalwarts who contributed hugely to making the Department what it is. We also welcomed Gonzalo Blanco, Sangeeta Chawla, Rob Edwards, Gareth Evans, Julia Ferrari, Thorunn Helgason, Michi Hofreiter, Frans Maathuis, Paul Pryor (CII and an ex-Wellcome Trust Fellow), Kelly Redeker and Danni Ungar. These appointments will, I am sure, inject dynamism and great science into the Department in the years to come.

Collegiality

During my time as HoD I was increasingly impressed by the way in which York academics were able to see the bigger academic picture beyond their own remit. I should not have been surprised really: in my early days as a lecturer the intellectual breeze that transcended disciplines was sweet compared to my time at Yale School of Medicine. A culture of help and support pervaded. Ottoline Leyser and I used to laugh about how one could develop a great scientific environment without being ruthless. One incident sticks in my mind as HoD.

A newly-arrived professor had made an appointment to negotiate some terms in addition to those agreed when the appointment was made. I took a hard line, and the professor exited my office slamming the door in frustration. I emailed that evening simply to say that "we don't do door-slamming at York". The message was responded to with kindness and appreciation. We worked together productively for the next six years.

It's an age-old conundrum: how to maintain the best position as a department nationally and world-wide, yet how as an individual to balance competitiveness with departmental demands. There is no single answer. York Biology managed these issues in spades – somehow. With goodwill, common-sense, and an attitude of fairness, probably.

Acknowledgements

As HoD I viewed my position as only minor in all our decision-making processes. The Strategy Group – effectively the senior management – should take credit for successes in the period 2004-2010. Strategy Group comprised the following, all in *ex officio* capacity:

- Associate HoD (Terry Crawford, then Jim Hoggett)
- Chair of Board of Studies (Peter Hogarth, then Calvin Dytham)
- Chair of Biology Graduate School Board (Peter Young, then Debbie Smith)
- Chair of Research Committee (Ottoline Leyser)
- Biochemistry Chair (Colin Kleanthous)
- Director, IIU/CII (Paul Kaye)
- Director, Technology Facility (John Pillmoor)
- Finance Advisor (Duncan Rotherham, then Michelle Squires)
- HR Manager (Nina Pirozek)

I cannot finish this missive without paying tribute to Rebecca Regan. We worked together when I was chairing Research Committee, and when she moved to be the HoD PA she taught me how to organise time, and how not to get flustered. She saw cannonballs coming over the horizon, and shot them down before they reached my office. When Rebecca left, she was ably succeeded by Belinda Wade.

The Future

In the two years since I have left the Department, it has been a pleasure to hear from others outside it how highly York Biology is regarded. The day I departed was a sad one. However, I handed over the reins to Debbie Smith confident in the knowledge that a York ethos of collegiality and fairness would be adhered to, and that a responsiveness to change would be retained as the Department developed in its second half century in these fast-moving times in biological sciences.

References:

1: http://www.rae.ac.uk/submissions/ra5a.aspx?id=14&type=uoa&subid=1005
2: http://www.timeshighereducation.co.uk/Journals/THE/THE/18_December_2008/attachments/RAE_2008_THE_RESULTS.pdf
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2010-2013

Deborah Smith

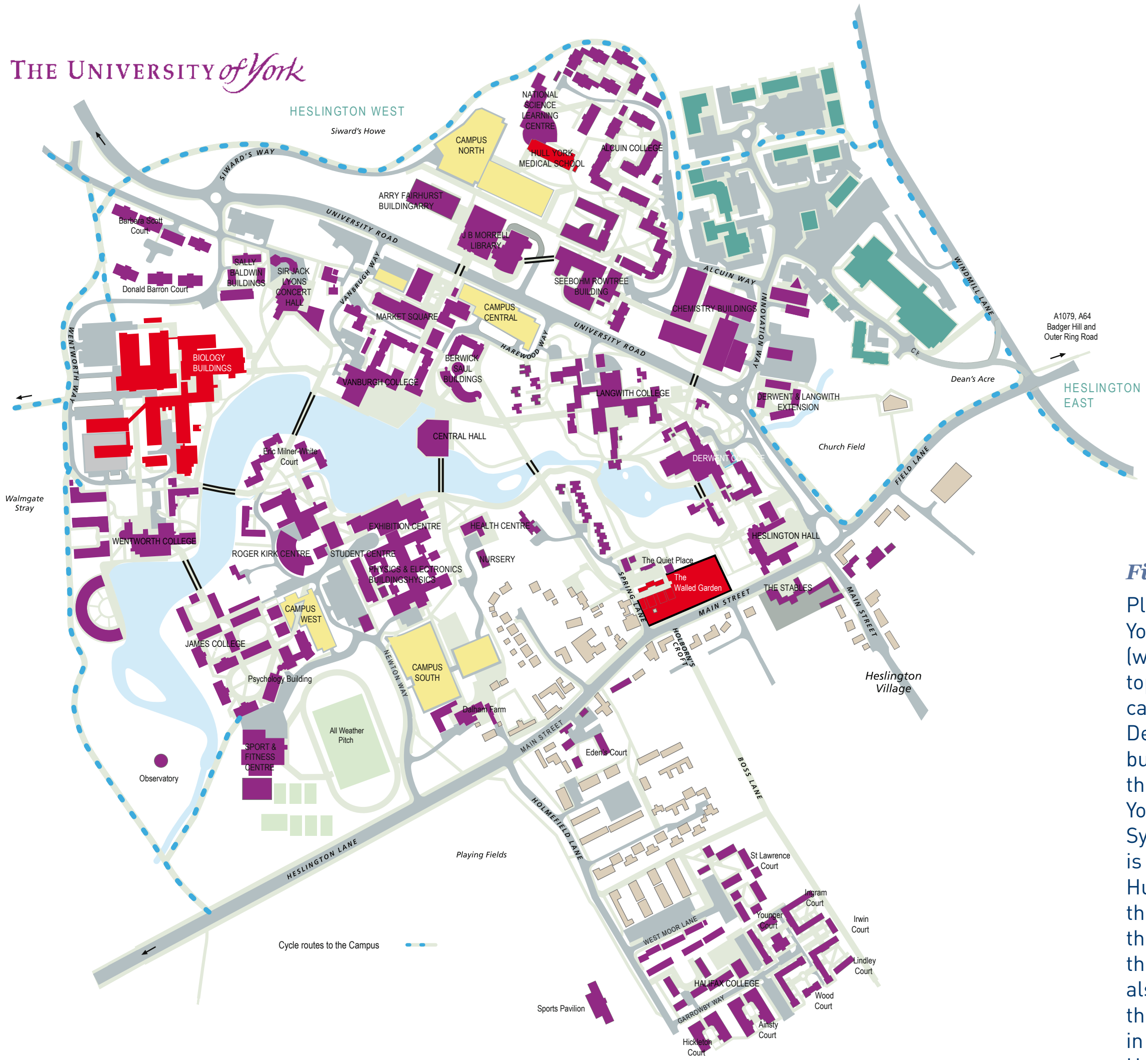
It is with some trepidation that I approach this final chapter of the first 50 years of the Biology Department. My predecessors, from Mark Williamson to Dale Sanders, were all steeped in departmental tradition over many years, each contributing hugely to the establishment and maintenance of one of the best Biology Departments in the UK. I am a newcomer, a member of the York Biology community only since the last days of 2004.

With a career largely built in a Biochemistry Department (at Imperial College London) with very different characteristics from the York environment, I was recruited by Alastair Fitter to help establish and carry out research in the Immunology and Infection Unit (IIU), a joint endeavour between Biology and the Hull-York Medical School. Arriving with 6 members of my London team and a large lorry full of equipment, we joined Paul Kaye and his group in the old IFAB building. Paul's account of the founding of the Centre for Immunology and Infection and its subsequent successes can be found elsewhere in this volume (page 55 (Dale) and p 126 (Paul)). I might have continued very happily to focus solely on my CII research programme (with occasional forays into the main Department to attend seminars, use the Technology Facility and do some teaching) until Dale asked me to take over running the Biology Graduate School in 2007. With considerable earlier experience in graduate education, I was confident that this was where I would make my major contribution to the Department (aided by expert support from Julie Knox). No such luck! In my next serious conversation with Dale, in April 2010, I learned of his recruitment to the Directorship of the John Innes Centre and imminent planned departure to the wilds of Norfolk. It was only during the next few weeks that I discovered that other senior members of the Department might be leaving too, that there was no succession planned and that the future leadership of the Department was currently uncertain. To cut to the chase, by the end of June, I found myself in the Vice-Chancellor's office for the first time since arrival in York, to be asked if I would take over from Dale as Head of Department. Not 100% sure of what I was taking on, I finally agreed to accept the post and started my tenure on 1st September 2010.

It has been an exhilarating if exhausting 30 months - and a time of major change across the Department. Firstly, there have been the continuing retirements of those colleagues who helped establish Biology in the early days and maintain its strength over the years. We have said formal goodbyes to Dianna Bowles, Richard Law and John Sparrow, all still around as Emeritus Professors.

Secondly, Dale's move to to the John Innes Centre in Norwich was followed by the departure of other senior colleagues: Ottoline Leyser left at the end of 2010 to take up the role of Associate Director at the Sainsbury Laboratory in Cambridge, while Colin Kleanthous moved to Oxford in April 2012 to take up post as the Iveagh Professor of Microbial Biochemistry in the Biochemistry Department. The influence that these three had on the continuing successes of York Biology in recent years should not be underestimated. Their recruitment to such prestigious senior roles in UK science is a testament to their many achievements - and a source of pride for the Department.

Thirdly, I have had overall responsibility for extensive academic staff recruitment, still progressing at the time of writing. This has been in part to replace the leavers – the positive aspect of staff loss is the opportunity to recruit and realign expertise. However, we have also been presented with new opportunities via the 50th Anniversary recruitment drive – and received strong support from the Vice-Chancellor in re-building senior staff levels and enhancing our strategic research strengths. Hence, I have had the privilege to welcome 13 new members of academic staff to the Department to date, with more to come.



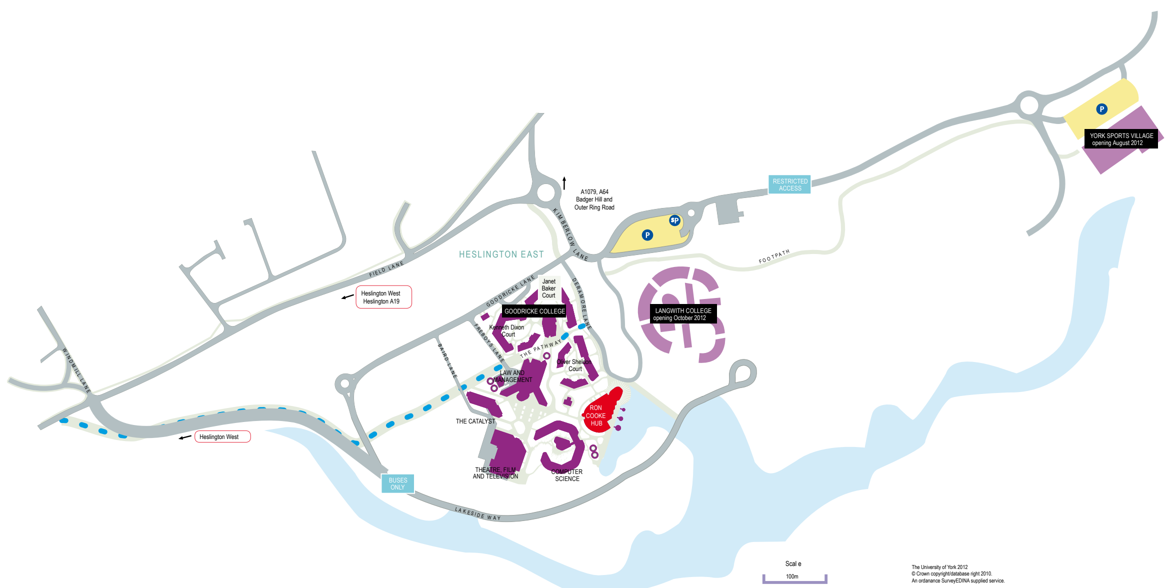


Figure 7-1

Plan of the University of York showing the main (west) campus at the top with the new east campus below. The main Department of Biology buildings are in orange on the left near the top. The York Centre for Complex Systems Analysis (YCCSA) is housed in the Ron Cooke Hub on the East Campus, the orange building beside the lake at the bottom of the figure. The department also has glasshouses in the walled garden shown in orange to the west of Heslington Hall.

Of these, three have been recruited via the University 50th Anniversary Chair scheme: Michael Brockhurst (a microbial ecologist and evolutionary biologist from the University of Liverpool), Peter McGlynn (from the University of Aberdeen, with research interests in DNA replication and repair) and Mark Leake (a single-molecule biophysicist from Oxford and Biology's first joint appointment with the Physics Department). Also at the frontier between Biology and the Physical Sciences, Jennifer Potts has been promoted to a Chair in Molecular Biophysics while another recent appointee, Michael Plevin (an NMR spectroscopist appointed to a Lectureship from the Institute of Structural Biology, Grenoble), will contribute structural expertise to our interdisciplinary research. Another recruit from Aberdeen, Maggie Smith brings international expertise in microbial genetics and synthetic biology to her appointment as Chair of Microbiology. Of two new Lecturers in the ecological area, Colin Beale joins us from Aberdeen via Tanzania, with specialist interests in the spatial effects of climate change, while Kanchon Dasmahapatra (ex-UCL) brings ground-breaking research on speciation in neotropical butterflies to the Department. A third new Lecturer, Pegine Walrad (appointed from the University of Edinburgh under the 50th Anniversary Research Lectureship scheme), brings expertise in pathogen RNA biology to the Centre for Immunology and Infection. All these new colleagues have already arrived in York.

York's long history of excellence in plant biology will continue of course, with the appointment of two new Chairs and a Lecturer, all of whom join the Department over the next few months. We welcome Ian Bancroft (ex-John Innes Centre) as a new Chair in the Centre for Novel Agricultural Products (CNAP). Ian's research is focused on understanding genome structure, function and evolution in the Brassicaceae, of high relevance to the sustainability of the UK oilseed rape crop. The research of our second new Chair, Seth Davis (from the Max Planck Institute for Plant Breeding Research in Cologne), is focused on understanding the mechanistic basis of biological time-keeping in plants. Thirdly, Michael Haydon (from the University of Cambridge) will establish his research group in the area of plant cell-wall signalling.

Our most recent recruit, to the vacant Chair in Biochemistry, is Bob White (ex-University of Glasgow) with research expertise in the regulation of gene expression, particularly in mammalian cells and in cancer. Our plans for 2013/14 include Chairs in Cell Biology and Biomedical Science (but more of the latter below).

These new appointments represent a tangible shift in the composition of the Department, indicative of distinct strategic research directions underpinned, for the first time, by a formal Departmental Research Strategy (a real "sign of the times" and not just a consequence of REF 2014 (the latest form of RAE, see p 103). These developments point to exciting times ahead for both our research and teaching programmes. A major new initiative in the latter category is the new undergraduate degree course in Biomedical Sciences, with its first student cohort arriving in October 2014. A joint programme between Biology and the Hull-York Medical School, with input from the Departments of Health Sciences and Psychology, the new BSc in Biomedical Sciences (BMS) will benefit from the scientific rigour and collaborative ethos of our current programmes in Biology and Biochemistry and also allow more medical students to undertake intercalated degrees in the basic sciences. This new degree provides another opportunity to recruit new academic staff in 2013/14 and beyond, expanding York's research base in defined areas of biomedicine. These posts will include a new Chair in Biomedical Sciences and four Lecturers, some of whom will be members of the Biology Department. To enhance new teaching opportunities and support the BMS programme, Biology will also appoint a seventh Teaching Fellow to join our resident team of teaching specialists.

Another critical requirement for teaching a new degree stream is additional teaching lab space so that all of our undergraduates can benefit from first-rate practical teaching. Excitingly, the BMS developments have catalysed building plans to support a 2-phase relocation of the existing Biology teaching labs into the space currently occupied by the car park outside K block. The first phase of this new build will also house the home base for the new University-wide Natural Sciences

Peter Hogarth with tutorial group in the 1970s.

Gavin Thomas with tutorial group in 2012

degree course, starting October 2015. In the longer term, relocation of the teaching labs will release space for a new research wing that can accommodate both new and existing research groups and further accelerate research activities across the Department. A fund-raising programme to support this expansion is about to kick-off, in parallel with the 50th Anniversary celebrations, and there is great enthusiasm across the campus for these new and exciting developments in the Biosciences, with their longer reach into interdisciplinary research in the sciences and beyond.

In outlining the recent developments, I am aware that I am really writing the first chapter of the next phase of York Biology rather than the last chapter of this Departmental history. In the 50 years since the University was founded, Biology as a science has advanced beyond recognition but there is so much still to learn. The breadth and depth of our current knowledge bears little relationship to what I was taught as an undergraduate, nor to the state of knowledge when the Department admitted its first students. Our colleagues over the last 50 years, many now retired, have contributed strongly to this explosion of information while our current staff and students will accelerate future research discoveries with often life-changing consequences. It is a very exciting time to be a scientist working in the biological domain. While I am aware that my legacy as Head of Department will unfortunately include building on the car park, I hope more seriously that this "first chapter of the next phase" will further consolidate our Department's long-established reputation for excellence in research and excellence in teaching – and all while maintaining the strong collegiality and mutual support for which Biology and the University of York are renowned.

Alastair Fitter teaching in lecture theatre B006 in 2011.

Teaching: Undergraduate and Masters' courses

Mark Williamson

Introduction

The department has always tried for excellence in both teaching and research. That is emphasised in almost all the Head of Department accounts. Chapters 1, 2, 5 & 6 emphasise undergraduate teaching, chapters 1 & 4 graduate teaching. There is an additional incentive in that the departmental income depends to an important extent on student numbers (chapters 2 & 6). There is a detailed description of the teaching day in chapter 2 but beyond that we have not tried to describe details of the course nor the continual changes that have taken place. With such a broad course, we felt most of the detail would be of little interest to most readers, unlike the research unit accounts which are easily skipped if the area is not that of the reader.

So this chapter is essentially an account of the courses offered, both undergraduate and graduate, the dates we offered them and the numbers on the courses.

TABLE 8-1: Dates and details

BIOLOGY	1965 – now
JOINT COURSES (all ⅔:⅓ except where noted):	
Biochemistry *(with the Department of Chemistry)* *called* **Biology with Chemistry** *in its first four years*	1966 – now
Biology with Education *(with the Department of Education)*	1965 – 2007
Biology with Computer Science *(with the Department of Computer Science)*	1973 – 1986 ⅔:⅓ to 1981, ½:½ thereafter
Biophysics *(with the Department of Physics)*	1978 – 1985
Environmental Biology and Environmental Management *(with EEEM (later called the Environment Department))*	1996 – 1999
BIOLOGY SPECIALISATIONS:	
Cell Biology and Biochemistry *renamed* **Molecular and Cell Biology**	1978 – 1989 1990 – now
Genetics	1978 – now
Ecology *renamed* **Ecology, Conservation and Environment** *named* **Ecology** *again*	1978 – 1989 1990 –2011 2012 - now
Human and Environmental Biology *became* **Applied and Environmental Biology**	1978 – 1985 1986 to 2000
Physiology of Organisms *became* **Animal Physiology**	1980 – 1989 1990 to 2000
Biotechnology and Microbiology	2010 – now
FOUR YEAR COURSES:	
Sandwich (year in industry)	1990 – now
with a year in Germany *changed to* with a year in Europe *Both can be combined with either a Biology single subject or with Biochemistry*	1990 - 1998 1998 – now

Undergraduate courses

The university has always had a mixture of single subject courses, based on a single department and joint courses, run by two departments, usually ⅔ to ⅓ but sometimes ½ each.

Single subject course

Our main single subject course has always been called Biology, starting with courses common to all students in the first terms, and allowing specialisation in later years. We formalised that in 1979 when undergraduates could choose specialised names for their degrees, subject to meeting appropriate criteria. We started with four such courses, added one more in 1981 and still have four, three of them direct successors. Details of the dates and name changes are given in Table 8-1 below, and of numbers in Figs 8-1 and 8-2. Undergraduates have always been allowed to change freely between Biology and the specialist single subject degrees provided they have met the criteria for the specialist degrees, so I haven't attempted to graph them separately, just as a single collective category. From the '90s, we have offered variants to both the Biology degrees and Biochemistry of a sandwich course, which involves a year in industry, or courses with an extra year abroad.

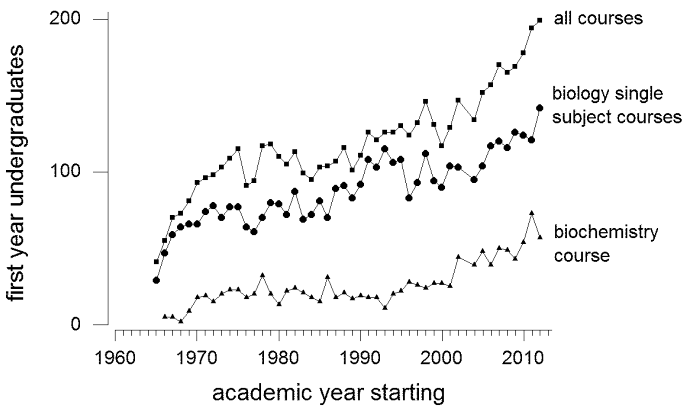


Figure 8-1

The numbers of undergraduates in the first year showing the total for all our courses, the total for all single subject degrees and the number for Biochemistry. Note the rapid increase in Biology in the first four years, followed by an irregular trend upwards thereafter. In Biochemistry note the relative failure in the first four years while named Biology with Chemistry and the boost given to the intake in 2002.

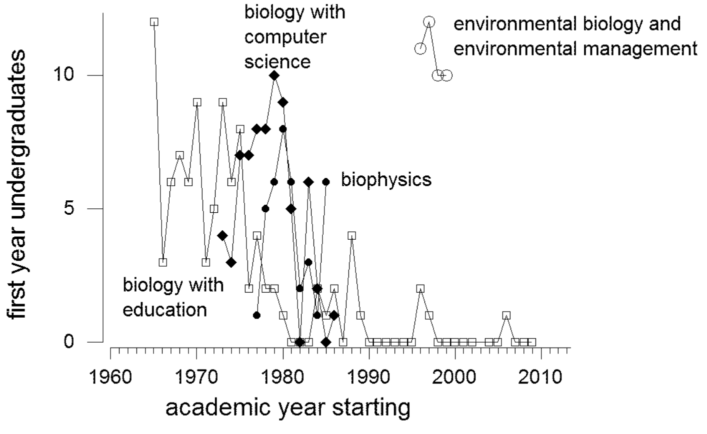


Figure 8-2

The numbers of first year undergraduates in joint courses.

Joint Degrees

For joint degrees, one with Education was important early on, dwindled to almost nothing and has now been abandoned. (We ran an MSc course with them in the '70s (see below, Masters courses)). A joint degree with Chemistry, the Biochemistry degree, on the contrary has grown more important over the years and with the single subject degree now constitutes all our intake, though both come in variants. With the encouragement of the UGC Biological Sciences Sub-committee, we started a joint course with Computer Science in 1973. That and the related masters course are described below, in the Masters courses section. In the '60s, we offered or considered joint courses with History, Language and Sociology and, although there were occasional undergraduates who tried them, they all came to nothing. After a false start, we ran a successful Biophysics course, joint with Physics, for some years. After EEEM (later the Environment Department) was established in 1991 (first students in 1992) we ran a joint course with them for just four intakes, 1996-99, having started the successful and continuing MRes EEM course in 1995 (see below).

Eileen Gowthorpe, Bryan Norman and James Merryweather setting up the Teaching Laboratories for a practical class in the Autumn Term 1979.

The Structure of the Degree Course

Box 8-1 shows the entry for the 1965 prospectus, written in 1964 while staff were still being appointed, so essentially all my own work. The course was divided into a Part I of two terms followed by seven terms for Part II.

Box 8-1

The course consists of two terms' work for Part I, followed by an examination, and seven terms for Part II. Those offering Biology as a single subject will take all four courses of Part II for three terms, and thereafter any two of them. Those offering Biology with a subsidiary subject will take two Part II courses for three terms and one of these two for the remaining four terms.

Part I

1	Genetics
2	The diversity of living organisms
3	Ancillary chemistry

Part II

1	Biochemistry (including that of cells), Microbiology, Biochemical Genetics.
2	Plant and Animal Physiology, Embryology.
3	Ecology, Population Genetics, Evolution, Behaviour, Statistics.
4	Taxonomy, Comparative Anatomy, Palaeontology, Histology, Electron Microscopy.

In 1978 the Board of Studies set up a committee to revise our teaching pattern. The result was Part I became 5 terms long with five courses and so with Part II starting in term 6. There was no Part I exam, only continuous assessment. From 1989, there was a choice of courses in terms 4 & 5. In place of the 1965 structure of Part II shown in Box 8-1, the lecture courses were a set of Options, typically each member of academic staff offering one nine-lecture option, with students taking ten of these. The Board of Studies, which had responsibility for organising the degree courses, had five course committees corresponding to the specialist degrees within biology listed in Table 8-1. These course committees were responsible for arranging the details of the options, a few of which were shared between two courses. For example, the Options offered in 1988-89 are shown in Box 8-2.

Box 8-2

OPTIONS AVAILABLE IN PART II 1989-90

Each option is a nine lecture course, except where marked

Term 6	Metabolic Regulation
	Plant Cell Biology
	Microbial Growth and Fermentation Technology
	Structure of Biological Membranes
	Movement and Locomotion
	Plant Physiology
	Molecular Evolution
	Recombinant DNA Technology
	Eukaryotic Genome Structure
	Behavioural Ecology/Socio-biology
	Marine Ecosystems
	Human Nutrition
	Degradation of Natural Materials
Term 7	Transport across Biological Membranes
	Exo/Endocytosis and Membrane Biogenesis
	Genetic Manipulation of Plants
	Muscle Contraction
	Neurophysiology
	Animal Intelligence
	Human Genetics
	Population Genetics
	Genetics of Bacteria and Bacteriophage
	Eukaryotic DNA Technology
	Invasions and Islands
	Ecotoxicology
	Biological Potential for Food Production
	Pure and Applied Aspects of Evolutionary Ecology
	Tissue Metabolism and Disease
Term 8	Energy Transduction in Cells/Organelles
	Protein/Nucleic Acid Interactions
	Eukaryotic Gene Expression
	Immunology (18-lecture course)
	Reproductive Physiology
	Parasitism, Disease and Immunity
	Environmental Physiology
	DNA Replication and Cancer
	Developmental Genetics
	Soils, Plants and Man
	Biological Conservation
	Environmental Technology
	Pesticides - Action and Use

Almost all the lecture courses in Part I had an associated practical class. These were normally laboratory-based, but a number of the ecological practicals were field based, and tended to be held in the summer term.

In 1995 the whole course became modular, no Part I or Part II, with many of the old courses being 'units' in 1995 and 1996' but modules ever since.

Field courses

Each year, many students attend a ten-day general field course in marine biology at the Marine Station at Millport on the Isle of Cumbrae in the Clyde. This was started by Martin Lewis in 1969 and continues to this day. It became a formal module only in 2011. Organisers since 1971 have been Chris Rees, Peter Hogarth, Calvin Dytham and Julia Ferrari, but many other members of staff have been involved.

An ecology field course at the end of the second year of the course was a regular feature from 1967, the first summer in which we had a second year. It became a substantial undertaking, involving 3 or 4 members of staff and 30 or more students; the courses lasted 2 weeks. Initially it was held at Malham Tarn Field Centre in the West Riding; from 1970 until the 1990s at the University College of North Wales, Bangor. The most adventurous course was created by Duncan Reavey, jointly with the University of Yaounde in Cameroon, with £10,000 a year funding from the Pilkington Trust and run in 1995 & 1996 by Calvin Dytham and Jon Graves and with Chris Rees in 1996. The third year in Cameroon had to be foregone for health reasons. The course was then at Blakeney Point, Norfolk for two years before becoming the North York Moors Field Course, which was a residential course first based on Scarborough, but run from York since 2011 when field work was incorporated in the Environmental Field Skills module.

Figure 8-3

Students studying the rocky shore on the Millport Field Course. Photograph courtesy of James Merryweather.

BOX 8-3: The Course in 2013

The first year is based around core modules (see box 'First year modules'), taught primarily through a combination of lectures and practical classes. These provide an introduction to the main areas of modern biology, and lay the foundations for more specialised second and final year modules. An additional module, including regular tutorials, develops more general scientific and transferable skills. At the end of the first year, many students attend a highly popular field course in marine biology, held at Millport off the west coast of Scotland.

In the second year you begin to focus on areas of special interest, extending your knowledge and deepening your understanding through your choice of modules (see box 'Second year modules') and tutorials.

In your final year, a free choice of modules (see box 'Final year modules') allows you to concentrate on your special interests, and the two-term research project is your opportunity to interact with one of our many research groups and to produce an original scientific report.

Specialist degree programmes In the first year you follow the core Biology programme. In the second and final years, your selection of modules must contain a core set in the area of your specialisation (see box 'Second year modules' and 'Final year modules'), and the topic for your research project must also lie within your area of specialisation.

First year modules

In the first year, all modules are compulsory for all students and provide a foundation in all the main strands of the subject.

- Molecular Biology and Biochemistry of the Cell explores the relationship between structure and function at the molecular and cellular levels. It examines how chemical reactions provide energy and building blocks, and how enzymes provide catalysis and control.
- Genes, Genomes and Evolution considers how DNA is organized into chromosomes and genomes in a variety of organisms, from bacteriophage to humans, and examines gene expression through the processes of transcription and translation. Gene mutations and chromosome aberrations are considered in the context of human genetics and disease, and in terms of their significance in evolution.
- Microbiology, Cell Biology and Development reveals how knowledge of the biology of various microorganisms, including bacteria and viruses, has led to the development of genetic engineering and the control of infectious diseases. It also examines how fundamental processes within cells are organized and regulated, how cells communicate with one another, and how unicellular and multicellular organisms divide and reproduce.
- Physiology and Adaptation explores how the diversity of both animal and plant species, and their anatomical and physiological adaptations, have been shaped by evolutionary processes.
- Ecology highlights interactions between organisms and their environment, at the level of individual organisms and ecosystems through to biomes. It includes an introduction to animal behaviour, and a consideration of how an understanding of ecological concepts is crucial to conservation.

In addition, a module covering essential scientific and transferable skills, including tutorials, runs throughout the first year.

Second year modules

Students select modules from the provisional list below. For students registered for specialist degree programmes, a number of core modules in each term will be compulsory.

- Cell Biology
- Immunology
- Human Genetics
- Molecular Biotechnology
- Environmental Interactions
- Animal and Plant Ecology
- Millport Field Course
- Behavioural Ecology
- Developmental Biology
- Neuroscience
- Biomedicine
- Evolutionary and Population Genetics
- Environmental Ecology
- From Gene to Function

In addition, a scientific and transferable skills module runs throughout the second year. This includes tutorials, group projects and other sessions aimed at developing experimental design and research skills. You also choose two from a list of specialist experimental and transferable skills areas, which is likely to include:

- Protein Interactions
- PCR
- Cell Biology and Cytometry
- Environmental Field Skills
- Genomics
- Evolutionary Trees
- Bioenterprise
- Communicating Science
- Systems Biology
- Molecular Imaging

Final year modules

Biology students have a choice of modules from the list below, while specialist degree students select a set of core modules in their area of interest. The topics cover areas of current scientific importance, and may change from year to year. The following provisional list gives a selection of those currently planned for the 2013 student intake.

- Molecular Machines
- Protein to Protein Recognition
- Advanced Topics in Developmental Genetics
- Cancer and the Cell Cycle
- Learning and Memory
- Evolutionary Ecology
- Global Change Ecology
- Biorenewables
- The Dynamic Genome
- Epigenetics in Development and Disease
- Molecular Microbiology
- Molecular Virology
- Plant Biotechnology
- Biocatalysis
- Glycobiology
- Advanced Topics in Developmental Biology
- Advanced Topics in Immunology
- Bioremediation
- The Brain in Health and Disease
- Cell and Tissue Engineering
- Conservation Ecology and Biodiversity
- Ecological Genetics
- Nutrient Acquisition and Cycling
- Molecular and Cellular Parasitology
- Protein Nucleic Acid Interactions
- Systems and Synthetic Biology

In addition, students take a research skills module that deals with topics of particular relevance to the final year research project and finals examinations, including information retrieval, scientific writing skills and problem solving.

When the Human and Environmental Biology degree was set up, Mike Chadwick arranged a joint field course with the University of Bayreuth, which was held alternate years in York and Bayreuth for some years. Later there was a York-based AEB course on the River Foss which ceased with the course in 2000.

The course in 2013

To complete the course descriptions given above, the prospectus entry for 1965 in Box 8-1 and the list of Options for 1989 in Box 8-2, above is the prospectus entry for 2013. It shows the development of the structure with the changing nature both of the subject and the staff, but no revolutionary change.

Finally, I would just re-iterate a couple of points discussed in the Head of Department accounts. All students at York have a supervisor (see chapters one and four) who is normally also their tutor in their first term. York has always held tutorials in various forms. The place of tutorials in Biology is mentioned variously in chapters one and two but particularly in the discussion between Simon Hardy and Barry Thomas of the differences between Biology and Chemistry in this (pp. 24-25).

Masters Courses

As I said in chapter one, from early on the department wanted, as far as possible, that all research students would attend and be assessed on formal courses. We thought, as American universities had thought for a long time, that a first degree was seldom, of itself, sufficient preparation for three years of research work for a doctorate. One difficulty was a lack of sufficient suitable courses, so the development of one year taught graduate courses, initially called BPhil but quite soon MSc, was a natural one for us. However, it was difficult to get funding. The first one was the MSc in Computation in the Life Sciences, later Biological Computation, described below, which ran from 1970 to 1999. As graduates from other universities had often had weak numerical training, it served too for some DPhil (now PhD) students. We also tried an MSc in Biochemistry which ran from 1977 to 1981 but never had more than a handful of students.

More successful was our MSc in Biology with Biological Education, described below, which also started in 1977 and ran for ten years. It was for school teachers on secondment and usually had about ten of them a year. Before discussing the MRes courses that came in the '90s, here are descriptions of the Computation in the Life Science course and one of its successors, the MILE MRes course, and of the Biology with Education course.

Michael Usher, with help from ***Terry Crawford***, writes:

> In the early days, around 1970, there was an unusual mixture of interests, for the time, amongst the academic staff. Two of the members of the Computer Science Department (David Burnett-Hall and John Wilmot) had research interests in problems related to biology, especially classification. Two members of the Biology Department (Mark Williamson and Michael Usher) were interested in modelling and statistical analyses and had experience of using computers. The UGC Biological Sciences Sub-committee, at their visit on 13 February 1970, encouraged us to develop courses based on our quantitative interests. This was the beginning of a synergy between the two departments that continues to this day.
>
> The first manifestation of this synergy was the development of a taught, one-year, postgraduate, degree course, named the BPhil 'Computation in the Life Sciences'. The course began in 1970 with a single student, Bill Howard, who had returned to Britain after a career in a Colonial Forest Service. During the following three years only three more students were attracted to the course. However, the course was noticed by the Medical Research Council (MRC). Although the MRC did not allocate a set number of studentships, it would consider any applicants submitted by the University of York 'on appeal'. This was important early recognition for what we were attempting to do in York, and opened a very successful collaboration with two other Research Councils.

Subsequently, the course started to gain more interest and momentum. With the change of degree titles in York, it became an MSc course, with the title being changed to 'Biological Computation'. During the 1970s the climate of opinion in many areas of biology became less descriptive and more quantitative. Recruitment of academic staff in the Department of Biology resulted in considerably more expertise in mathematics, computing, statistics and modelling; similar recruitment in the Computer Science Department led to more staff with an interest in applying their expertise in the biological sciences. Demand for the course increased, with more than 100 applicants in some years in the 1980s and with more than 20 students on the course each year. The greatest intakes, 27 in each year, were in the academic years 1985/86 1986/87 and 1987/88, with the number of students falling off rather irregularly after this peak (Figure 8-4).

Support from the Research Councils increased, with 2 grants per year initially from the Natural Environment Research Council and eventually 9 grants per year from the Science Research Council, later the Biotechnology and Biological Sciences Research Council. Very few students failed to complete the course satisfactorily and the career prospects of graduates were generally excellent. Until he left the University in 1991, Michael Usher had been the course organiser – he handed this task over to Chris Elliott for the next decade. A small advisory committee whose members were all external to the University, initially chaired by Michael Dadd of BIOSYS, helped the University staff in keeping the course relevant to the employment prospects of the graduates. A cash prize for the best student in each year was offered for several years by British Sugar, a company that the students visited on their January 'Field Course' exploring the use of computers in research, business and industry.

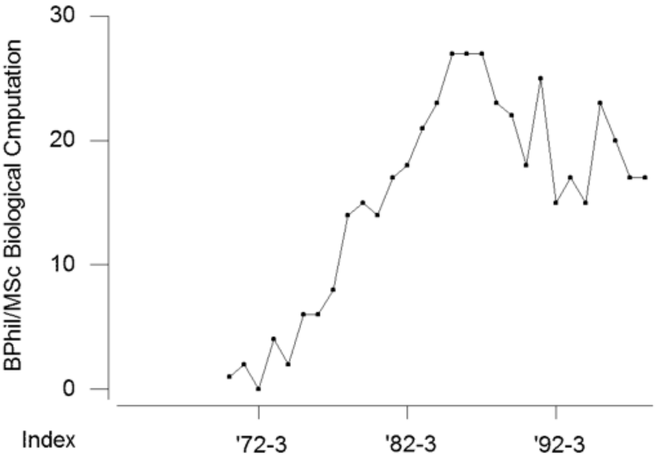


Figure 8-4

Total students, including diplomas and fails. Diploma available from 1987-8. Final year 1998-9.

Looking back it is hard to realise that computers had not completely dominated people's lives even a quarter of a century ago. The change was becoming noticeable towards the end of the 1980s, when far more graduates with a biology degree had been exposed to computers, either during their degree course, or at school, or indeed at home for their own interest. Demand for the course therefore started to decline until the University decided to discontinue the course towards the end of the 20th Century.

Although the one-year taught postgraduate degree was the main focus of the synergy between the two departments, there were other areas of cooperation. One was the joint BSc degree between Biology and Computer Science which began in 1973 initially, as noted above, ⅔:⅓ but ½:½ from 1981-86. The Computer Science Department at first only offered joint undergraduate degrees with other departments and hence this degree was a welcome addition to their portfolio. Later in the 1970s, the Computer Science Department started its own single-subject undergraduate programme and in the 1980s its MSc in Information Technology. The joint undergraduate degree was never a particularly popular course, with a maximum of 10 students beginning it in any one year (at which time there were three variants – Biology, Ecology or Genetics with Computer Science). The courses reached their peak in 1979/80 with 24 students in all three years of study;

however, the number of students in the two preceding years as well as in the two following years was hardly less. With the increasing use of computers in everyday life during the late 1970s, these joint undergraduate courses attracted some extremely bright undergraduates.

Another area of cooperation was the one-term course linking the University of York and the Fisheries Laboratory at Lowestoft from 1975, an initiative by the deputy director, David Cushing. Later we had scientists from other places on that course including from the NERC Institute of Terrestrial Ecology. Staff from these institutes were seconded to the University for the autumn term, attending the taught sessions of the MSc course and often undertaking small projects related to their work. Indeed one of them, Colin Bannister of Lowestoft, was so content with his time in the department that, for several years, he personally funded a prize for the best 3rd year quantitative field biology project.

This collaboration between the Biology Department and the Computer Science Department was virtually unique in British Universities during the 1960s to 1980s. Several of the graduates of both the MSc and BSc courses have gone on to careers that reflect very well on the teaching and project activities in the University of York.

The MSc ended in 1998-9 and was replaced by an MRes in Bioinformatics and, from 2001 by MILE, which is now described by ***Richard Law***.

MRes Mathematics in the Living Environment

This course replaced, in part, the MSc Biological Computation that closed in 1999 when BBSRC ended its funding. (The other part became the MRes in Bioinformatics.) We could see that the degree-level education in more quantitative aspects of the life sciences was getting weaker. At the same time the needs of employers for quantitative life-science skills was becoming greater, and there was a requirement for more advanced mathematical and computational skills in the life sciences. This motivated a new masters course intended primarily for students with a background in mathematics, interested in a career using applied mathematical skills in the living environment. The course was funded by NERC from 2001 until 2011 when funding and the course ended.

The course got strong support from the Mathematics and Biology Departments, and helped to build links between the departments that are still developing. The key personnel were the course organiser, Jon Pitchford, who was given a joint appointment in Maths and Biology, Maurice Dodson of Maths, who championed the course at an early stage, and me. We felt it was important to run the course with minimal extra work for staff in the two departments, but nonetheless received strong support from a number of colleagues. Throughout the time, an Advisory Group of senior people from the environmental sector kept track of the course development. They represented potential employers of students graduating from the course, and gave us a lot of advice and encouragement; the course benefited greatly from their involvement.

The cornerstones of the course were dynamical systems, modern statistical methods, and computation, all in the context of the living environment. Students needed to come out from the course knowing enough about the culture of ecology to be able to work effectively with people involved in the living environment, so they were also given some background modules involving ecology. Research projects were a key part of the curriculum, starting with a group project, and moving on to an external placement during the summer. The latter was especially important as this is not an obvious career path for maths graduates, and the students needed to get a sense of what it would be like working in research institutes in the environmental sector. As time went on, the students became much in demand around UK for the special skills they could bring when on their summer placements.

The number of students enrolling each year was not large, as we were looking for people with skills in maths, and if possible an interest in the environment. My sense is that the demand for graduates was greater than the supply: there was, and still is, a national shortage of people with these skills. However, we have been able to bring into the system quite a number of young mathematicians over the years, and expect this to make a material difference to environmental research in UK in the future.

Thirdly, here is an account of the MSc in Biology and Biological Education:

Alastair Fitter

For 10 years from 1977 Biology joined with Chemistry and Physics and the Education department to run a series of MSc courses for secondary school teachers. The teachers came to the department full-time on secondment from their schools for two terms and took a range of modules that were mostly specific to the course and were intended to acquaint them with current understanding in their subjects and in educational theory and practice, and then returned to their school and did five more terms on a research project, usually using school facilities, sometimes enhanced by equipment loaned from the department. The students were enthusiastic and committed - some of the best groups to teach we have experienced - and some of the research projects were highly successful: several led to significant publications, one of which is cited by John Lawton in his account of the work that led up to his FRS (see p.87). We set aside a small room as a common room for the students and decorated it with a set of Paul Nash drawings previously loaned to the department; their unrecorded location caused consternation some years later when the Registrar was trying to discover what had happened to the University art collection. The course eventually died when the government changed the rules on funding for teacher in-service training, and what had been a ring-fenced pot that could only be used for courses of this ilk vanished, leaving LEAs free to use the cash to support their own budgets and the course with no students.

Masters in Research (MRes)

There was a sea change when, as described by David White in chapter four, the research councils invented the MRes degree. As he describes there, we took up the opportunity with alacrity and had two MRes courses from 1995, a biochemical one with Chemistry called Biomolecular Science and an environmental one with the Environment Department called Ecology and Environmental Management. Both are still going strong (Table 8-2), the latter with the same name, the former first Functional Genomics and now Post-Genomic Biology.

In the latter years of the MSc in Biological Computation there were usually two sets of students, those interested in quantitative molecular biology and those interested in environmental problems. With the end of that course in 1999, the former were catered for by a new MRes in Bioinformatics under Sandy Baldauf (see chapter five), the latter, after a short pause, by the MRes Mathematics in the Living Environment, described above by Richard Law. Apart from a couple of short-lived other courses (see Table 8-2) the other development is the MSc in Bioscience Technology which started in 2006 which is run by our Technology Facility and so is a most unusual course, unique and unrivalled as the brochures says.

Table 8-2

No. of students on Master's courses from the introduction of MRes in 1995.

year	EEM	MCEEM	PB	BS	FG	PGB	BC	Bioinf	CB	BT	MILE
1995	10			8			23				
1996	12	5		10			21				
1997	23	15	5	14			17				
1998	24	6		12			18				
1999	37			21				19			
2000	23			14				20			
2001	17			20				20			5
2002	19			17				20			8
2003	14			17				19			8
2004	23				9			16			9
2005	17				14			16			8
2006	16				17			20		9	8
2007	27				9				9	8	7
2008	17				10				11	12	7
2009	14				7				11	10	6
2010	19				12				7	11	8
2011	20					12			9	13	
2012	15					13			9	13	

Key

Course	Title	Taught by:
EEM	MRes in Economics & Environmental Management	Originally ⅔ Biology, ⅓ Environment, now ½ Biology, ½ Environment
MCEEM	MRes in Marine & Coastal Ecology and Environmental Management	⅓ Biology, ⅓ Environment. ⅓ Scarborough University College
PB	MRes in Plant Biology	Biology
BS	MRes in Biomolecular Science, replaced by	½ Biology, ½ Chemistry
FG	MRes in Functional Genetics, replaced by	½ Biology, ½ Chemistry
PGB	MRes in Post-Genomic Biology	run by Biology with some input from Chemistry
BC	MSc in Biological Computing, replaced by	½ Biology, ½ Computer Science
Bioinf	MRes in Bioinformatics, replaced by	½ Biology, ¼ Computer Science, ¼ Chemistry
CB	MRes in Computational Biology	
BT	MSc in Bioscience Technology	Biology
MILE	MRes in Mathematics in the Living Environment.	½ Biology, ½ Mathematics

Biology D wing in winter (2005).

The Department has a research environment that is diverse in technology and in subject area. (A) Colin Beale training interpretive wildlife guides in the Maasai Steppe of Tanzania, holding a juvenile Rock Python, (B) Simon Baker of the Jack Birch Unit at work (C) John Sparrow studying Drosophila melanogaster, (D) research on plant breeding in one of the Departmental glasshouses and (E) output from a scanning electron microscope in the Technology Facility's Imaging Laboratory.

INTRODUCTION TO PART 3

David White

This introduction has two main sections: a commentary on the research environment and a short summary on the department's research and how they have each developed over the fifty years. This is then followed by several chapters providing more detail of the department's research.

THE RESEARCH ENVIRONMENT

The early 1960s were a period of great change for biological research. Mark Williamson's first chapter discusses the Robbins Report, the creation of six 'new' Universities and, importantly for this chapter, the Royal Society report chaired by Sir Howard (later Lord) Florey. This recognized the growth and changing nature of biological science, with the recommendation that the new 1960s Universities in particular should seize the opportunity by recognising these changes in how they structured their biological departments.

Research Councils for all

At the start of 1963 there were just two Research Councils (RCs): MRC and ARC which had been created in 1913 and 1931 respectively. In addition, government funding for research came from the Department of Scientific and Industrial Research (DSIR) which had been created to aid the war effort in 1915, and provided a major source of research funding for science in universities. DSIR had strong academic/industrial links. In 1963, DSIR was wound up and SRC, SSRC and NERC were founded.

This meant that from the Department's inception there was a research council relevant for all natural and social sciences, thereby creating a consistent policy towards funding science across the whole spectrum. Further, it was made clear that the Haldane Principles were accepted policy, namely that University Research should be at arm's length from government departments, whose responsibility would be the operational research for that department.

In the case of our broad-based Department of Biology, several RCs were of roughly equal importance: SRC (later SERC), ARC (later AFRC and then BBSRC), MRC and NERC all having major biological responsibilities, though it seemed that MRC was somewhat wary of funding research outside the more traditional medically-based departments.

Dual support and the well-found laboratory

One aspect of this consistency was that the dual-support system, recognized when the University Grants Committee was created in 1918, became key within RC thinking. That is, publically-funded (Government) scientific research in Universities was paid for in part via funds direct to Universities from the University Grants Committee, and in part by Research Councils.

This in turn consolidated the concept of the 'well-found' laboratory. Implicit in dual-support at that time was that the UGC paid for academics to have the basic laboratory, equipment and staff to explore new ideas, with funds to pursue the further research coming from application to the appropriate research council for a peer-reviewed project grant, to purchase items of capital equipment that were bought for that work alone and to hire research assistants/fellows to help undertake that research. The university/department was expected to supply the technical staff, major equipment and support services such as an animal house.

Since the 1960s, biological research has become far more expensive, requiring more high-cost equipment. Further, as the volume of research in universities increased in the 1980s and beyond, the burden of funding the well-found laboratory as defined above became prohibitive and led to teaching income being diverted into research provision. In order to address this, the research councils were required from 1992 to fund many of the indirect costs of the research they were funding, and there was a transfer of funds from UGC to the RCs to enable this change. Charities, notably the Wellcome Trust, refused to follow suit. From then, the technical help required for that research, appropriate contributions to the cost of the major equipment and of running scientific support such as an animal house were all provided as indirect costs to the university via grant income. A consequence was that the department had fewer technical staff and a smaller equipment grant from FC income. It could no longer support academics without external income with the level of technical help they had been receiving, and decisions about the use of resource were more biased in favour of those with external grants. The concept of the 'well-found' laboratory became very different from that in the 1960s.

The Research Assessment Exercise

A major influence on research funding, and driver for change within the department, was the introduction in 1986 of the Research Selectivity Exercise (RSE) and its successor the Research Assessment Exercise (RAE). It was started during a period of tight budgetary constraint in order to determine the Funding Council allocation to Universities when it was deemed that there was insufficient funding to maintain all Universities at the same level. Before this time, Funding Councils determined funding based largely on student numbers; the RAE introduced a measure of the quality of the research output, the RAE rating, for individual disciplines in determining the funding for each University. This is discussed in greater detail in Chapter 12. It was essential, to be considered a serious research department, to obtain a high rating. It was not only the base funding that was at stake, so was the Department's reputation in the outside world and it was more difficult to obtain research grants from a poorly-rated department. Fortunately, the university understood this and took steps in the 1990s, described in Chapter 4, to ensure that high RAE ratings were obtained.

The 1993 "Realising our Potential" White Paper

A major change to the research environment followed the publication of the Realising our Potential White Paper in 1993. The Research Councils were re-aligned, with most biological research coming under the wing of the new Biotechnology and Biological Sciences Research Council (BBSRC) which took on board the remit of AFRC and the biological and biotechnological components of SERC. The Office of Science and Technology with its head, the Director General of the Research Councils (DGRC), which is responsible for RC funding, moved from the Department of Education to the Department of Trade and Industry, thereby emphasising the importance to the Government of applied, goal-directed research, and with the danger that, despite its ring-fenced budget, DTI would find ways to move the boundary towards its own objectives of benefitting (subsidising) industry directly rather than indirectly via core understanding.

The Realising our Potential White Paper was also responsible for the creation of a new type of master's degree, the MRes, described in Chapter 8.

Joint Infrastructure Fund (JIF)

By the early 1990s it was widely recognised that there was a crisis of underfunding of capital and infrastructure in British universities, mainly due to periods of austerity and in part due to the way that universities reacted to changes in government policy. The Government gave the Research Councils significant funds to rectify this situation, with major input from the Wellcome Trust too. The importance of having high RAE ratings was clear in the way these funds were distributed.

As described in Chapter 5, the Department, with Chemistry, put in an inspired and successful bid to JIF which transformed the Department in its structure and ability to move forward. The result was a new modern research building, dramatically increasing (and more importantly improving) the Department's area for research. Of equal importance was the creation of the Technology Facility, a suite of laboratories centrally-run, well-equipped and available to all. These provided equipment and personnel in all the main areas of modern research of the Department: Analytical Biochemistry, Bioinformatics, Genomics, Imaging & Cytometry, Molecular Interactions, Protein Production, Proteomics plus the Structural Biology Laboratory, part of the chemistry department though with members from both departments.

The creation of the new Medical Schools

Again as described in Chapter 5, in 2001 the Universities of Hull and York were successful in their joint bid to create a new medical school, the Hull-York Medical School, taking its first students in 2003. The major effect this partnership has had on the Department, especially the creation of the Centre for Immunology and Infection (CII), a joint endeavour between HYMS and the Department is described in Chapters 6 and 7. CII staff can be either HYMS or Biology paid. All HYMS biological research is administered through Biology, and entered for RAE/REF as Biology and the staff teach students from both HYMS and Biology.

THE DEPARTMENT'S RESEARCH

When the Department was started in 1963, biological research teams in Universities were mostly small. Those appointed to lectureships in the first twenty years or so were generally offered a departmental technician, equipment and an annual research budget sufficient for moderate research activity. Most good research, though, needed grant support too. As said in Chapter 1, we went strongly for research grants from the start. The departmental equipment budget from the 1970s allowed updating of most necessary equipment to a good standard. The physical design of the department was fairly flexible, certainly for the needs at the time, and could accommodate research groups of various sizes, small being an academic and a technician with one or two PhD students, with the largest that could be readily accommodated being that plus up to perhaps four or five research fellows and assistants.

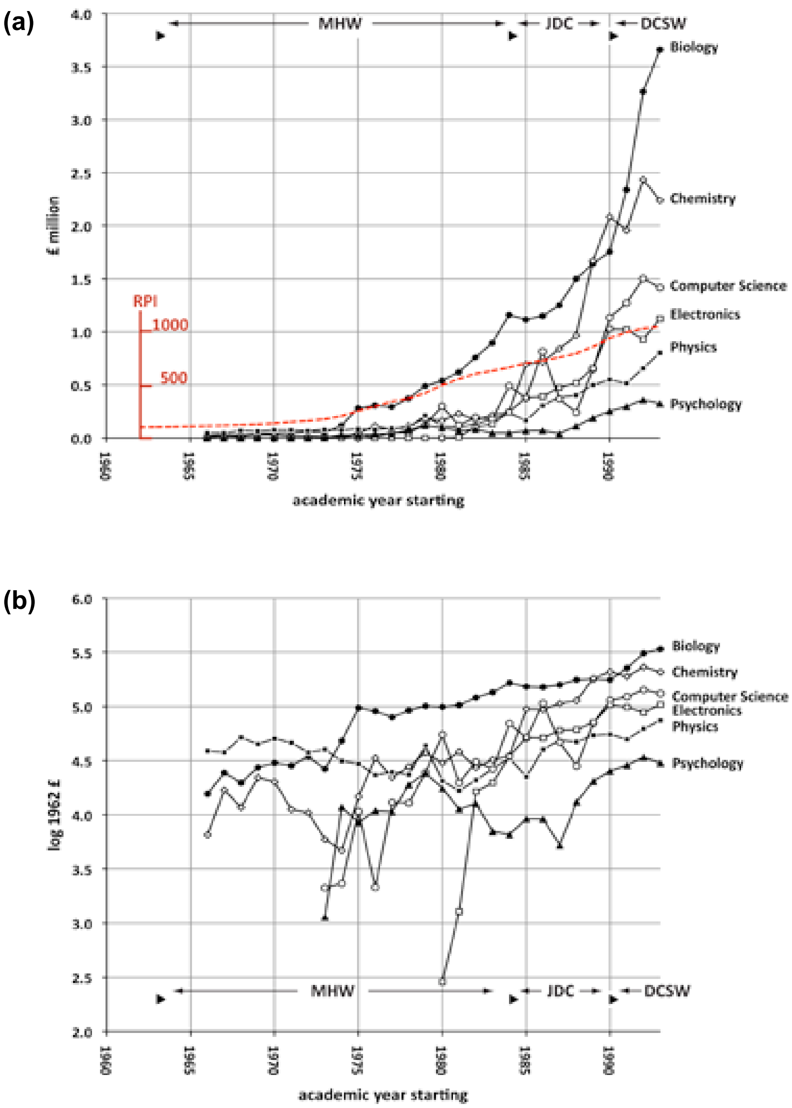
We did not have personal computers then, indeed the first departmental computer was not bought until about 1969; its input was punched tape and output a noisy flexiwriter. Papers and grant applications were typed, for most, by the staff in the General Office. We had excellent research support: a mechanical workshop with fine tools inside and coarse ones in a draughty garage, an electrical workshop and a glassblower. It was fairly common for members of staff other than the mechanical workshop specialists to work on lathes and milling machines; safety was less regulated then. There was an good animal house and a number of glasshouses.

The department's research spanned virtually the whole gamut of biology, in those days from biochemistry at the molecular end, through physiology to ecology, including the full range of living organisms, prokaryotes and eukaryotes with genetics spanning the whole although we did little research on viruses. We have always been strong in quantitative biology, in those early days without computers but with electrical calculators.

Covering such a wide range of research with about 30 research leaders, the steady size from the mid-1970s to the mid 1980s, had both advantages and disadvantages. Cross-fertilisation of ideas was good and some notable joint activities arose but on the whole these were between people in closely-related areas (Beddington/Lawton, Digby/Firn).

TABLE 9.1: Applied topics in the Open Day programme 1975

Reclamation of coal waste	Mike Chadwick
Nitrogen supply in coal waste	
Reclamation in progress	
Reconstructing the past the EAU	EAU
Resistance to anti-cancer drugs	CRU
Chemicals and Cancer	Colin Garner
Anti-feedants as crop protectants	John Digby
Commercial use of plant growth hormones	Richard Firn
Storage of human blood for transfusion	Martin Rumsby
Myelin sheath of nerve tissue and multiple sclerosis	
The rabbit oviduct	Henry Leese
Water absorption from the gut and cholera	
Liver fluke disease	Alan Wilson
Parasite of man Schistosoma mansoni	
The role of activated sludge in sewage treatment	Martin Davies
Sewage treatment – anaerobic sludge digestion	
Ecology and conservation of Red Sea coral reefs	Rupert Ormond



Figures 9.1

The research income of the various science departments up to 1994 plotted (a) on a linear scale of income by year, and (b) on a logarithmic scale. Plot (a) also shows the Retail Price Index (RPI). To make a valid comparison of funding over time it is necessary to correct for the RPI, which was around 10% or more for nine years, over 20% for two of them, from 1973 to 1982. The data in plot (b) has been so corrected using January 1962 as the reference. The University only published these data up to 1994.

We were young, most at the start of our scientific careers, and as a general rule it takes time to make a research impact.

Although our effort was primarily towards basic research, we also did a variety of applied work. The programme for the Open Day described in Chapter 2 displayed the applied output shown in Table 9.1.

After fifty years, the situation is very different. Biology itself is transformed from what it was in the 1960s, in large part due to the genomic revolution and modern molecular, post-genome and high-throughput technologies. These technologies are used across the spectrum of research. Single-molecule techniques are increasingly important.

Nonetheless, the interests of the department still cover virtually the entire gamut of biology, from the molecular to the ecological, and we are very strong in modern developments in biological research in the post-genome world.

Although we have undertaken medically-biased basic research throughout the department's history, this has not been our area of highest visibility. In the first twenty five years, Alan Wilson working on schistosomiasis and Martin Rumsby on multiple sclerosis headed two of the larger groups; Ramsey Bronk, George Kellet and Henry Leese were active in epithelial transport. We had a Cancer Research Unit from 1975 (Chapter 13).

However, the advent of the Hull York Medical School, and in particular the creation of the Centre for Infection and Immunology (CII), has transformed our strength in basic medical research. As Debbie Smith writes at the end of her account in Chapter 7, a new phase in research in Biology is starting. I hope that we do not lose our traditional strengths in basic biology.

Funding

Competitive research activity requires research grants in almost any area of the department's research, and maintaining external research income is essential both for the individual and the Department. The department's research income has increased steadily and considerably over the years, as shown in Figures 9.1 and 9.2. Biology has brought in the most research income of all departments since 1974 except in 1989. The steady maintained rise in research income throughout the department's history indicates a major increase in research activity throughout, stalled slightly in the last few years.

Academic Staff Numbers

In the early days, the term 'academic staff' was fairly tightly defined in the department, and meant someone appointed to a fully tenured post with both teaching and research responsibilities. This definition held until the early 1990s, although tenure was abolished in 1988.

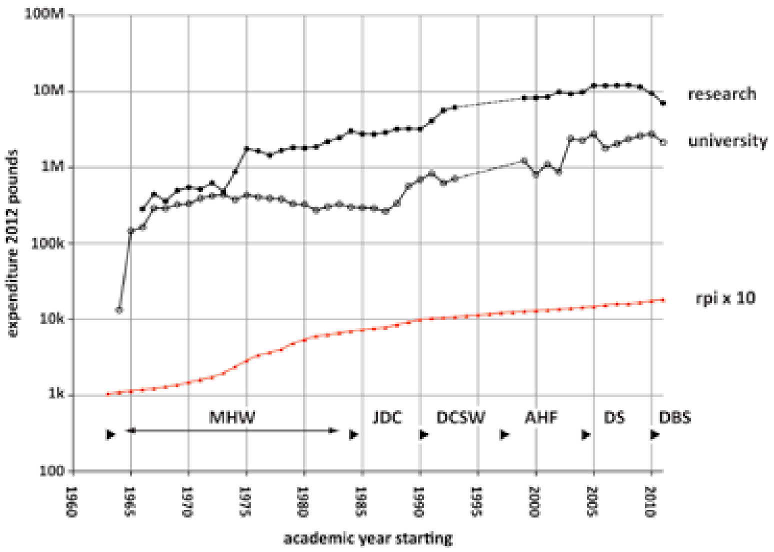


Figure 9.2

shows the departmental income, separated into its research income and its departmental grant. The gap in the data from 1994-5 to 1998-9 is because the records are in an obsolete electronic form. The data has been corrected for inflation against the RPI using 2012 as the base year. Note that one shilling (5p) in 1963 is roughly equivalent to one pound in 2013.

Research income from a funding body consists of two elements: the direct costs, which go to the researcher, and the indirect costs, which go to the University to pay for those provisions that the university makes to enable the research (space, heat, library, administration and so on). The top line of the graph shows the direct costs of the departmental research grants.

The departmental grant is the department's share of university income. This is made up of a number of components, principally from the Funding Council plus part of the indirect costs from those funding research (see also page 80).

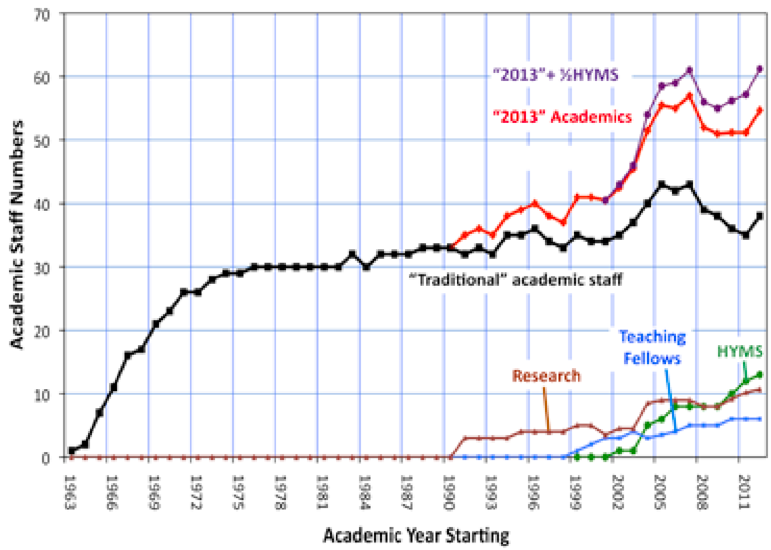


Figure 9.3

Academic staff numbers by year. Data taken from Annex 1. '"Traditional" academic staff' are those undertaking both teaching and research. 'Research' are those working as researchers with no or little undergraduate teaching, 'Teaching Fellows' those appointed for teaching. The total of these three categories are summed to give the '"2013" Academics' line. HYMS are members of HYMS working within CII and thus with a strong association with the Department. The '"2013"+½HYMS' line attributes 50% of HYMS staff to the grand total.

Now, the situation is different. In part prompted by the Research Assessment Exercises, and starting in the 1990s, the Department has appointed staff to senior positions at professorial level, whose primary role is research, and who do no or little undergraduate teaching. These posts are usually initiated by external funding, but the staff have long-term contracts and, especially if their source of external funding ends, can be asked to undertake the full range of teaching duties. With the appointment since the turn of the century of Teaching Fellows, the concept of an academic has become far more diverse.

Thus, there is no single definition of the term 'academic staff' which covers the whole history of the department. The concept of 'academic' has changed from a tightly-defined status to a heterogeneous one. At one time academics in the Department were supported directly by the University's Funding Council grant allocated by the University Planning Committee. Now that budgets are devolved to departments, tenure abolished and employment law changed, it has become the Head of Department's responsibility to balance the books and juggle appointments within the available budgets and the constraints required of those budgets.

Figure 9.3, derived from the data in Annex 1, shows how academic numbers have changed over the course of the department's history. The black line shows how the traditional 'research and teaching' appointments have changed over time, building up to a plateau in the 1970s that changed little until the late 1980s except for the appointment of three 'New Blood' staff (Dale Sanders, Richard Law and Chris Elliott) in the mid-1980s. Since the turn of the century there has been a large number of new appointments, shown by the upturn starting in 2002, in part anticipating the retirement in the latter part of the 'noughties' of a number of staff who were appointed in the 1960s and 1970s. The numbers are now starting to rise again.

Also shown are members of the Centre for Immunity and Infection (CII) who are close and integrated associates of the department as described earlier in this Introduction. All except two of them (Debbie Smith, Adrian Mountford) are on the Hull York Medical School (HYMS) pay-roll.Two 'Totals' lines are shown, one without CII staff, and one counting CII staff as 50% departmental, a broad-brush estimate of their departmental contribution.

We have not included one set of staff in the above calculation of people who appear on the department's academic-staff web-site. These are the senior members of the Technology Facility, John Pillmoor and his senior team: Peter Ashton, Jared Cartwright, Andrew Leech, Peter O'Toole, Jerry Thomas. Though these are crucial members of the department, their role is sufficiently different to see them separately.

Collaboration beyond the Department

Increasingly the Department has shown itself capable of working in partnership with others: with other Departments within the University as witnessed by the presence of Chemistry's Structural Biology Laboratory adjacent to the Technology Facility, the development of joint academic appointments with the Departments of Physics, Mathematics and Computer Science, the creation of cross-Department centres and the integration of CII with staff from both Biology and HYMS. We also work well with industry as shown by the way the Technology Facility works as a good environment for manufacturers to test their equipment in a working situation.

WHAT HAS BEEN ACHIEVED?

In terms of specific research outputs, it is impossible to summarise the research output of fifty years of an active research department in a few pages, or to do justice to the wealth of our contributions, so we have chosen to identify some highlights. What we have done is to:

- Ask each of those who became Fellows of the Royal Society to write a short description of their research during their tenure here (Chapter 10);
- Pick twenty-one key papers, trying to cover all the decades since the Department started and also the breadth of interests of the Department (Chapter 11);
- Discuss the Department's achievements in the Research Assessment Exercises, and their importance (Chapter 12);
- Identify the various Units and Centres that have been created, with a short commentary on what each has achieved (Chapter 13);

Giving so much space to Units and Centres tends to underplay the research of the other research groups in the department. This is alleviated to some extent by the reports of those elected to FRS, and the twenty-one key papers. For those interested in greater detail of the research of the Department in the last twenty-five years, the RSE and RAE submissions since 1989 are available on a web-site linked to this book and give considerable detail. Further information on the research output of the first half of the department's history is less accessible.

Technical support in the 1970s. (a) John Hoggarth, Chief workshop technician, (b) Wladech Wloch, Chief Animal House technician, (c) Brian Smith, glassblower, (d) Dick Hunter, photographer. Photos © Peter Humpherson,2013.

Some of the organisms used as model species in the FRS accounts. (a) bluebells, (b) the silver-spotted skipper butterfly, (c) bracken, (d) barley.

RESEARCH WHICH LED TO FRSs

by the Fellows

In Britain, election to a Fellowship of Royal Society is the top recognition of the quality of scientific achievement for an individual, with some of the lustre passing to the Department in which that science was done. Five members of the Department have been elected FRS when members of the Department, with a number, both ex-staff and students, achieving this distinction later.

In deciding to emphasise key research achievements, it was clear that these must include the work or these five who were asked to present a short description of that work.

John Lawton

Dale Sanders

Alastair Fitter

Ottoline Leyser

Chris Thomas

JOHN LAWTON

Elected 1989

I joined the Biology Department from Oxford in 1971, and left in 1989 to move to Imperial College; 1989 was the year I was elected to the Royal Society, so all the science that somehow led to my FRS was done in York. It was a wonderful place to work.

Just before I left Oxford I had started to think about a debate, then topical in ecology, about the relationship between the diversity of ecological communities (the number of species they contain) and the stability of those communities. The prevalent view was that populations in species-poor communities tended to fluctuate much more wildly than those in species-rich communities. The idea lacked a formal theoretical underpinning, but it was of applied importance – for instance it was widely argued that crop monocultures were prone to damaging pest outbreaks because they were species-poor. I thought I had spotted a system that refuted that idea. Bracken (*Pteridium aquilinum*) is a very common and widespread fern that forms extensive natural monocultures, but never (or exceptionally rarely) suffers any outbreaks of insect herbivores. So I chose bracken to 'solve' the diversity-stability problem, and started a long-running field study on bracken and its insect-herbivores at Skipwith Common, just south of York in 1972. Mark Williamson provided a technician to support that early work, which would simply never have got of the ground without that help.

But I never did solve the diversity-stability problem as the bracken work took on a life of its own. Colleagues, much more senior and experienced than I, argued that

Figure 10.1
John Lawton looking for insects on bracken on Skipwith Common in 1984.

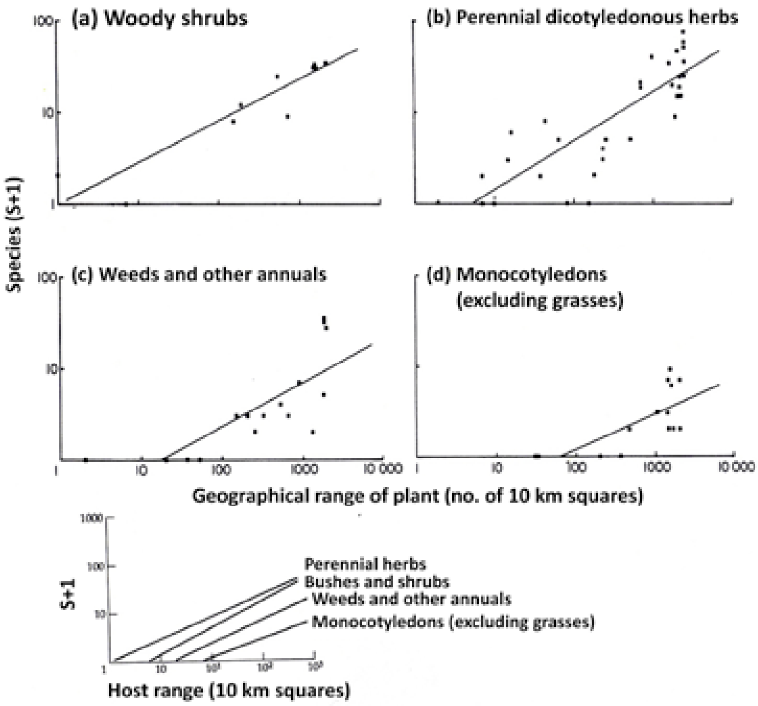


Figure 10.2

The number of herbivorous species of insects (S) feeding on different species of British plants (from Lawton and Shroeder 1977). The number of species of insect increases with the size of a plant's geographic range (measured by the number of 10km squares in which the plant is found) – the familiar 'species-area' relationship. The data are derived from extensive natural-history records accumulated over many years by entomologists. The plants are grouped into four types from those with the most complex architecture (woody bushes and shrubs) to those with the simplest architecture (monocotyledons excluding grasses, for which no reliable data were available). The small insert shows how, for a given range-size, insect species richness is greater on more architecturally complex plants. Finally, some of the remaining unexplained variation is due to 'taxonomic isolation'; plants with no, or few relatives in the same genus in the UK host fewer insect species than plants with many relatives.

somehow bracken was unusual in having so few herbivores. But how many species of herbivores should I expect to find on it? That led to my first foray into what is now called 'macro-ecology' the mining of existing large-scale data sets to reveal patterns in nature over space and time. By mining the literature I showed that bracken supported an absolutely average number of herbivorous insect species by comparison with other common and widespread plants. A paper in Nature [1] written with Dieter Schröder followed in 1977, on the effects of plant type, growth-form and size of geographic range on the number of insect species feeding on British plants.

The bracken work also went international when I discovered that it was one of the five commonest plants in the world, growing naturally on every continent except Antarctica. Over the years I exploited its global distribution to gain some degrees of freedom in the study of assembly-rules for ecological communities, because its insect herbivores were quite different (and independently evolved) on different continents. I was able to show, for example, that the insect assemblages exploiting the plant were not saturated with species, there were numerous 'vacant niches' [2], and that inter-specific competition was not the potent structuring-force that contemporary theory held it to be. My emerging ideas about the insect communities feeding on plants more generally were brought together in a book [3] jointly written with Dick Southwood and Don Strong in 1984 entitled Insects on Plants: Community Patterns and Mechanisms. It's still in print and I still get the occasional (small) royalty cheque. After the fire in the Biology Department (see pp.25), with my laboratory destroyed, I found myself temporarily housed in a teaching laboratory, sitting next to John Beddington. Although we were young colleagues, John and I had barely interacted. But here we had to, and we soon discovered that we shared scientific interests. I was able to continue the bracken field-work (which in the early days required essentially no equipment) but I also wanted to get to grips with more formal mathematical theory in ecology. John was an adept mathematician, and with Mark Williamson's encouragement we joined forces to work on mathematical models of predator-prey interactions in a collaboration that extended over several years, numerous papers and a life-long friendship. In the process I learned enough mathematics to be able to appreciate the power of models in ecology.

Fired up by my new skills (basic as they were) I returned to the diversity-stability problem, because I now understood the emerging body of theory round the controversy. My initial intention was to try and model enemy-victim interactions in the bracken food-web. But once again I got distracted, because I first wanted to understand some of the general dynamic properties of food-webs and food-chains. With a former undergraduate student from Oxford (Stuart Pimm, by then working in America) I launched into a series of theoretical and general empirical studies of existing data on food-webs (more macro-ecology) and I never did get back to modelling the bracken system. The result was, however, a series of theoretical papers on food-webs and food-chains [4] and an ecological industry that still runs to this day. Our first paper in Nature in 1977 arguing that the length of food-chains is constrained by population dynamics, not energetics, is still widely cited.

My work in York eventually produced more than 110 refereed papers. As well as the 'core work' I had forays into some unlikely areas. In no particular order they included: the impacts of predation by domestic cats on the birds in an English village [5], and of mink predation on water-voles; the way in which the fractal dimension of vegetation may influence the body-sizes and abundance of insects living on their surface; patterns in the distribution, abundance and body-sizes of species-assemblages; the defensive role of ants exploiting extra-floral nectaries of plants; 'communication' (or rather lack of it) between trees via volatile organic molecules; the energy costs of food-gathering by animals and humans; and the theory and practice of biological pest control.

It was a phenomenally happy experience [6].

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DALE SANDERS

Elected 2001

My entire scientific career has been shaped by the Biology Department at York.

It was as an 18-year-old in 1971 that I first arrived in the Department as an undergraduate to embark on a rigorous and demanding course that managed at the same time to be great fun. The enormous dedication and enthusiasm of lecturers was inspiring. Field courses at Millport and in North Wales convinced me that I wanted to become an ecologist. I marvelled how Mr Fitter (as he then was) seemed to know not only the name of every plant species we encountered, but also had entertaining ecological stories to tell about all of them. Thus I embarked on my final year of undergraduate study with principally an ecological selection of courses - including a wonderful series of lectures on species diversity and stability in ecosytems by John Lawton – and a research project supervised by Mike Chadwick.

My project was to look at the response to pH of calcicole and calcifuge ecotypes of the grass *Festuca ovina*. It was well known that pH influenced the solubility of all sorts of beneficial and harmful mineral ions, but nobody seemed to have asked the question about whether ecotypes might have evolved to cope with extremes of pH *per se*. In my slightly eclectic mix of final year courses, I had chosen one by Martin Rumsby on biological membranes. Membrane structure was just beginning to be understood for the first time [1] and I began through Martin's lectures to think about what my *F. ovina* ecotypes might be experiencing at a cellular or even molecular level. I found this environment in which I could flip between ecology and biochemistry incredibly stimulating, and it remains an enormous tribute to Mark Williamson that he had the vision not only for a multidisciplinary department, but also to employ staff who could get students to think "out of the box". Mike Chadwick was one of those, ever willing to listen to my slightly crazy ideas on proton pumps – which were just emerging then in a little-noticed paper [2] as a potential major player in plant membrane biology.

Figure 10.3
Dale photographed in the glasshouses in the new JIF-funded biology building.

It was therefore from an ecological domain that I became interested in plant membranes. I decided to train more in this area and was accepted to do a PhD in the plant biophysics laboratory of Enid MacRobbie at Cambridge University. Both there, and as a post-doc in Clifford Slayman's lab in the-then Physiology Department at Yale University School of Medicine, I was able to explore the properties of proton-dependent transport systems,

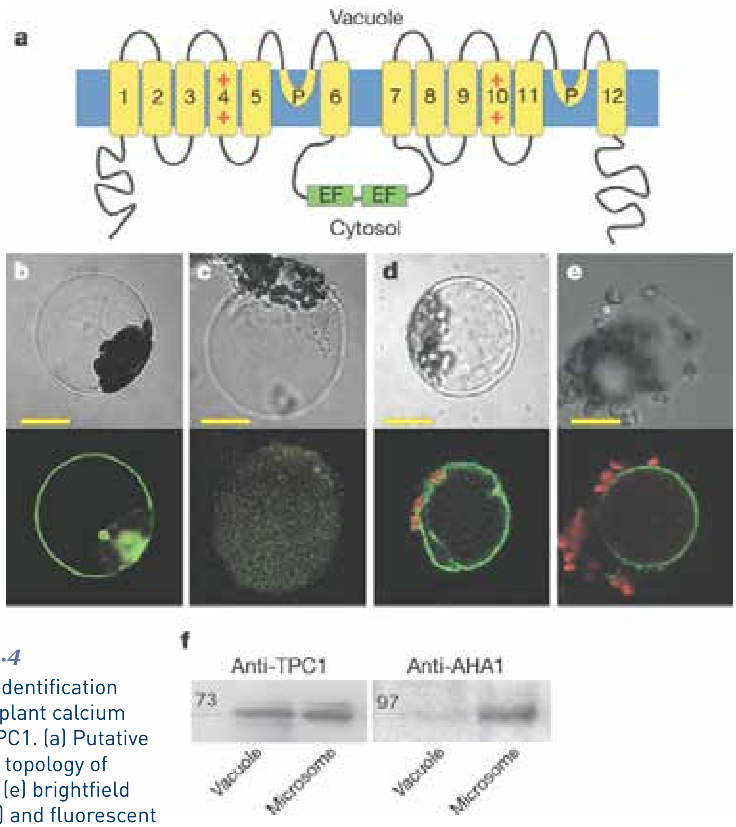

Figure 10.4

Molecular identification of the first plant calcium channel, TPC1. (a) Putative membrane topology of TPC1. (b) – (e) brightfield (upper row) and fluorescent (lower row) images of (b) a protoplast expressing GFP; (c) a similar protoplast, osmotically lysed; (d) a protoplast expressing GFP-tagged TPC1; (e) a similar protoplast, osmotically lysed. TPC1 can be clearly visualised as located within the cell (behind the red-fluorescing chloroplasts) and resides in the large central vacuole once the protoplast is lysed.

developing the electrophysiological tools to investigate these along the way.

By 1982, I was ready to move on from my lengthy post-doc position at Yale, and a return to the UK seemed neither desirable nor even possible. There was talk of Mrs Thatcher closing down universities, and certainly no possibility of new academic positions. Thus it came as a huge surprise when, as I was in negotiation for a faculty position at the University of California, suddenly 300 "New Blood" lectureships were announced in the UK. Mrs Thatcher had had a brainstorm! Before I interviewed at York in May 1983, I had fully intended to remain in the US. But my return sparked memories of York's hugely supportive and interdisciplinary environment, and struck me as the place to be. The overt message from California was that I should be "mission-oriented". The covert message from York was to do great science! I gravitated towards the latter.

Enormous possibilities were emerging during the 1980s concerning the characterisation of new membrane transport systems. Not only were these systems apparently involved in nutrient acquisition and membrane energisation, they were also potentially involved in cellular signal transduction. My first grant, from the Agriculture and Food Research Council (AFRC), aimed to utilise calcium-selective electrodes to determine whether changes in cytoplasmic calcium might be involved in signal transduction. My long-suffering post-doc, Tony Miller, spent nine-months getting these new electrodes to work, but the efforts were worthwhile. We were able to demonstrate photosynthesis-induced changes in free calcium that were commensurate with calcium being key in communication between metabolism in the chloroplast and the cytoplasm [3]. Tony's work further enabled an understanding of the energetics of calcium transport across fungal plasma membranes [4].

A wonderful spin-off from this first AFRC grant was that it enabled the employment of Ian Jennings to develop the recording software for ion-selective electrode measurements. David White and I had purchased the first two IBM-PCs in the Biology Department in 1984, and it was through Ian's expertise with PCs that he became an IT guru in the Department – and heads the IT team to this day. With the award of two more AFRC grants and a grant from the Science and Engineering Research Council (SERC), my lab grew quickly. Phil Rea (now a Professor at University of Pennsylvania) arrived as a post-doc and introduced some excellent biochemical approaches into the lab. As a result of continuing grant success, the Biotechnology and Biological Sciences Research Council (BBSRC) – formed from the merger of the AFRC and the biological components of SERC – invited me to apply for a "rolling grant" in the early 1990s. The grant employed five post-docs and lasted for most of the decade. We combined biophysical, biochemical and physiological approaches with an emerging electrophysiological technique (patch clamp) to demonstrate the existence of novel pathways for release of calcium from plant vacuoles during cellular signalling [5], to define the energetics of vacuolar proton pumps [6.7] and to elucidate the essential pathways for uptake of potassium by plants [8].

My laboratory benefitted very much from the growing strengths in plant science at York. Outside my own lab, these were not in membrane biology, but in genetics. As the prominence of Arabidopsis genetics grew in the 1990s, the input of Ottoline Leyser, Dianna Bowles, Ian Graham and others had a significant impact on the how my lab did research. A holy grail of the plant cell signalling community was the molecular characterisation of ionic channels that released calcium into the cytosol as part of the signalling process. We spent many years investigating candidate genes before realising that one of those that we had been working with was located not at the plasma membrane – as others had thought – but at the plant vacuole. Within a couple of weeks of appreciating this, we realised we had all the tools available to demonstrate that this gene encoded the prominent calcium release channel at the vacuolar membrane [9] – a channel many other labs had been working on for decades and for which no molecular identity had been ascribed.

It is impossible to portray every dimension of the unique academic environment at York that enabled my research. At one level there were the academic colleagues with whom I discussed hypotheses and concepts. Their lab personnel interacted freely with those in my lab to exchange techniques and ways of doing things. The underpinning support of the Technology Facility – a vision of Dianna Bowles and Alastair Fitter – enabled my lab to perform experiments (especially in the area of microscopy [10] and proteomics) that would never have been possible had my lab operated in isolation. At a more remote level, I benefitted enormously from serving under three Heads of Department who recognised that I needed space and facilities for my growing lab and who had the vision to appreciate what I was trying to achieve even though they were not from my rather narrow field. In 1624, John Donne wrote "No man is an island, entire of itself". The same applies to researchers – male and female: we are all interdependent in a way that is complex and symbiotic. My research at York would never have thrived without that complex network, and for that I am eternally grateful.

Throughout the 26 years I spent as an academic at York, a total of over 50 PhD students and post-docs passed through my lab. Many have moved on to independent academic positions – including at the Universities of Pennsylvania, Halle, Cambridge, Glasgow, Lancaster and even York! Others attained success outside the academic arena: for example my former PhD students Shelagh Muir and Catriona Giffard are, respectively Vice-President for Research at Unilever and R & D Director at HJ Heinz. Biology at York offers the most brilliant training environment possible: the essence of the Biology Department at York pervades through into the next generation.

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Figure 10.5

Alastair Fitter at the edge of the wild-flower meadow in his garden at home. In addition to the achievements discussed in the text, Alastair together with his father, Richard, authored the best-selling guide "Wild Flowers of Britain and Northern Europe", illustrated by Marjorie Blamey.

ALASTAIR FITTER

Elected 2005

I find it odd that I should have ended up working in soil and especially odd that one major focus should have been on fungi; neither was a strong interest for me as an undergraduate. The soil bit came from my PhD work on reclaiming old coal spoil heaps in Lancashire under Tony Bradshaw, which taught me (to quote Arthur Fallowfield) that 'the answer lies in the soil', and the interest in mycorrhizas from Bernard Tinker, who was at Leeds when I first came to York in 1972. The other influence was being at York and being faced with a quantitative approach to ecology that was largely absent from my previous training. I doubt I would ever have started modelling root system architecture without the rather spurious confidence that being in a mathematically oriented environment gave me. The actual spur to the modelling work came from doing a literature search – manually, in printed volumes of Biological Abstracts - fragrant memories! – for something quite different and finding a paper with the keyword 'trees' that was actually about rivers. I was intrigued, followed it up, and discovered the mathematical concept of a tree about which I was wholly ignorant. I realised it could be applied to root systems and that no-one had done that, which is one of the most exciting things about being a scientist: there really are *terrae incognitae* that can be explored. However, in the end I could only take the modelling so far [1] because I lacked either mathematical skill or a mathematical collaborator.

Work on mycorrhizal symbioses and on root architecture proceeded in parallel and, despite a few attempts to link the two, remained largely separate enquiries. What I wanted to achieve in the mycorrhizal work was to understand how the symbiosis functioned under field conditions, but the difficulties of identifying the fungal species were a major obstacle. Nevertheless, I set up two studies of mycorrhizal functioning in the field: one was in Pretty Wood, ten miles north of York, where James Merryweather meticulously recorded colonisation and phosphate nutrition of bluebells, throughout their life cycle, demonstrating for the first time that there could be obligately mycorrhizal plant species [2]. The other was a collaboration with Andrew Watkinson at the University of East Anglia. I was seeking a system in which to measure the fitness benefit to a plant of being mycorrhizal, and Andrew had used populations of the annual grass *Vulpia ciliata* as a model system for measuring population dynamics. Using fungicides and transplant experiments in natural *Vulpia* populations, Kevin Newsham showed that the grass did gain fitness from being mycorrhizal, but thanks to getting protection from a pathogen (*Fusarium oxysporum*) rather than from increased phosphate uptake, as assumed [3]. From this we developed the concept of the multifunctional mycorrhiza.

Nevertheless, not being able to tell what fungal species were involved was a problem. At this time, molecular techniques were revolutionising most of biology and I tried hard to persuade several practitioners of that art to get interested in this – to them – obscure group of organisms. The turning point came when Peter Young was appointed to the department as its first professor of molecular ecology and, though he had previously worked on *rhizobium*, arrived with an ambition to work on mycorrhizal symbioses. That collaboration was hugely fruitful and led to a series of papers that demonstrated for the first time the role that particular fungi played in plant performance [4] and community structure [5]; one of the postdocs on our first joint NERC grant was Thorunn Helgason, now a lecturer in the department. An obsession of mine has been to promote a mycocentric approach to mycorrhizal research: there has been an assumption, only sometimes explicit, that the symbiosis must deliver plant benefit and usually that the benefit should be measurable as increased growth in a pot, possibly both because most mycorrhizal researchers are first plant scientists and only secondly fungal biologists and also because of the difficulty of identifying, culturing and working with fungal species. The selection pressures that act on the fungus are typically ignored.

The common thread that underlies work on mycorrhizal symbioses and on root system architecture is a desire to understand how plant root systems and their associates function in soil and in the field. The root work led to a focus on the heterogeneity that root systems encounter in all soils and so to an interest in their plasticity, in collaboration with David Robinson (then at the Scottish Crop Research Institute) whose expertise in stable isotopes allowed measurements of the success of roots at exploiting local nutrient-rich patches by measuring the dynamics of ^{15}N and ^{13}C in the system [6]. Angela Hodge, now a senior lecturer in the department, worked with us as a postdoc on a joint BBSRC grant, and showed that the response to heterogeneity was surprisingly slow and best explained in terms of inter-plant competition rather than a simple cost-benefit response [10], a neat example of the tragedy of the commons. I also teamed up with Ottoline Leyser to use *Arabidopsis* as a model system to investigate mechanisms of root system response to heterogeneity.

A separate interest led in an unexpected direction. In the late 1980s, stimulated by writing a popular book about plants and their ecology and frustrated by the lack of easily available information for many species, I initiated a project to collate ecological data on the entire British flora. The Ecological Flora project was funded by NERC and the British Ecological Society; the main product was a database [7], constructed by Helen Peat, that is still available and continually updated (www.ecoflora.co.uk). One of the ecological characteristics that I wanted to include was the photoperiodic requirements for flowering for as many species as possible. To my surprise, I found that I could only find the information for about a dozen species. It occurred to me that it might be possible to deduce photoperiodism by studying flowering times over a long period: species with little variation would be those with strong photoperiodic control of flowering. My father had been recording first flowering dates of over 500 species around his home for around 40 years. This data set revealed that almost 9 out of 10 species were strongly influenced by temperature in the month or two prior to flowering and that this was by far the strongest effect [8]: any photoperiodic control presumably determined the sequence of flowering. However the data up to 1990 showed no trend of earlier flowering over time. In 2000, my father moved house and the data series stopped, so I reanalysed the data [9]: now there was a striking effect of earlier flowering, specifically in the 1990s, which had been the warmest decade on record. At the time (and probably still) this was the most extensive demonstration of the impact of climate change on plant phenology. When the Science paper appeared, we put the entire data set into the public domain and several researchers have made use of it since, one of them recently urging that such openness become the norm [10].

These recollections seem to me to show two things: one was that I was not good at focussing on a single problem or set of problems and the other that all the more interesting bits of science that I have done have been collaborative. The first point makes me, I guess, one of Isaiah Berlin's foxes rather than a hedgehog (taken from the early Greek poet Archilocus – "the fox knows many things, but the hedgehog knows one big thing"); whether a scientist is a fox or a hedgehog probably matters more to him or her than to the outcome of their science, and for me it was just a matter of enjoyment. The point about collaboration is a bigger one though: I simply could not have made progress on most of the problems I was intrigued by without teaming up with others who had complementary interests and skills. Of course, it is the complementarity that matters. An essential for good collaboration is openness; your collaborator has to be confident that you are not holding back, but the result is far more fun than slogging away solo.

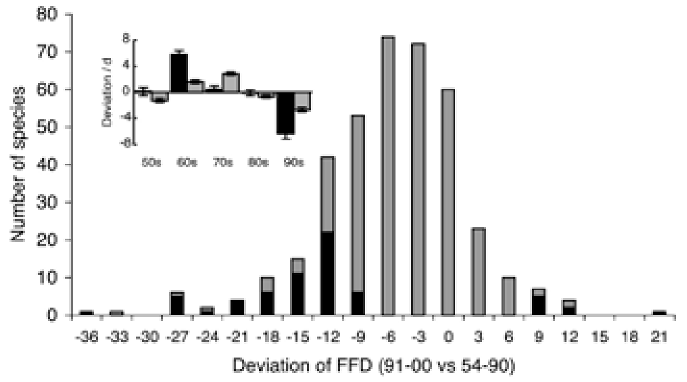

Figure 10.6

This illustration is taken from reference 9, in which the dates of first flowering (FFD) of 385 plant species in once locality had been determined over almost 50-years. The data show that the average first flowering date of 385 British plant species had advanced by 4.5 days during the decade 1991-2000 compared with the previous four decades, and revealed the strongest biological signal at the date published of climatic change. The histogram shows the frequency distribution of deviations in FFD in the decade 1991-2000 from the mean over the period 1954-1990. Negative values indicate earlier flowering than the 1954-1990 mean, positive values later flowering. Inset: Mean deviation of the FFD for each decade from the long-term mean (1954-2000); solid bars represent species flowering in spring (January to April); open bars denote summer-flowering species (May to August).

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Figure 10.7
Ottoline Leyser in the department glasshouses, with *Arabidopsis* plants and her daughter Francesca (c.f. Figure 10.9).

OTTOLINE LEYSER

Elected 2007

I was appointed to a lectureship in the Department in 1994, as part of the grandly named Plant Biomolecular Initiative. The initiative was an excellent example of the extremely successful research strategy that the Department has developed over the years. Everything has to count at least double, and to build distinctiveness. The Plant Biomolecular Initiative built on the considerable strength already established in Plant Biology from the ecological through to the biochemical, but also built critical mass in molecular biology in the Department, which at the time was limited to rather few groups. The University invested in three positions in Plant Biomolecular Science one senior- Dianna Bowles, and two junior lecturers- myself and Jurgen Denecke. In addition, Simon McQueen-Mason won a Royal Society University Research Fellowship to join the initiative. We were all housed in a new building (now J wing), along with the existing groups at the more molecular end of Plant Biology including Dale Sanders and Sue Bougourd, with Rachel Leech's group just down the corridor.

This was an excellent environment in which to start a research group. The labs were open plan and equipment was shared. The expertise in the groups was diverse, making for interesting interactions and access to techniques unfamiliar to me. The Department as a whole had a great atmosphere. There had been very few new appointments since the original cohort of staff had been assembled, and many of the academic and support staff had been there from the beginning, or shortly thereafter. Everyone was very upbeat about the new developments and extremely helpful and supportive in helping me to get things started.

Despite the constrained funding at the time – it was the end of Thatcher/Major era – I was fortunate to obtain two grants before I arrived, one each from the then still separate Science and Engineering Research Council, (SERC) and the Agriculture and Food Research Council (AFRC). It was still quite early in the ascendancy of Arabidopsis as a model organism, and so even my limited experience from my PhD and Post-Doc meant I was able to compete with more established labs. The grants were on auxin signalling, and shoot branching control. Both these themes have remained with me ever since, although the auxin signaling work has been subsumed into the shoot branching project.

During my Post-Doc with Mark Estelle at Indiana University, I had characterised two allelic mutants at the AXR3 locus, which conferred altered responses to auxin and a range of auxin-related morphological phenotypes, including reduced shoot branching. Mark had generously allowed me to take this mutant with me, and it was the starting point for much of the early work in my lab. My auxin grant, from the AFRC, involved trying to clone the cognate gene by map-based cloning. The SERC grant was centred on looking for novel regulators of shoot branching, through various mutant screens, including suppressors of axr3. More good luck brought excellent post-docs to work on these projects. Dean Rouse, with superb technical support from Pamela Mackay, drove the AXR3 cloning project, and Petra Stirnberg identified a range of shoot branching mutants, many of which we have been working on ever since.

We were very excited to discover that AXR3 encoded a member of the Aux/IAA family of auxin-related transcriptional repressors and that the dominant mutations all affected a specific conserved domain of the protein [1]. This family of proteins had been identified by Sakis Theologis, and one of their characteristics was their extraordinarily short half-lives. In the mean time, Mark's lab identified an F-box protein, TIR1, as a core component of the auxin response. F-box proteins are the target recognition subunit of SCF-type protein-ubiquitin ligase complexes. This immediately suggested the hypothesis that auxin might work by destabilising the Aux/IAA proteins, and that the dominant mutations in the Aux/IAA proteins prevented this from happening. Several labs set about testing this idea. Our main approach was to use fusion proteins between the mutant and wild-type versions of the Aux/IAAs and a GUS reporter protein, allowing us to follow the decay of the proteins in response to different treatments and in different mutant backgrounds. It is unusual in biology that a hypothesis turns out to be quite as true as it was in this case. The proteins were destabilised by auxin in a way that depended on TIR1. The mutations in the dominant axr3 alleles abolished this effect. The collective efforts of several labs including Mark's and that of Judy Callis, established that the short conserved domain where these mutations mapped was sufficient to confer auxin-regulated degradation on any protein. Indeed a synthetic peptide with the sequence of this degron domain was able to interact with SCFTIR1 in an auxin-dependent way [2].

During this phase of the work, several important things happened at once. Dean Rouse went back to Australia (he missed the wide open spaces) and Stefan Kepinski joined the project. Meanwhile, Dianna Bowles led a successful bid to the Joint Infrastructure

Figure 10.8

The plant hormone auxin regulates the expression of 1000s of genes by triggering the destruction of members of the Aux/IAA family of transcriptional repressor protein. Mutations that stablise these proteins, rendering them resistant the the effects of auxin have dramatic consequences. Mutations of this type in the IAA17 protein (left) result in plants with very few branches, where as similar mutations in the IAA3 protein (right) have the opposite effect.

Fund for new labs and the Technology Facility, giving us all access to a fantastic range of new analytical tools. My lab moved into the new building, on L2 corridor, which was an interesting and York-typical mix of Plant Molecular Genetics, and Developmental Biology including the labs of Betsy Pownall and Harv Isaacs, who used *Xenopus* as a model system. Once again, several of us counted double (as both Plant Molecular Geneticists and Developmental Biologists) and the floor rapidly became a strong community.

From the point of view of the auxin project, all this was perfect. Having established that auxin triggered the degradation of the Aux/IAA proteins, we set about trying to work out how. At the time, the paradigm for regulated protein degradation involved some kind of modification of the target protein in response to the signal, for example phosphorylation. Using the new mass spec facilities available, we were able to show that there was no detectable modification of the degron peptide in response to auxin treatment. And we were also unable to find any evidence to support emerging ideas about isomerisation around the two proline residues in the centre of the peptide sequence. We began to come to the conclusion that it was not the Aux/IAA that was modified at all, but rather it was SCFTIR1 or an unknown protein associated with the complex [3]. Narrowing the focus further, we then found that auxin itself directly associated with the complex. So we began to look for a heterologous system in which to express the parts of the system we knew about, so that we could use these to find the additional unknown auxin-binding subunits.

Fortunately we had *Xenopus* eggs just down the corridor. Stefan spent many hours injecting

Figure 10.9

In 2007 Ottoline was funded by a Rosalind Franklin Award for a project to produce a booklet 'Mothers in Science" outlining the careers of women who have combined a successful career in science with motherhood.

them with TIR1 message and showed that, astonishingly, TIR1 in Xenopus extracts was sufficient to give auxin-regulated interaction of TIR1 and the degron peptide. The entire auxin signal transduction pathway pretty much consists of only these two proteins, with auxin promoting the interaction between them [4]. This triggers the ubiqutinylation of the Aux/IAAs, targeting them for degradation, and de-repressing the transcription of 100s of genes.

There is no doubt that the environment at York made this story happen. I could write similar stories about our shoot branching work, about the very fulfilling collaborations with York's ecologists on nutrient-hormone interactions, and with computer scientists on modelling auxin transport, and many more. During the time I was in the department, it changed in many ways beyond recognition, in terms of the buildings, the infrastructure and the people. But in other ways, schmaltzy though it may be, the core feel of the place and its amazing community atmosphere remained the same throughout. It's a near-universal experience for new appointees at York. Everyone tells them how supportive and collegial the atmosphere is, and they don't believe it. But after a few months, they are saying exactly the same thing to the next set of appointees.

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3. Kepinski S, Leyser O (2004) Auxin-induced SCFTIR1-Aux/IAA interaction involves stable modification of the SCFTIR1 complex. Proceedings of the National Academy of. Science USA 101:12381-12386
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Editorial note: Ottoline received the Rosalind Franklin Award of the Royal Society in 2007.

Figure 10-10

Chris Thomas searching for the eggs of the orange-tip butterfly on lady's smock.

CHRIS THOMAS

Elected 2012

York has been a great place to work, and if York were mountainous and forested it would be just about perfect. I moved to York from Leeds in 2004, but nearly didn't. I had come second to Phil Ineson when I had applied for a Chair in York a few years earlier. I then nearly missed my interview for my current position. I already lived closer to York than to Leeds, so I stayed at home the night before the interview, only to find that Cawood bridge was closed because of flooding. I drove like mad through Selby and up the A19, making it with minutes to spare. Alastair Fitter, anxious, at the door of Heslington Hall, gave me just one piece of advice. Don't ask any questions at the end of the interview. The VC, Brian Cantor, doesn't like that. Noted – and they offered me the job.

I arrived in the wake of my first of a pair of papers [6] on the extinction risks to species from climate change, my most heavily cited and controversial work. I became interested in the impact of climate change initially because it provided a great way to test the ideas of metapopulation biology: how species survive or die out in landscapes where suitable patches of habitat, for example hillsides supporting chalk grassland, are few and far between. As the climate changed, species started to spread, colonising a succession of patches of habitat as they started to shift their distributions. Increasingly, we have been able to show [7] that butterflies spread more rapidly through landscapes where more habitat patches are available, where the gaps are small enough for them to be able to fly from one patch to another. It proved a great test of metapopulation theory.

Whilst I have been based at York, I have had the flexibility to engage with a number of conservation NGOs such as Butterfly

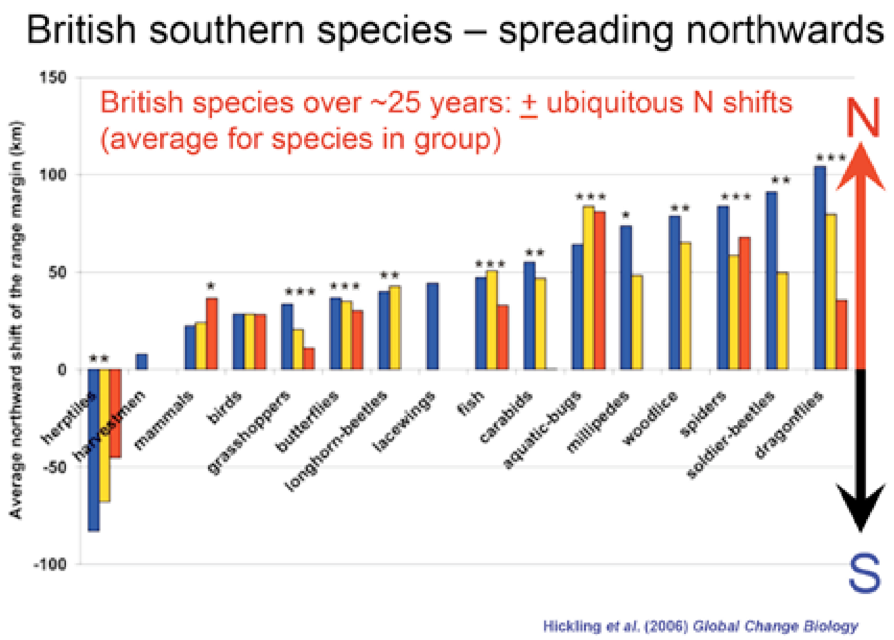

Figure 10.11

Taken from Hickling et al. (2006), showing for the first time that species from a wide diversity of taxonomic groups are, on average, spreading northwards as the climate has warmed. The bars indicate the average range shift across all species considered within each taxonomic group. The different colours represent different ways of controlling for recorder effort (blue least, red most) by volunteers, showing that the overall direction of range shift is not affected by the vagaries of biological recording. Asterisks indicate statistical significance (←0.05) for each change, in isolation. 15 out of 16 groups showing the same direction of change is also significant (0.0005). C.f. Figure 10.6.

Conservation and the Royal Society for the Protection of Birds, and well as Natural England and other government agencies, discussing how to put these conclusions into practice. Plenty of good quality habitats are required across entire landscapes if species are to survive in the long run. This message is now acknowledged by almost all major conservation organisations both in the UK and across the world. In England, John Lawton's influential report, *Making Space for Nature*, of which Alastair Fitter was also a co-author, admirably summarised the state of knowledge, and this fed directly into policy. "Nature Improvement Areas" have already been established, aiming to protect wildlife across entire landscapes, from the Humberhead peatlands of Yorkshire to the South Downs of Sussex and Hampshire.

Rapid climate change is a great experiment for an ecologist, though it would be preferable to have a spare planet available if this one goes horribly wrong. Ecologists have always wondered what factors determine why species reach the edges of their distribution in particular places. The problem is how to test the various competing ideas when analysing the static patterns of species across the planet. But heat the planet up a bit and we can see what happens. By good fortune, Britain has a long history of natural history recording, allowing us to deduce which species have changed their distributions, where they have spread, and how fast they have moved [5].

Working with Jane Hill, my former post-doc who I re-joined when I moved to York, Butterfly Conservation, the Centre for Ecology and Hydrology (CEH), and many other collaborators and students, we have been able to put together a pretty remarkable story [3]. About 80% of the species we have been able to look at – including birds, butterflies, spiders, dragonflies, various beetles, and even woodlice and millipedes – have spread northwards in Britain, exactly as would be predicted if they were responding to the warming of the climate. And while the species that used to be restricted to the south of England have expanded northwards, life has got tougher for the northerners. Northern butterflies and dragonflies have declined while their southern relatives have thrived. Again, exactly as expected had these species been restricted to relatively cool regions by the climate. Then, our Taiwanese PhD student I-Ching Chen managed to show [1] that moth species were shifting uphill on Mount Kinabalu in Borneo as the climate warmed. Species are on the move throughout the world. This work culminated, in 2011, when we were able to demonstrate [2] that species were moving faster in regions of the world where the climate had warmed more, and that they were moving much faster than previously recognised: they have been moving towards the poles at around 1.7 kilometres per year, on average. Climate really is a major determinant of where species can live.Whilst the overall pattern is clear, why are some species moving their distributions extremely quickly whereas others are sluggish or not moving again? We have already found out that species which use many habitats find lots of new places to colonise and have expanded particularly rapidly – back to the lessons of metapopulation theory. We have also found some fascinating feedbacks between ecology and evolution. Bush crickets and butterflies are evolving to be stronger fliers and to change their diets as they move, allowing the rate of expansion to accelerate as they go. But there is still a great deal to learn about why some species are doing so much better than others.

This brings us back to extinction. A species stuck on the top of a mountain in southern Europe cannot suddenly descend the mountain, cross the hotter and drier human-dominated landscapes of the lowlands, and reach the cooler climes of northern Europe. If the climate becomes unsuitable where such a species currently lives, it will die out. Our analyses suggest that of order of 10 to 30% of species on land could face extinction for this reason [4]. Although this generated a storm in the scientific literature about the best way to make such estimates, there is near unanimity that we face a major problem.

These observations and analyses have cemented climate change as one of the key causes of the current biodiversity crisis. Conservation organisations are scrambling to formulate policies, but what to do when the forces of change are so great. The Intergovernmental Panel on Climate Change accepts the evidence that we and others have gathered together, summarising the conclusions within reports for which the IPCC shared the Nobel Peace Prize in 2007. But governments have achieved far too little since. Everyone recognises the problems, but the immediacy of the subsequent global economic downturn has sent environmental issues shooting back down the political agenda. Short-term and parochial interests predominate. The experiment goes on.

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3 Hickling, R., D.B.Roy, J.K.Hill, R.Fox & C.D.Thomas (2006) The distributions of a wide range of taxonomic groups are expanding polewards. Global Change Biology 12:450-455.

4 Hoegh-Guldberg, O., L.Hughes, S.L.McIntyre, D.B.Lindenmayer, C.Parmesan, H.P.Possingham & C.D.Thomas (2008) Assisted colonization and rapid climate change. Science 321:345-346.

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RESEARCH HIGHLIGHTS: KEY PAPERS

Alastair Fitter and David White

This section is concerned with what the department has contributed to the knowledge base in terms of publications. We decided to limit this section to twenty-one papers. Since there have been over one hundred members of academic staff in our existence so far, this necessarily means that most members of staff are not represented.

This table was produced by first listing and ranking citations of members of the department from the "Web of Science" / "Science Citation Index" databanks. This list included multiple papers in the top ranking by some individual members of the Department (often from a body of coherent work, and a not surprising correlation with FRSs), so we decided that we would only take one paper from this list from any individual, and ask the FRSs for a commentary on their work, to include a short list of key references. Some members of the Department appear more than once when a co-author would otherwise have not appeared.

We excluded reviews and publications for which the work was done elsewhere before coming to York. The papers are presented in order of number of Web of Science citations in February 2013.

York Authors	Date	Title	Journal
Collins **Maitland**	2005	Prospective identification of tumorigenic prostate cancer stem cells	Cancer Research **65** 10946-10951
This paper provides the first demonstration of an undifferentiated cell population within human prostate cancers which is responsible for tumour initiation and spread i.e. the prospective identification of prostate cancer stem cells. The phenotype of these cells indicates that they are likely to be resistant to conventional cancer treatments, thus providing an explanation for tumour relapse after therapy.			
Baldauf	2000	A kingdom-level phylogeny of eukaryotes based on combined protein data	Science **290** 972-977
Ancient speciation events ~1.5 billion years ago gave rise to the major groups of eukaryotes. Previous attempts to reconstruct these events used single genetic loci and often seemed to contradict each other. Ours was the first attempt at global phylogeny of eukaryotes based on multiple loci. We found highly statistically significant resolution of nearly all major branches in the tree and showed that most of the apparent conflict between single gene trees was trivial.			
Leyser	2005	The Arabidopsis F-box protein TIR1 is an auxin receptor	Nature **435** 446-451
This paper describes the short, elegant signal transduction pathway through which the plant hormone auxin regulates gene expression. Auxin binds to the F-box protein, TIR1, increasing its affinity for a family of transcriptional repressors called the Aux/IAAs. Auxin-mediated binding of Aux/IAAs to TIR1 triggers their ubiquitination and degradation, thereby activating gene transcription. The work revealed an important mechanism for auxin action, and identified a new type of signal transduction pathway.			
Jeffries **Lawton**	1984	Enemy free space and the structure of ecological communities	Biological Journal of the Linnean Society **23** 269-286
'Enemy free space' is defined as ways of living that reduce or eliminate a species' vulnerability to one or more species of natural enemies. Mike Jeffries (a PhD student) and I realised that whilst many aspects of species' niches are moulded by interactions with enemies, in 1984 most ecologists continued to see resource-based competition as their primary determinant. Reviewing an extensive literature we argued that this view was wrong, and showed how the idea of enemy free space had been independently 'discovered' by at least 15 authors.			

Williamson Fitter | 1996 | The varying success of invaders | Ecology **77** 1661-1666

Is there a statistical regularity to biological invasions? We test Williamson's tens rule: the probability of progression up our defined stages (imported, casual, established, pest) is about 10%. It can be a useful rule and the exceptions are instructive. It remains one of the few robust generalisations about invasions.

Leyser **Bowles** | 1996 | Ethylene as a signal mediating the wound response of tomato plants | Science **274** 1914-1917

The research demonstrated the actions of two hormones, ethylene and jasmonate, were linked in the regulation of stress-responsive gene expression in plants. Up until that time, a role for ethylene in the wound-induced activation of proteinase inhibitor [pin] genes in tomato plants had been discounted. The work showed that both ethylene and a second hormone were simultaneously required, influenced each other's levels in the plant and together acted to regulate pin gene expression.

Beddington | 1975 | Mutual Interference Between Parasites or Predators and its Effect on Searching Efficiency | Journal of Animal Ecology **44** 331-340

Earlier experimental data showed that the searching efficiency of predators and parasites for their prey/host declined with their own density, according to a simple power law. The model here allows for time to be lost on the encounter with the prey/host (the traditional functional response formulation), but also allows for time to be wasted on encountering competing predators or parasites. This behavioural formulation mimics successfully the empirical results and has implications for the biological control of pests

Hardy | 1986 | Correlation of competence for export with lack of tertiary structure of the mature species: A study in vivo of maltose-binding protein in E. coli | Cell **46** 921-928

This work showed that once folded into its mature functional structure inside a cell, a newly made protein was no longer exported through the membrane to the outside where it belonged. This suggested that there were components in the cell, later identified as 'molecular chaperones', that maintained 'young' exported proteins in an unfolded state to allow membrane passage, and led to the concept of kinetic partitioning, a race between folding and chaperone binding.

Currey | 1988 | The effect of porosity and mineral-content on the Youngs modulus of elasticity of compact-bone | Journal of Biomechanics **21** 131-139

This paper showed there was a non-linear relationship between the stiffness of the bone material and the amount of mineral in it. However, if one wanted a good relationship one had to take into account the porosity. You then got an R squared of →80%. The paper was notable for the large number of different species it used.

Helgason Fitter **Young** | 1998 | Ploughing up the wood-wide web? | Nature **394** 431-431

Arbuscular mycorrhizal fungi form a globally important symbiosis on the roots of most plants, but are hard to investigate. This short paper presented the first practical method to identify the diverse fungal species that colonise roots in the field. We showed that arable crops supported a low diversity of fungi compared to nearby woodland plants. The paper initiated a thriving new research field and is more cited today than ever.

Fitter | 2002 | Rapid changes in flowering time in British plants | Science **296** 1689-1691

The first analysis of a large phenological dataset that demonstrated substantial advances in flowering time in response to rising temperature for a large proportion of the British flora during the 1990s, then the warmest decade on record, based on records collected by my father, Richard Fitter, the senior author, over nearly 50 years.

Molloy White | 1995 | Movement and force produced by a single myosin head | Nature **378** 209-212

A long-standing controversy at the time in understanding how muscles contract was how much movement is generated on a single actin by a single molecule of myosin. Work on whole muscle fibres could not resolve this because it was not possible to determine how many molecules were responsible for any particular movement. In this paper we developed a sensor for working on single molecules based on optical tweezers, and showed that the elemental movement was of the order of 5-10nm.

Milner | 2003 | Disruption of the nucleolus mediates stabilization of p53 in response to DNA damage and other stresses | EMBO Journal **22** 6068-6077

Development of cancer can be triggered by exposure to environmental agents which induce DNA damage. Under these circumstance the cellular protein p53 plays a vital protective role and functions as a tumour suppressor. In this work we show that p53 activation in response to DNA damage occurs in a specialised sub-domain of the nucleus, called the nucleolus, rather than throughout the nucleus as previous believed.

Law	2000	Fishing, selection, and phenotypic evolution	ICES Journal of Marine Science **57** 659-668

Fishermen try to take larger, older fish when they harvest marine fish stocks. This leads to selection on genes affecting growth and maturation, and this in turn may cause evolution of smaller size and earlier maturity, from one decade to the next. Changes of this kind are hard to reverse, and this paper was one of a series drawing attention to the dangers of such change to marine ecosystems

Garner	1988	Correlation of DNA adduct levels in human lung with cigarette smoking	Nature **336** 790-792

The first paper describing the linear human lung dose / response relationship between the number of cigarettes an individual smoked and the amount of DNA damage. A mechanistic reason was provided why the more an individual smoked, the greater the chance of getting lung cancer. The DNA damage was substantial with thousands of damaging events per lung cell supporting the hypothesis that lung cancer causation was unlikely to be through a single mutational event.

Hill Thomas	2006	The distributions of a wide range of taxonomic groups are expanding polewards	Global Change Biology **12** 450-455

This paper showed for the first time that hundreds of species from a wide range of insect and other invertebrate groups had shifted their geographic range margins northwards during a period of climate warming. It effectively sealed the argument that the geographic ranges of species were responsive to climate, and that these effects were taxonomically widespread. The work was also significant because it showed how volunteer-collected data (citizen science) can contribute to globally important research, which in turn influenced policy through the Intergovernmental Panel on Climate Change.

Hodge Fitter	2001	An arbuscular mycorrhizal fungus accelerates decomposition and acquires nitrogen directly from organic material	Nature **413** 297-299

The discovery that arbuscular mycorrhizal fungi can acquire nitrogen from organic matter was surprising because they are obligate symbionts with no saprotrophic capability, but we now know that they play a major role in the N cycle

Sanders	1995	Release of Ca^{2+} from individual plant vacuoles by both $InsP_3$ and cyclic ADP-ribose	Science **268** 735-737

In eukaryotic cells, changes in intracellular calcium are fundamental to transduction of cellular signals into physiological responses. Although numerous channels were known to elicit elevation in cellular calcium, it was not clear whether these drew on a common pool of calcium. Using plant vacuoles that uniquely render themselves applicable to electrophysiological approaches, we were able to demonstrate co-residence of channels in a single membrane, and for the first time in plants, existence of a novel calcium release channel.

Leese	1984	Pyruvate and glucose uptake by mouse ova and preimplantation embryos	Journal of Reproduction and Fertility **72** 9-13

A novel, ultramicrofluorometric non-invasive method was devised to measure the nutrition of small numbers (1-5) of mammalian embryos. There was a switch from pyruvate to glucose as primary nutrient during preimplantation development. This led to similar research on domestic animal embryos, and ultimately those of the human (which are scarce), and on the relationship between nutrition and developmental competence.

Ormond	1987	Habitat complexity and coral reef fish diversity and abundance on Red Sea fringing reefs	Marine Ecology Progress Series **41** 1-8

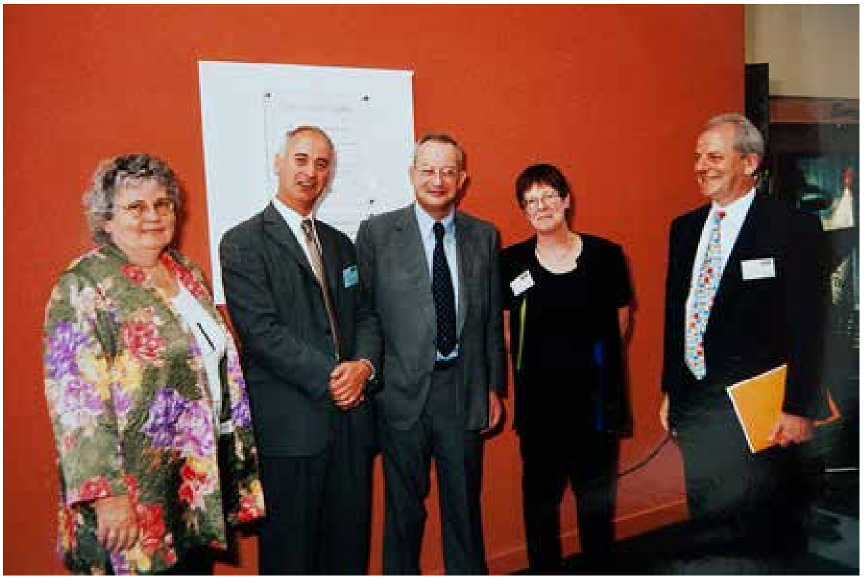
There was debate as to what factors promote high species diversity in habitats such as coral reefs. During a study in the Saudi Arabian Red Sea, we found that overall species richness of five families of reef fish (butterflyfishes, damselfishes, parrotfishes, surgeonfishes, wrasses) was highly correlated with habitat complexity as measured by substrate diversity and abundance of reef cavities, but not correlated, or only weakly so, with the abundance of live coral.

McQueen Mason	1997	Induction of leaf primordia by the cell wall protein expansin	Science **276** 1415-1418

Expansins were identified for their ability to induce the extension of plant cell walls, something believed to be required for plant cell and organ expansion. This work showed that ectopic application of expansin protein on the flanks of developing stem meristems in plants was sufficient to initiate the development of leaf primordia in abnormal positions. The work also showed that expansin genes are expressed very early in normal leaf primordium initiation suggesting an important role for these proteins in organogenesis in plants

Terry Crawford in the office set aside for the Teaching Quality Assessment assessors in 2000.

Opening of the Biosciences Building in 2003 by Lord Sainsbury, then Minister for Science. Photo: Dianna Bowles, Alastair Fitter, Lord Sainsbury, Julia Goodfellow (then Chief Executive of BBSRC) and Brian Cantor (VC).



RESEARCH SELECTIVITY EXERCISE (RSE)

RESEARCH ASSESSMENT EXERCISE (RAE)

David White

As discussed above in various chapters, the RAE was introduced in 1986 by UGC as a mechanism for measuring the quality of research in Universities. This enabled it to apply a quality factor Q to its funding of the research element QR of its grant to Universities.

Six RAEs have been held during the period covered by this history, in 1986, 1989, 1992, 1996, 2001 and 2008 with another, termed the Research Excellence Framework (REF), due to be held in 2014. The assessments were undertaken by subject areas termed 'Units of Assessment' (UoA), and for York the UoA 'Biology' was identical to the Department.

For each assessment, the Department was required to prepare and submit a set of documents detailing the Department's performance over the period of the assessment. Those wishing to learn more detail of the Department's research can read the submissions on the web site associated with this book

Although the precise nature of the RAE was refined to take account of experience, the principles have been broadly consistent. Each UoA is judged by an Assessment panel of peers on the basis of a mixture of criteria, some Individual-specific and some Department-wide.

- Individuals had to provide a list of their publications published over the period of the review; two such publications were required in early exercises, increased to four in 1996. Crucial for this component was the choice of individuals. The Department was at liberty to choose which academic staff to declare; these were termed the 'research active' staff. It was widely understood that this choice was critical; the Assessment Panels rated each individual member of staff into categories ranging from 'International' to 'National' via intermediary categories largely on the basis of these publications, with some attention being paid to Measures of Esteem insofar as this discussed individuals. Crucial to the outcome was the distribution of staff between these categories.
- Departments (UoAs) provided statistical information about staffing, including research assistants and fellows, numbers of students studying for masters and doctorates, research income and statistics of publications in various categories. There were also two forms requiring prose i.e. not against a proforma, in which the Department discussed (RA5) its present environment and plans for future development and (RA6) General Observations, which included Measures of Esteem, the contributions made by the department to the wider scientific community; this covered a range of activities from membership of national and international scientific committees, editorships, invitation to join learned societies (FRS highest on this list) and other awards and so on.

From all this wealth of information, the Assessment Panels were required to come up with a single score for each UoA from each University for the RAEs until 2011, with a distribution of four scores in 2008. Originally there were five scores, 1 (low) to 5 (high) with a starred 5* added in 2001.

The funding received by a University for each UoA was critically dependent on the RAE score. For each UoA a base value was set, being the base funding contribution for each member of research-active staff. Other research staff and students also qualified, at a fraction of the Academic Staff unit as shown in Table 12-1. Aggregating these values gave the staffing volume.

Table 12.1: Volume Measure	
Academic Staff	1
RA	0.1
RF	0.1
RS	0.15
£Charity/£25,000	0.25

The staffing volume was then multiplied by the base funds, and then multiplied by the QR factor, based on the RAE score. The differential between the RAE scores increased for subsequent RAEs, in 2001 being as shown in Table 12-2.

TABLE 12.2: Funding weights 2001	
QR Score	Factor
5*	4.05
5	3.375
4	2.25
3a	1.5
3b	1
2	0
1	0

The funding attributable to each Department (UoA) was provided to the University. It was each University's responsibility to determine how to distribute its funds, but it was a brave VC who did not recognise the contribution a department made from QR.

Thus, in financial terms, the effect of the RAE was dramatic, with the ability of a department to provide core funding to its research being considerably greater for the Departments judged to be of higher quality. A very strong positive feedback.

The Department's performance in the RAEs is shown in Table 12-3.

Table 12.3 RAE* Outcomes							
	Year	Funding Council	Name	P**	Range		Dept Score
1	1986	UGC	RSE*	2	1-5		4
2	1989	UGC	RSE*	2	1-5		4
3	1992	UFC	RAE	2	1-5		4
4	1996	HEFCE	RAE	4	1-5		5
5	2001	HEFCE	RAE		1-5*		5
6	2008	HEFCE	RAE		Quality profile	4*	25%
						3*	35%
						2*	30%
						1*	10%
7	2014	HEFCE	REF14				

*The first two of these exercises were known as the Research Selectivity Exercise.
** P is the number of publications required from each member of staff declared in the submission.

UNITS AND CENTRES

by the Directors and others involved

Over the existence of the Department, a number of activities have developed in such a way, usually to such a size, that identifying them as Units of Centres has been expedient. Visibility, particularly to the outside world is generated, with a sense of continuity and recognition of their importance.

In this chapter, a short account is given of the activities of the main Units and Centres that have existed within the Department since its inception. They have been grouped as those that are the initiatives of individuals in the department, and those that are interdepartmental. The Institute for Applied Biology (IFAB) is placed separately because it was a departmental initiative with the specific remit to be a commercial activity.

Within the Department

Environmental Archaeology Unit	1975-2002
Bronk Cancer Research Unit	1975-1991
Stockholm Environment Institute at York	1979-2010
Tropical Marine Research Unit	1982-1999
Mycotech (later the Microbiology Research Unit)	1989-2001
YCR Unit of Cancer Research	1991 to date
YCR p53 Research Unit	1991-2010
Jack Birch Unit	1991 to date
Medical Cryobiology Unit	1993-2013
Smith & Nephew Bone Research Unit	1995-2001
Centre for Novel Agricultural Products	1999 to date

Departmental

Institute for Applied Biology	1986-1995

Interdepartmental

Centre for Immunology and Infection	2004 to date
York Centre for Complex Systems Analysis	2004 to date
York Environmental Sustainability Institute:	2011 to date

THE ENVIRONMENTAL ARCHAEOLOGY UNIT (EAU)

1975-2002

Allan Hall and Terry O'Connor with help from Harry Kenward and Bone Jones

The Environmental Archaeology Unit (EAU) was set up within the Department of Biology in 1975 and formally dispersed at the end of 2002. It grew out of a group of young 'environmental archaeologists' working with York Archaeological Trust (YAT) in the early 1970s. Realising the exceptional potential for archaeological deposits in the city to yield dividends in terms of understanding the past through studies of preserved plant and animal remains and their sedimentary matrix, YAT sponsored work in Micklegate House in York by the Unit for Environmental Research in Archaeology (UFERA) on such materials as animal bones and insects by James Rackham and Paul Buckland, respectively, and latterly on insects by Harry Kenward. With funding secured from the Ancient Monuments Laboratory (AML) of what was then the Directorate of Ancient Monuments and Historic Buildings of the Department of the Environment (DAMHB), precursor to English Heritage, and with a grant from the Leverhulme Trust, the YAT and AML approached the University of York to establish a research group. In the absence of a Department of Archaeology at that time, and in view of the nature of the work envisaged, it was obvious that the EAU would be established within the Department of Biology, then under the leadership of Mark Williamson.

The fire in the Department of Biology (see pp 25) meant that the EAU was initially housed on the top floor of the Department of Physics' tower building. Eventually a resurgence in student numbers in Physics and the opening of the Department of Electronics led to the Unit removing to the walled garden of the University's original Heslington Hall estate for a number of years, and finally in 1999 taking up residence in a stretch of Portakabins and part of H block, then the IFAB building, along the western edge of the Biology Department.

In 1975, the unit comprised John Hood (Director, with responsibility for studies of soils) and Marion Berry (technician), funded through a Leverhulme Trust award, with AML supporting three fellows: Harry Kenward (investigating insects) Penny Spencer (molluscs, then also bones) and Dorian Williams (plant remains), and a technician, Patricia Veilleux. In 1976 Andrew ('Bone') Jones joined the Unit as senior technician, later becoming a fellow and establishing studies of fish bones and intestinal parasites. A year later, Allan Hall replaced Dorian Williams as the Unit's archaeo-botanist. On John Hood's departure in 1980, Harry Kenward took over as Director and continued in that role to the end of the life of the Unit. A little later, in 1981 Terry O'Connor arrived to assume responsibility for analysis of animal bones and molluscs, and on his departure for a lectureship at the University of Bradford in 1990, Annie Milles and Keith Dobney were appointed to cover these areas of study. Andrew Jones left to take up a post with YAT in 1990 and EH decided to fund a geo-archaeologist post, taken up by Maria-Raimonda Usai in 1994.

The management of the unit was overseen by an essentially 'triangular' committee comprising representatives of the Department (Mark Williamson and John Currey in the early years, then Alastair Fitter, and towards the end, Peter Young), the AML (usually the then head of the laboratory), and YAT (in the form of its Director, Peter Addyman), with advisors at various times from the Yorkshire Museum and from DAMHB's (from 1984 English Heritage's) Ancient Monuments Inspectorate. Having three main protagonists with rather different agendas forming the committee led to some interesting tensions.

As well as the core Research Fellows, the EAU drew in a wide variety of other staff over the years. Some were sponsored by research council funding, as in the case of a project on metrical analysis of cattle and pig bones (SERC), involving John Tyldesley, Elizabeth Hardy and the late Alan Turner, and there were research studentships from research council and other sources for Enid Allison, Philippa Tomlinson, Michael Hill, and Andrew Leak. As well as many volunteers, the unit played host to numerous short-term employees on government-sponsored 'job creation schemes' through the 1980s, some of whom were YAT employees engaged with work on

Trust material within the unit, others directly employed by the University.

In part through its association with YAT, and in part because of its innovative work, the EAU welcomed a wide range of visitors over the years, including academic colleagues from many leading institutions across northern Europe, colleagues from the up-and-coming heritage industry, journalists and, on more than one occasion, a party of MPs. The work of the EAU was featured in New Scientist (Bone Jones appearing as the 'cover girl') in 1986, and EAU staff made occasional appearances on TV and the wireless.

Figure 13.1
In 1986, New Scientist ran an article based on the work of EAU, and featuring 'Bone' Jones on the front cover holding the 'Lloyds Bank Stool', a near complete human coprolite which came out of excavations in 1972 under the Pavement branch of Lloyds Bank. It led quite a few people to add balloons, of which perhaps the best was from Clifford Price, who was the Head of AML at the time (and therefore our English Heritage 'boss'): "What the Viking's behind left behind'...

A feature of the early 1990s was a sea-change in the way 'rescue' archaeology in the country was organised and funded, with developers being required to support excavation and post-excavation work for sites where their development could not be mitigated to prevent destruction of the archaeological record. The EAU quickly established mechanisms for undertaking work in this new world and 'commercial' environmental archaeology soon became a prominent aspect of the unit's endeavours, resulting in involvement in projects over a much wider geographical area than hitherto demanded by English Heritage as the core funder. The work was organised within the Unit under the formal designation of Palaeoecology Research Services (PRS) from 1994. Such was the success of this funding strand, that members of the unit largely responsible for the day-to-day execution of developer-funded work set up a wholly independent company, Palaeoecology Research Services Ltd, initially in Shildon, Co. Durham, in 2001.

With the loss of PRS funding, the resignation and non-replacement of Dobney and increasing budget constraints on English Heritage, the three remaining fellows (Hall, Kenward, Usai) were relocated in the Department of Archaeology at the King's Manor at the end of 2002 and the unit was, in effect, disbanded.

During the quarter-century and more of the EAU's existence, it became a focus for integrated studies of biological remains and their sedimentary matrix from archaeological excavations, with a strong emphasis on the kinds of complex urban occupation deposits (with copious preservation by anoxic waterlogging) seen in York – as well as in the nearby towns of Beverley and Kingston-upon-Hull. This led to major reports in the series Archaeology of York and significant contributions to monographs produced by the former Humberside Archaeological Unit. Members of the EAU were active in the early years of the Association for Environmental Archaeology, and instrumental in founding its research journal, Environmental Archaeology, in 1997. Further afield, members of the unit contributed to studies of early medieval sites in Co Antrim, N. Ireland and Oslo, Norway, and, on a smaller scale, to many hundreds of other projects of every period from early prehistory throughout the British Isles. Members of the unit had strong international contacts and their work influenced the development of the subject across Europe. As well as project-based studies, in which the need for comprehensive sampling and integrated investigations of diverse remains was emphasised, the Unit pioneered ways of obtaining and analysing information within specific areas of study. These have influenced a generation of workers in a field which the University of York, by embracing the concept and reality of the EAU, was instrumental in causing to be popularly known as 'Environmental Archaeology'.

THE BRONK CANCER RESEARCH UNIT

1975 – 1991

Mark Williamson

The department had a cancer research unit under the direction of Ramsey Bronk, professor of biochemistry, from 1975 to 1991. As Ramsey died in 2007, I've put this short account together from such documents as I can find, some information from Yorkshire Cancer Research, some notes by Colin Garner and my own recollections.

In the early 1970s, the Yorkshire Cancer Research Campaign (YCRC) had units in the older Yorkshire universities but not the newer ones. One unit in Leeds was in two parts and the part in 'the annex' decided they wanted to separate. One of its fellows, Colin Garner, came to York to talk to Ramsey Bronk about the possibility of moving to us. That was agreed by all parties fairly soon. It was customary for units to have an established academic as the head, so Ramsey became Director.

Initially we had insufficient space for them. The unit had three long-term members, Mike Gronow (senior fellow) and Antonia Flaks and Colin Garner (fellows). There were also three other short-term fellows and six technicians. This largish group was initially housed in the chemistry building. The Open Day programme for May 1976 says: "The Cancer Research Unit was established in the Department ... in 1975. Most of the support ... comes from ... YCRC. The main research aim ... is ... the aetiology of cancers ... induced by ... chemical carcinogens. ... also concerned with the development of 'early warning' systems for detecting potential carcinogens and using ... known carcinogens to study the biological and biochemical features of tumour formation; particularly changes ... in the genetic material during the early stages of carcinogenesis."

The YCR administration tell me that "in 1980 YCR funded a new research laboratory and animal house at a cost of £212,000. ... This funding was in addition to £120,000 awarded in research grants in the same year." The laboratory was a set of portable buildings and some brick building work on the site of H block, the animal house was portakabins further north and to the west of G. Mike Gronow left in 1979, Colin Garner became a senior fellow and Carl Martin, who had been in the unit when it came from Leeds, was appointed to the vacancy.

In 1981, the British Association for the Advancement of Science held its 150th meeting in York and the department displayed its research. Colin Garner described both the development of short-term tests to detect environmental and occupational carcinogens and also his work on the interaction between the carcinogen Aflatoxin B and DNA. Carl Martin was working on the mechanism of action of benzidene. Antonia Flaks was working on liver and pancreas cancers induced by paracetamol and other compounds.

In about 1983, YCRC ceased to support the unit, which continued on other funds. Antonia Flaks retired in 1982 and was not replaced. In '82-'83 the unit had, as well as Colin Garner and Carl Martin, two other research fellows, two research assistants, a laboratory attendant, a full-time and a part-time secretary.

In 1987 Colin Garner and others founded York Against Cancer, a charity to support cancer research work. In 1991 the unit became the Jack Birch Unit for Environmental Carcinogenesis (see p. 117) under the direction of Colin Garner; Ramsey Bronk ceased to be involved though the staff otherwise were more or less the same.

STOCKHOLM ENVIRONMENT INSTITUTE AT YORK (SEI)

1979-2010

Johan Kuylenstierna and Mike Chadwick

The Stockholm Environment Institute and its predecessor, the Beijer Institute, had a presence in the Biology Department from 1979. The Beijer Institute for Resource Assessment and Management (BICRAM) was created by Mike Chadwick in the department in 1979. This grew out of the professional relationship between Mike Chadwick and the Director of the Beijer Institute, Gordon Goodman, and built some of its work on the research of the Derelict Land Reclamation Research Unit which Mike Chadwick had previously set up in the department.

The Beijer Institute, attached to the Royal Swedish Academy of Sciences, was set up to study the problems of energy use, environmental impacts and economic growth and development. In the BICRAM centre in York, Mike Chadwick developed research into impacts of coal mining and its use, and also the environmental impacts of coal mining in developing countries, as interest in the health and environmental problems associated with the use of coal developed in Sweden following oil price hikes in the 1970s. He and his team studied the wider environmental impacts of increased coal use in Europe, and in particular the impacts of 'acid rain'.

In 1989, the Royal Swedish Academy of Sciences and the Swedish Government agreed to transfer many of the Beijer Institute staff, along with the Director, into a new agency, the Stockholm Environment Institute (SEI). This included the York centre, which joined the headquarters in Stockholm and the other centre in Boston, USA, in developing the work programme of the new institute. Mike Chadwick continued to develop the research in the new SEI York centre until he became the Executive Director of the SEI in Stockholm from 1991 until 1996.

As the Stockholm Environment Institute work continued, other projects diversified into the implications of the use of low grade fuels, where Mike Chadwick worked with Mary MacDonald, in a collaboration with the former Soviet block and in examining potential land use change in Europe which Mike undertook with the help of Alison Thomas.

SEI developed its acid rain and air pollution projects as a major focal area in the York centre of SEI. Harry Vallack worked with Warren Spring Laboratory on developing novel methods to monitor dust around Drax power station, research which showed that dust from pulverized fuel ash (PFA) was clearly being re-suspended from the mounds of discarded PFA. Projects on acid rain and nitrogen pollution in Europe continued to expand. One of the

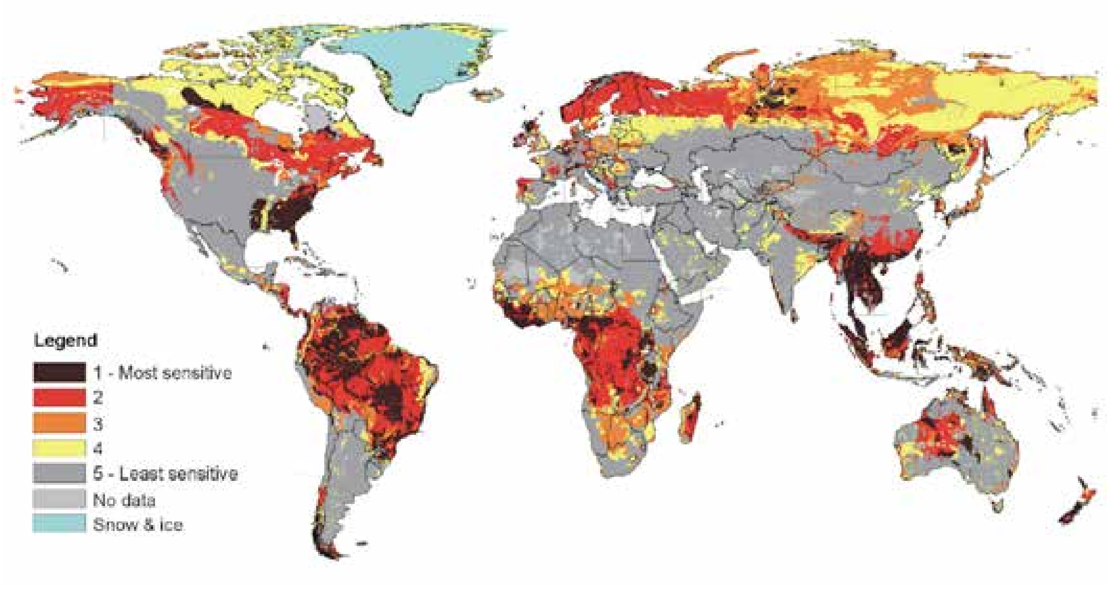


Figure 13.2

The SEI global assessment of relative sensitivity of terrestrial ecosystems to acidic deposition. The map shows areas (orange, red, dark red) where the ecosystems might be most affected by acidifying deposition. A combination of deposition overlaying the relative sensitivity would give an indication of actual risk. From: Kuylensticrna, lC.I., Rodhe, H., Cinderby, S., Hicks, K. 2001. Acidification in developing countries: Ecosystem sensitivity and the critical load approach on a global scale. Ambia 30 (1): 20- 28.

major projects during this period was the development of the Co-ordinated Abatement Strategy Model (CASM) by a team, Johan Kuylenstierna, Clair Gough and Peter Bailey, in a project initiated by Mike Chadwick. This was able to generate emission scenarios and investigate ways by which acid rain impacts can be reduced by comparison to critical loads, which are thresholds to acidification-related damage to ecosystems. SEI developed the first map of sensitivity in Europe to acidic deposition to which critical loads were assigned; this was the first critical load map used in the modelling to support the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The CASM model informed the negotiations of the Second Sulphur Protocol of CLRTAP, where most countries in Europe negotiated emission reductions based on this and other models. SEI at this point was heavily involved in informing this policy process and was an advisor on the Critical Loads Advisory Group of the UK Department of Environment, and this included the development of different emission scenarios for transport in Europe.

Carrying out research to inform CLRTAP was an important focus for SEI during the 1990s and remains one now for providing science that informs inter-governmental policy making. e work continued with a focus on the impacts of tropospheric ozone on crops in Europe and consideration of critical levels and damage associated with flux of ozone into plants. This has been taken forward by Lisa Emberson and Patrick Buker together with Mike Ashmore, who joined SEI as a joint appointment with the Environment Department and who had worked with Lisa previously. This work went on to consider impacts in Africa, Asia and at global scale with a mixture of experiments and modelling. The work on nitrogen has since been continued by Kevin Hicks, partly through interaction with the International Nitrogen Initiative, taking a more global approach to ecosystem impacts.

In the early 1990s, Johan Kuylenstierna, Steve Cinderby and Howard Cambridge also started to consider air pollution in Asia through involvement in the RAINS-Asia programme, focusing on the likely impact of sulphur and nitrogen deposition in Asian countries. This was taken further in the development of the Programme on Regional Air Pollution in Developing Countries (RAPIDC) looking initially into acid rain in Asia, Africa and Latin America, and which developed into a programme that looked into all aspects of air pollution, building capacity in developing countries coordinated by Johan Kuylenstierna and Kevin Hicks, with input from Howard Cambridge, Lisa Emberson, Patrick Buker, Harry Vallack, Dieter Schwela and Gary Haq to undertake emission inventories, use dispersion models and estimate impacts, as well as developing strategies to introduce policies to reduce these emissions. SEI has become an advisor to the Malé Declaration on the Control and Prevention of Air Pollution and its Likely Transboundary Effects in South Asia, an intergovernmental science-policy process that SEI in York developed together with UNEP, covering the eight countries of South Asia, as well as setting up a regional science-policy network in southern Africa called APINA, the Air Pollution Impacts Network for Africa.

In 1997 Johan Kuylenstierna became Director of SEI York and, together with Alastair Fitter when he became Head of Department, strengthened engagement with the Biology Department with the appointment of Phil Ineson as a joint appointment between SEI and Biology. He has developed influential research on terrestrial carbon cycling, building a group between SEI, Biology and the Environment Department, with Andreas Heinemeyer and Harry Vallack in SEI.

SEI also developed linkages with social science departments and the Environment Department at the University, developing approaches to engage various stakeholders in environmental issues by linking geographical information systems with participatory approaches, developed by Steve Cinderby and John Forrester. Initial work included understanding the use of natural resources by villagers in South Africa using such techniques, which was led by Steve Cinderby in the 1990s. There have also been a number of projects examining the role of behavioural change in delivering sustainability by Gary Haq and further projects understanding the process of decision making in issues such as sustainable transport solutions. Transport issues in southern Africa now form the focus of a new programme of work led by Dieter Schwela. Further focus on stakeholder engagement has developed such as through the Open Air Learning (OPAL) project engaging different publics in the environment, run by Sarah West and Mike Ashmore.

SEI also built up exciting work related to sustainable consumption and production under the leadership of John Barrett, and a group of people including Tommy Wiedmann, Jan Minx, Ellie Dawkins and Anne Owen, which examined the carbon emissions related to different lifestyles and consumption patterns; this showed that embodied emissions in goods consumed in the UK, including those produced in countries outside the UK, were increasing, even when territorial emissions are decreasing in line with the Kyoto Protocol. This questioned the idea that the UK is meeting its obligations to reduce carbon emissions. This work has expanded to consider carbon emission down product supply chains and the economic aspects of low carbon urban development by Corrado Topi and Johan Kuylenstierna, and the implications of consumption in the UK on biodiversity worldwide by Chris West.

Another area of work that developed in the 2000s related to water and sustainability issues. John Soussan, Matthew Chadwick and Stacey Noel joined and took forward projects looking at water pollution in Bangladesh from cotton dying industries and water issues related, for example to hydropower development along the Mekong river. Further water-related research was initiated when Jennie Barron joined SEI York and together with Steve Cinderby, Annemarieke de Bruin and Howard Cambridge they have undertaken projects demonstrating the benefits of different water management regimes in dry lands in Africa and parts of Asia.

More recently, SEI has been involved in writing a chapter in the Global Environment Outlook (GEO), UNEPs flagship publication, and Johan Kuylenstierna coordinated chapters on Atmosphere for GEO4 in 2007 and GEO5 in 2012. Some of the most influential work on air pollution and climate change has been SEI-York's coordination of the development of key assessments for UNEP on short-lived climate forcers – tropospheric ozone, black carbon and methane – by Johan Kuylenstierna, Kevin Hicks, Lisa Emberson and Harry Vallack, the results of which has led directly to the formation of a Climate and Clean Air Coalition (CCAC) to implement the measures identified in these and reap multiple benefits for climate and air quality, which now (2013) has about 50 country and non-state partners. Johan Kuylenstierna was nominated by CCAC partner countries to be one of eight scientists to sit on the Science Advisory Panel that advises the coalition. This success was built upon the 25 year programme of atmospheric science research and policy interaction within SEI.

The Stockholm Environment Institute York Centre moved from Biology to become part of the Environment Department in 2010 to promote the greater opportunity for joint research with that department and build upon its joint appointments and interaction over a number of years. And in 2012 Lisa Emberson took over as SEI York Centre Director, with Johan stepping down after 15 years to take on a role as SEI-wide Policy Director, but remaining in York. SEI retains many linkages with Biology and is grateful for the support given over 20 years of development in Biology.

TROPICAL MARINE RESEARCH UNIT (TMRU)

1982-1999

Rupert Ormond

I came to York primarily to teach animal behaviour, which had been my first great interest. I fell into being a marine biologist almost by chance, though I had always experienced a deep attraction to the oceans which I suspect must have some genetic basis. Between Cambridge and York I had set up a marine lab on the Red Sea, in what was then a very peaceful and appealing Port Sudan. I headed a small team that had used the then quite new technology of SCUBA diving both to undertake some of the first studies of reef ecology and make recommendations for managing coral reef resources, including establishing a Marine National Park covering the unique atoll of Sanganeb.

Leaving that behind I had at first tried to busy myself with the behaviour of animals ranging from zebra finches to sea anemones. But, as one of the few people then who understood tropical marine environments, I was increasingly approached by the international organisations and middle eastern governments to provide advice on their own coastal seas, and indeed with offers of funding on a scale which at that time was difficult to obtain for behavioural work. Moreover there was big push from government for UK universities to bring in more money through applied and commercial work, so this seemed the way to go.

Marine work requires at least a small team for small-boat work and diving if nothing else, and with opportunities presenting themselves a core of keen research student grew in my lab. In the late 70s I made proposals for a network of marine parks in the Egyptian Sea, in places such as Ras Mohammed and Sharm el Sheikh, which was then a tiny Bedouin market place with only two hotels. Then in the early 80s major funding became available for an even more intensive survey first of the Saudi Arabian Red Sea coast and then the Arabian Gulf coast, and with a permanent team of three post-docs (Alec Dawson-Shepherd, Andrew Price and Lynne Barrett), several graduate student (including Callum Roberts, Martha Holmes and Mary Stafford-Smith), and occasional involvement of one or two other staff (notably Peter Hogarth). We adopted the name Tropical Marine Research Unit (TMRU), as much as anything because the funding agencies expected it.

Figure 13.3
Diving in the Red Sea

After Saudi there were similar marine habitat surveys and assessments in Yemen, Oman, Bahrain, Jordan, and elsewhere, and eventually we completed some 60 or more projects in around 30 or different countries, some conservation or management studies, others essentially environmental impact assessments, but always where we could use the opportunity to collect data of more ecological (or even behavioural) interest. Colleagues jokingly referred to the outfit as the "Nice Places Research Unit", but in truth we avoided pleasant exotic locations, and the fieldwork, mostly in remote and arid regions that lacked modern facilities, was often tough going. During those years we not only brought in some two million pounds in grants and contracts, but gave the opportunity to a large number of final year project students and graduates to experience research in coral reefs, mangroves and other marine environments, in locations that as often as not dazzled with their biodiversity.

By the early 90s things had inevitably changed. The skills we pioneered became widely known and there were plenty of big consultancy companies eager to get in on the act. At the same time government policies and university priorities had changed. Semi-commercial units were to be spun off as new companies into business parks, and eventually we found ourselves in a new joint business with one of the medium large consultancy firms, Huntings, with Lynne (Barrett) serving as Managing Director. At the same time the pressure really developed for academics to focus on high impact research, something that for a while became very difficult for the small community of marine ecologists to achieve when judged alongside the armies publishing in biomedical and genetics journals. For a while two quite separate operations, one a non-university business, the other a reduced academic lab, used the TMRU name and track record. Eventually TMRU Ltd was absorbed in to Huntings, while my lab in Biology used the title TMRU as seemed fit. Perhaps most notably during the mid to late 90s we assisted in research and development in the series of marine protected areas that I had helped initiate and that now occupy almost all the Egyptian Red Sea coast, hosting some 10 million visitors per year.

With the millennium approaching, since I was by now clearly a marine biologist, the time had come for a change, and so I left York in 1999 to take up the directorship of the University of London's Marine Biological Station at Millport.

MYCOTECH

(later to become the MICROBIOLOGY RESEARCH UNIT [MRU])

1989-2001

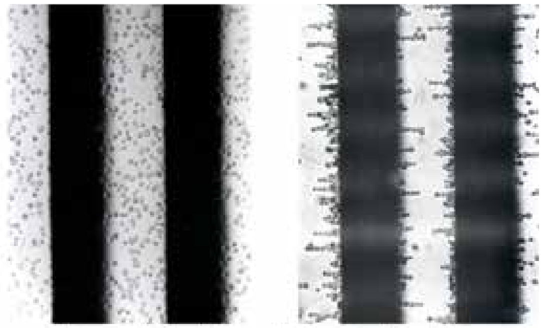
Bernard Betts

As one does at interviews, I nodded and smiled at questions and recommendations, and agreed with almost every comment made by the strangely diverse group of biologists that I met on that snowy day just before Christmas 1987. I had previously spent a brief period as temporary lecturer in molecular microbiology at Liverpool University and had decided to aim for the simple academic life. Little did I know how my time at York would unfold.

My contract as lecturer at York began on 1st April 1988. I was shown to an empty office cum laboratory on the first floor of D wing, a most unsatisfactory arrangement for a microbiologist, who shouldn't be expected to meet with supervisees or eat his sandwiches in the same location that deadly microbes might lurk. But never mind that, where was the PC? Yes, this must be an April fool's prank, I thought.

Over the next day or two at almost every corner I seemed to hear whispers of something akin to IFAB, IFAB. What was this IFAB, I wondered? My good friend and colleague over the years, Richard Firn, was the one to elucidate. "IFAB is the Institute for Applied Biology" Richard explained, "and with your background you're ideally suited to become involved in it." He reminded me of how I had shown great interest in such applied ideas on my interview day. So off we trotted to meet Tony Robards and make arrangements for my initiation into the IFAB club.

At that time IFAB was little more than a set of ideas. With the expected fall in grant income due to government cuts, IFAB would be a centre for applied biology funded from industrial sources and commercializing the department's research output. Simple - and I was going to have a chance to be in at the start! I signed on the dotted line, and would never look back - so I was told.



Dielectrophoretic collection of cells on microelectrodes.
(left) before electric field applied, (right) during electric field application

Figure 13.4

Figure 13-4.
Dielectrophoresis (DEP) is the term used to describe the polarisation and associated motion induced in particles or cells by a non-uniform electric field. The behaviour is strongly dependent of the frequency of the applied field, and is different for different materials. For example, different species of bacteria have different spectral responses. The phenomenon arises from the difference in the magnitude of the force experienced by the electrical charges at each end of the dipole, induced when a non-uniform electric field is applied.

Within a year or so a new IFAB building appeared next to the main department and I was installed in an office, with a separate state of the art laboratory much of which originally had been designed for a proposed unit named Florotech that didn't happen. Early discussions on the organization of the institute yielded names for the units within, and a management structure related to that found in commercial enterprises. My own unit was named Mycotech. I would have preferred something with a 'micro' in it, but that seemed to be exhaustively exploited by the silicon (micro)chip industries. Though we did a little work on fungi, Mycotech seemed to imply a mycological exclusivity and eventually the unit was renamed the Microbiology Research Unit (MRU) to better reflect its broader base.

Two major research themes were developed in the MRU:

- The microbial degradation of natural and synthetic materials, and
- The analysis and separation of cells.

In its early days, commercial survival was the aim and the MRU's portfolio was quite diverse. This attracted criticism from some members of the department who were used to having very focused research interests. I resisted any change in the short-term but the politicking around this issue made for a difficult time. Eventually, large commercial contracts were won from companies such as Yorkshire Water, National Power and BTG. Alongside them, BBSRC ROPA (Realising Our Potential) awards, a large EU grant and charity funding were obtained.

IFAB eventually became well structured in terms of its management and administration.

The IFAB unit heads had very regular meetings with the overall director (Tony Robards), there were executive committees set up for each unit and an IFAB board to report to each term. The units were treated as full commercial enterprises, with marketing (often through Julian White's IFAB Communications unit), accounts (an external accountant was appointed - Robin Houston) and strategic planning. A manager headed most of the units but I took the title of Director because as a member of academic staff I felt that it was important to retain my autonomy in choosing the unit's research direction. After all, it was within the MRU that my personal research was undertaken. All of the MRU staff and my own research students were housed in contiguous offices and laboratories. The unit paid for the whole facility: ground rent, services, most equipment and almost all consumables.

During my development of the MRU I had my full academic role to play, with a substantial teaching load, departmental administration and maintaining a research output. IFAB did lead to some problems with the latter as much of the commercial work was confidential and typically there were delays in publication; some work was also too fragmented or insubstantial alone to publish, though it made up a large volume of the required reports to the funding companies. Eventually, the MRU had intellectual property to protect and further publication delays were introduced. Members of the unit generally felt quite happy with the publication rate but all understood that it might have been much higher without commercial restrictions. Of course, the large amount of money generated by the commercial activities made the group facility-rich for much of the time and we enjoyed large new laboratories and offices. There were occasions when the accounts were close to the borderline, but our shrewd accountant had usually put aside contingency funds, though more than once we had hearts in mouths until the money turned up in the ledgers.

The MRU eventually became very focused on analytical microbiology using the dielectrophoresis phenomenon. Several patents were granted on technologies for separating and analyzing cells. The systems were investigated for analysis of the protozoan parasite, *Cryptosporidium parvum* and a wide range of water and food poisoning bacteria. Various lab-on-a-chip designs were developed incorporating dielectrophoresis and impedance analysis. Amongst their achievements, scientists in the MRU were the first to show that viruses could be dielectrophorised. Eventually, through a spinout company, a system was developed that was able to detect bacterial contamination of blood products.

Many of the scientists working in the MRU had dual roles. For example, some worked part-time in the MRU when studying for PhDs or had part-time employment in the department. In particular, Andy Brown, Adrian Harrison, Geoff Archer, Jeremy Hawkes, Keith Gregory, Keith Milner and Carmel Quinn undertook important dielectrophoresis research. Some of those migrated in 1999 to the Innovation Centre on York Science Park to continue working on dielectrophoresis instruments within Cell Analysis Ltd, though that company's main product lines are now different. The MRU was generally successful throughout the long learning curve that it and the whole of IFAB experienced and was financially and scientifically profitable for most of its life. It ceased to exist when I retired in 2001 and some members either remain in the department or in the Innovation Centre though most have moved away from York.

YCR CANCER RESEARCH UNIT

1991 to date

Norman Maitland

In 1990, it was decided, after discussion with Yorkshire Cancer Research, that units (see chapter 4) should be established in the molecular biology of cancer, one under Jo Milner (described in the following section) and this. Within the remit was the opportunity to work with the Structural Biology Group, led by Guy Dodson in the Dept of Chemistry. This direction displayed considerable foresight, anticipating current ideas about rational anticancer drug design. Norman Maitland was

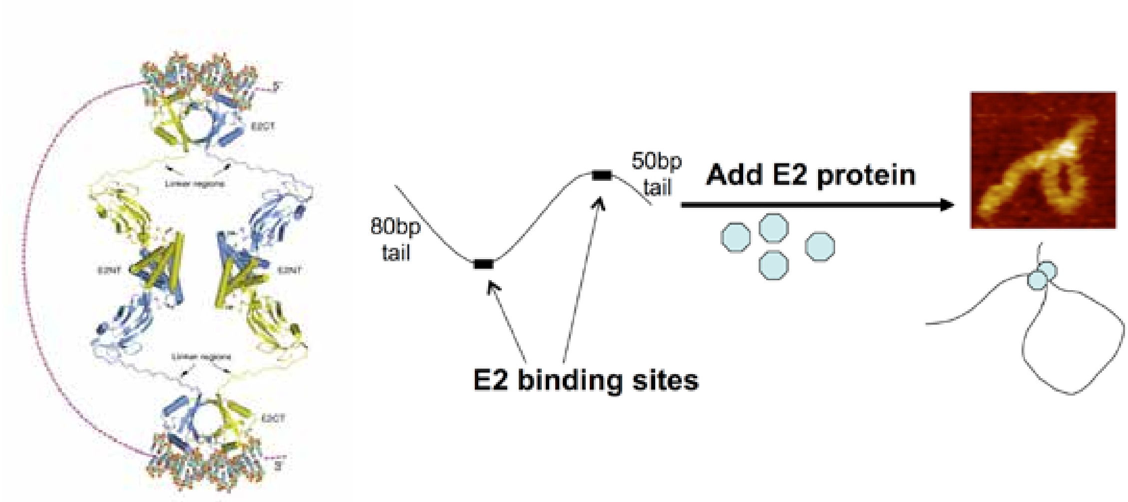


Figure 13.5

The E2 regulatory protein from human papillomaviruses induces and stabilises chromatin loops The crystallographic structure of the transactivation domain of the HPV16 E2 protein was determined in York 1995-2000 (Antson et al Nature, 2000) and is shown as a coloured ribbon diagram of 4 monomers, which form 2 sets of intra molecular dimers to tether DNA, which contains E2 binding sites. This property was predicted from the novel structure, and acts to bring transcription activator binding sites closer to the start of viral gene transcription (a mechanism subsequently shown in a number of other viruses). The loop generation is illustrated in a schematic form, which also describes the experiment used to visualise the actual loops (using purified chromatin and E2 protein: Hernandez et al, J Virol 2008). This is shown as an atomic force microscopy image of one characteristic loop, where the E2 protein is the bright spot at the conjunction of the 2 ends of the DNA.

appointed to this post in January 1991, and moved to York in September of the same year, bringing a number of staff from his previous department in Bristol.

The existing YCR facilities, the Bronk CRU (see p 108), 'a purpose build medical research facility' were no longer fit for this new purpose, and the University undertook a modernisation process which extended the lifespan of these temporary structures, together with the dedicated animal facility, which passed to University control for more general usage. One of the first events was a break-in to the latter building by animal research activists (who were extremely militant in York at that time), resulting in the release of hundreds of experimental animals, all of whom died in sub-zero temperatures.

The new research team had two priorities: to identify suitable proteins with a significance in cancer biology as candidates for X-Ray crystallographic studies, and to develop the first programme in prostate cancer biology in the UK, if not Europe, at a time when research into this most commonly diagnosed male cancer was seen as a Cinderella topic. The crystallographic programme determined a number of important structures over the succeeding 10 years, with programme grant support from YCR and elsewhere. The most notable of these structures was that of the central control protein (E2) from the oncogenic form of human papillomavirus, now know to be the major carcinogen in cervical carcinoma. This structure [1] predicted that the protein would induce loops in chromatin, bringing transcription factor binding sites close to the transcription initiation complexes, and providing a rationale for the sophisticated balance between replication and gene expression seen in HPV. The mechanism has subsequently been found in a number of other important DNA tumour viruses, and the actual chromosome loops were visualised at single molecule resolution, using atomic force microscopy in 2008 [2].

The second major aim, to provide a biological basis for improved diagnosis and treatment of human prostate cancers, remains a core focus of research to this day. For more than 40 years since the award of the Nobel prize to Charles Huggins in 1966, prostate cancer has been considered as an endocrine disease, triggered by male sex hormones. Although castration by physical and chemical means, provides a temporary respite from the tumour, it was never curative and the research in the YCR CRU developed an hypothesis that such palliative treatments were missing an underlying resistant cell, which was androgen unresponsive. This hypothesis coalesced in

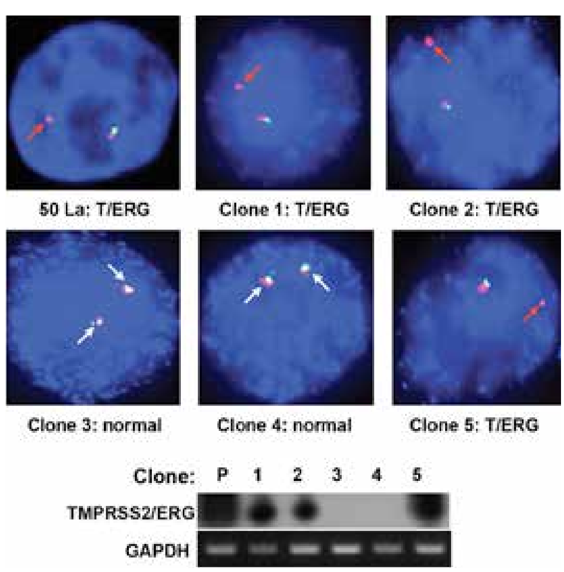


Figure 13.6

Molecular evidence for the presence and expression of a tumour inducing gene fusion (TMPRSS2-ERG) in cancer stem cells from a human prostate tumour.

2005, when the CRU reported the identification of a cell type, known as a cancer stem cell, from human prostate cancers with the correct properties. Since then the research has provided the first total genome expression phenotype for these cells, and has identified novel therapeutic targets, whose exploitation was carried forward by a university spin out company: Pro-Cure Therapeutics. With further grant support from the MRC, the European Community, the US Dept of Defense and the pharmaceutical industry, the CRU are now seeking to provide a completely new biologically based rationale for prostate cancer treatments to extend the lifespan of patients with late stage disease beyond the current two years. An independent review panel recently described the prostate cancer research in the CRU as world leading as a new 5-year programme of research began.

References

1. Maitland NJ et al. (2000) Structure of the intact transactivation domain of the human papillomavirus E2 protein. Nature 403: 805-809.
2. Maitland NJ et al. (2008) Dimerization of the human papillomavirus type 16 E2 N terminus results in DNA looping within the upstream regulatory region. Journal of Virology. 82: 4853-4861

YCR p53 Research Unit

1991-2010

Jo Milner

Some 20 years ago, when I first visited the Department of Biology at the University of York, I was struck by the diversity of disciplines within the Department with experts in ecology, parasitology, immunology, biochemistry, genetics, cell biology and much more. Specialised research equipment ranged from garden forks & wellington boots, to scintillation counters & radiation protection, to ultracentrifuges, and beyond. The relevance of these apparently disparate research areas was, and continues to be, global: it impacts upon world food resources, sustainability, global warming, infertility, parasitic transmission and disease, and human disease in general. The common denominator is biology in its broadest sense and, uniquely at York, there was this eclectic melting pot of scientists exchanging their ideas and enthusiasms. Since that first visit much has changed in terms of facilities and infrastructure in the department, but the interdisciplinary ethos has remained.

My own research is in cell and molecular biology and in cancer. Supported by generous funding from Yorkshire Cancer Research I moved from Cambridge in 1991 to set up the new YCR p53 Research Unit. This involved transforming an empty space into an efficient, well equipped laboratory and, in parallel, recruiting the scientists to develop and progress our research. Over the years a unit comprising 10 – 12 members was formed and the group functioned seamlessly to generate important discoveries, to train international and national visitors and students, and to broadcast our YCR-funded research at York to lay and scientific audiences worldwide.

Our initial research focussed on the protein p53, a tumour suppressor of major importance. p53 protects against conditions which predispose cancer development and can promote the repair of genetic damage or, if the damage is too great for repair, the p53 protein commits affected cells into programmed cell death thus removing them from the healthy cell population in body tissues. If the functioning of p53 is impaired, human cells lose a key part of their defence against cancerous changes. Impaired p53 function due to p53 gene mutation or other event is causally linked with most if not all human cancers. Cancer-causing viruses (e.g. human papilloma virus, HPV) target cellular p53 and this is part of the mechanism by which they induce cancer in infected human tissues. Our research identified a new means of selectively targeting and killing HPV-positive human cervical cancer cells. The principle of this discovery is now exploited by a promising new Biotech company (Aura BioSciences) based in Cambridge Massachusetts, USA.

One measure of our research is evident in the on-going success of lab members when they leave the YCR p53 Research Unit to establish independent careers in their own right. Three members reflect both the international nature of the Unit and its high scientific profile. Dr

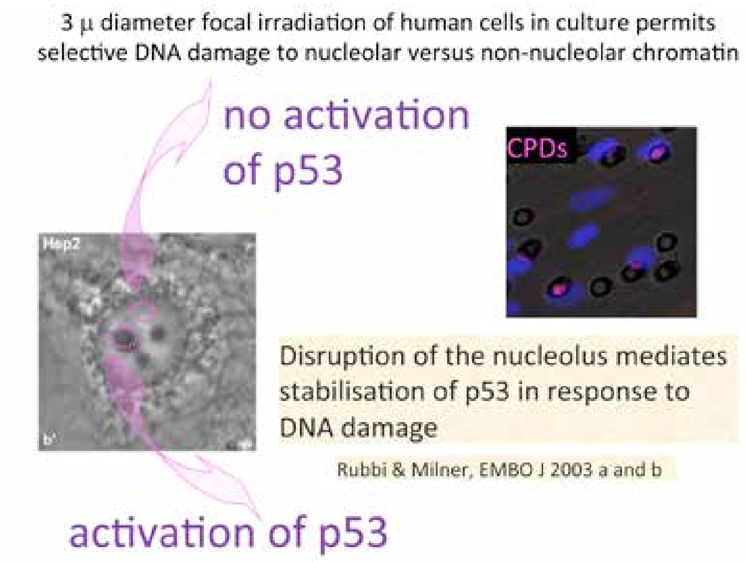


Figure 13.7

P53 protects against cancer through its ability to induce cell cycle arrest or cell death following damage to cellular DNA. This involves activation of pre-existing p53 protein, a sub-fraction of which is bound within the nucleolus of cells. Here we have used a micropore filter to localise UV-induced DNA damage within sub-nuclear areas < 3µm diameter. The upper right image shows micropores positioned over human cells in culture. The cell nuclei appear blue and sites of irradiation damage appear red. The upper left image is a micrograph of a single living cell with nucleus containing three dark nucleolar areas. DNA damage fails to activate p53 unless the nucleolus is affected. These results indicate that the nucleolus as a primary sensor of genotoxic stress in human cells.

Pierre Hainaut (Belgian) left the YCR p53 Research Unit at York to become Head of Carcinogenesis at the WHO International Agency of Research on Cancer in Lyon. In 2011 Pierre was appointed the new Director of the Ludwig Institute for Cancer Research, São Paulo-SP, Brazil. The Luwig Institute is the largest international, non-profit institute dedicated to understanding and controlling cancer, with ~900 staff in seven countries across Australasia, Europe, and North and South America. Dr. Andrei Okorokov (Russian) left to join a prestigious research group at Birkbeck College, London University and now holds a tenured Senior Scientist position at UCL, London. Dr. Ming Jiang (Chinese) left to become co-director of RNAi screening services, Cancer Research UK London. Happily we all remain in close contact.

The overall goal of our YCR-funded research in the Department of Biology at York is to better understand the process of cancer and to apply such understanding for the development of novel anti-cancer therapeutics. For this purpose the legal world of intellectual property becomes relevant – a more recent sign of the times and one which is, in itself, time consuming. But nonetheless this aspect is important in order to secure the commercial interest of the pharmaceutical industry and progression of inventions to the clinic. The YCR p53 Research Unit has a healthy IP portfolio and, even though I am now retired, the translation of our discoveries towards the clinic continues to attract funding and international collaborations. Having identified cancer-specific survival factors and invented a novel agent for silencing these factors (resulting in cancer cell death without harming non-cancer cells) we are now in the process of developing targeted delivery of therapeutic agents using nanotechnology *in vivo.*

THE JACK BIRCH UNIT

1991 to date

Jennifer Southgate, Colin Garner & Steven Leveson

The Jack Birch Unit for Environmental Carcinogenesis (JBU) was established in 1991 in the department with support from a local cancer charity, York Against Cancer (YAC). Founded in 1987, a prime aim of YAC was to foster collaborative research between clinicians at York District Hospital and cancer research scientists in the department. Jack Birch, a former Lord Mayor of the City of York, was the first Chairman and later President of YAC and the JBU was named in recognition of his significant contribution to the charity.

Before 1991, research at York District Hospital comprised a small volume of Phase 3 clinical

Figure 13.8
The Jack Birch Unit portakabins to the north of the teaching laboratories, with the new JIF-funded building to the right of the picture.

studies, but there was no locally-generated high quality research involving basic science. Original aspirations were modest, but due to successful fundraising efforts, YAC was able to contribute to funding some laboratory space at the university. Initially the JBU was housed in portakabins, but in 2002, as part of the £25M Joint Infrastructure Fund award to the Department of Biology, the JBU relocated to its current purpose-built office and laboratory suite in the new biology building.

Under the directorship of Colin Garner, the research focussed on the aetiology of a variety of human cancers including breast, colon and bladder. The JBU was one of the first research units in the UK investigating DNA damage, mutagenesis and gene-environment interactions in human tissue. Surgical specimens were obtained from hospitals from all over the UK, but particularly York District Hospital in collaboration with surgeons Steve Leveson and John Craven.

Significant research findings in the early years of the JBU included the staging of p53 mutations in colon cancer, the relationship between cigarette smoking and DNA damage in lung, cervical and stomach tissue, cervical DNA damage and tamoxifen exposure, and why humans are relatively resistant to the carcinogenic effects of the naturally occurring fungal toxin, aflatoxin. Later research programmes moved to the then new field of Exploratory Clinical Development, focussing on the development of new medicines, including anti-cancer drugs. In addition to funding from YAC, the JBU received funding from research councils, MAFF, the European Commission, and various commercial organisations including GlaxoSmithKline, AstraZeneca and Shell. At one time as many as 20 PhD students and post-doctoral fellows worked in the JBU with a total grant income exceeding £1 million per annum. In the first six years of the JBU's existence, some 60 papers were published in peer-reviewed journals including Nature, The Lancet and the British Medical Journal. The journal Carcinogenesis, founding editor Colin Garner, was published from the JBU for several years. Colin Garner resigned in 1997.

The Unit was renamed as the Jack Birch Unit of Molecular Carcinogenesis (still JBU) in October 1999 in consideration of the change in direction following the appointment of the current Director, Jenny Southgate. Since that time, the JBU has continued to receive infrastructure support from YAC under the remit of close clinical liaison and research focused on common human adult cancers of epithelial tissues, particularly the bladder and colon. Unlike most research groups who concentrate on studying cancer tissues alone, the approach taken by the JBU has been to isolate, grow and study the normal human epithelial cells and tissues from which bladder and other common adult cancers arise. The understanding of control mechanisms operating in normal tissues provides unique insight into the dysfunction and escape from normal controls that accompany malignant transformation. The JBU has pioneered the in vitro application of normal human cells as experimental models for investigating the early stages of cancer – for example following the introduction of initiating cancer genes or epigenetic changes following the exposure to non-genotoxic carcinogens.

The JBU is now a leader in research on bladder epithelium, with a strong portfolio of scientific publication and international collaboration. One offshoot of the establishment of robust culture systems for normal epithelia has been the development of tissue engineering and regenerative medicine approaches using adult stem cells and biomaterials to reconstruct tissues and organs in patients with end-stage bladder disease. A further multidisciplinary collaboration has evolved in the area of computational modelling. Jenny Southgate was a founder member of the Yorkshire Tissue Engineering Group, formed to bring critical mass to the nascent area of tissue engineering, which she chaired from 2001-2009, during which time it evolved to become the White

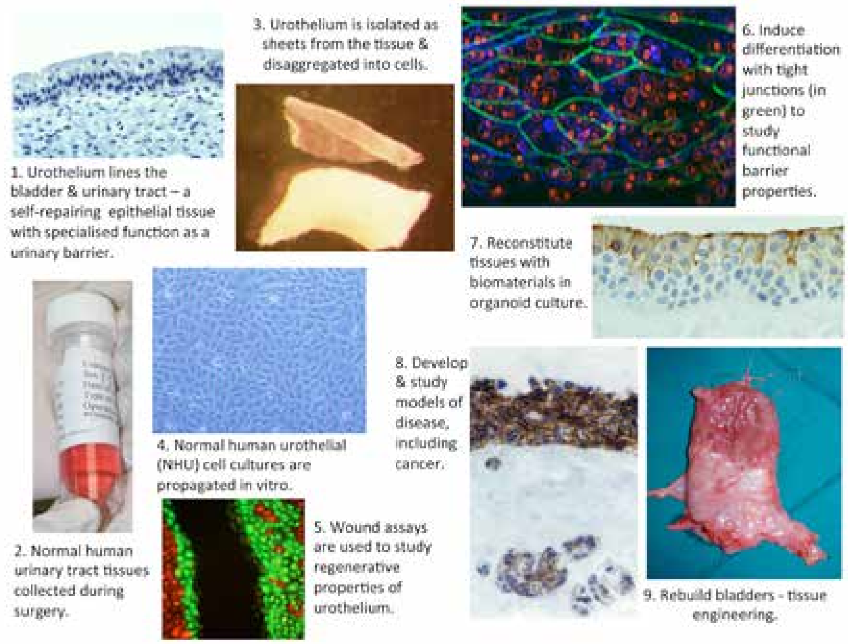


Figure 13.9

The figure outlines the workflow of research and translational activity in the Jack Birch Unit.

Rose Universities Biomaterials and Tissue Engineering Group, now in its 14th year.

Outside of the infrastructural staff support from YAC, a 5 year renewable programme grant, the JBU is entirely funded by external support from the research councils, medical research charities and industry. The JBU has a dynamic mix of postdoctoral fellows and associates, clinical research fellows, research technicians, postgraduate students, and visiting researchers from the UK and beyond. Current and past honorary staff include Ludwik Trejdosiewicz (epithelial immunologist), Sally Feather (paediatric nephrologist), David Thomas (paediatric urologist), and Ian Eardley and William Cross (adult-urologists). Clinical collaboration has remained a mainstay of the group's activities, with samples received from surgical colleagues across the UK.

Education and research training are at the heart of the Unit's activities and the JBU hosts international visitors and students, and York BSc final year project students. Since 1999, the JBU has had 18 successful PhD students, including six clinical research fellows, an intercalated BSc student from HYMS and three further clinical research fellows who have been awarded MRes degrees. The JBUMC also hosts occasional open evenings to promote public understanding.

Recent initiatives have included two University-embedded industry-facing enterprises aimed at increasing the research impact. "Kystis" (Greek for sac or bladder) is based on patented knowhow and promotes industrial research collaboration in preclinical assessment for bladder drug discovery and toxicology. "Histotech" has been developed to exploit the extensive internal expertise in immunohistotechnology for tissue engineering and biomaterials research.

Now in its 21st year, the Jack Birch Unit continues to be a successful collaboration between scientists, clinicians and YAC that continues to work to its stated purpose:

- To carry out high quality, ethical research within a scientific remit agreed with YAC.
- To promote and support scientifically-led clinical collaborations.
- To undertake the research training and education of young scientists and clinicians.
- To disseminate research findings to the scientific and medical communities through presentations and peer-reviewed publications.
- To promote opportunities for translation and exploitation of research findings through interactions with clinicians and industry, and by commercialisation where appropriate.
- To work with YAC to promote public education and awareness.

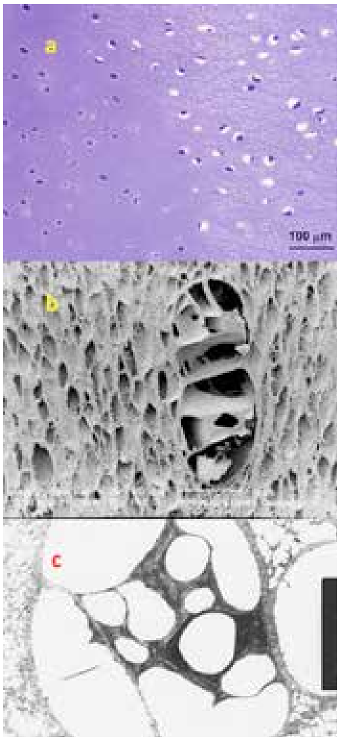


Figure 13.10

Chondrocytes from articular cartilage tissue to illustrate the effect of freezing. (a) shows an ice front advancing from the right through cartilage tissue, creating small crystals in the matrix but large crystals in and around the chondrocytes. (b) is an SEM of a chondrocyte and its surrounding matrix that has had the ice dissolved at -80°C leaving empty cavities where the ice crystals were. (c) is a TEM image with ice both surrounding the cell and crystallizing within it. Intracellular ice has been shown to be lethal in many systems.

THE MEDICAL CRYOBIOLOGY UNIT

1993-2013

David Pegg

The Medical Cryobiology Unit was established in 1993 when David Pegg's MRC team moved to the University of York from the Department of Surgery in Cambridge. Initial funding was provided by the Wellcome Foundation and subsequent work was supported by the MRC, the BBSRC, the EPSRC, the Department of Health (Medlink Programme), the RNIB, the British Heart Foundation, the EU Biomed Programme, the National Blood Service, Smith and Nephew, Ashby Scientific and Planer Products.

The unit has worked on the problems of the cryopreservation of living tissues intended for transplantation. For logistic reasons an effective method of storage is essential. Many cells can be preserved for long periods of time and recovered in a living state if the composition of the medium in which they are immersed is such as to reduce the amount of ice that is formed; this is done by including high concentrations of so-called cryoprotective agents. Previous work by the unit and others had established that under such conditions the ice forms outside the cells and the cells are not damaged directly by the ice but indirectly by the increase in the concentration of solutes that is caused by the removal of water to produce the ice crystals. It turned out that many single cell systems can be effectively preserved in this way but that is not true of multi-cellular, organised tissues. This was the main area of study by the unit: how to combine the effectiveness of storage at very low temperatures while avoiding damage by ice. The unit was able to demonstrate that the crystallization of ice can be prevented if the concentration of cryoprotectant is increased as cooling proceeds, leading to a glass-like state that the tissues will tolerate. This approach has been used effectively for corneal tissue and cartilage. However the glassy state is not without potential hazard: glasses are brittle and warming too rapidly can cause fractures in the tissue which is a particular problem with transplantable vascular tissues (blood vessels and cardiac valves). The unit established that these vitreous fractures can be prevented by careful control of the rate of temperature change, particularly during warming.

The unit is now collaborating with the NHS-BT (National Health Service – Blood and Transplant) Tissue Service to develop their method for the perseveration of cartilage to human grafts donated for the surgical repair of damaged articular cartilage – especially of the knee.

SMITH & NEPHEW BONE AND JOINT RESEARCH UNIT

1995-2001

Tim Skerry

In the 1980s, the healthcare/orthopaedics company Smith and Nephew had become well known for its orthopaedic implants, but it was clear that increasingly there would be scope for less inert products in therapy. This led to a need to develop materials that integrated with tissues, and biologically based therapies, particularly in the fields of bone and cartilage repair. Over the next years, the company undertook to grow in-house expertise by recruitment of basic scientists to work in the new Group Research Centre on the York campus, and also interacted with university scientists through collaborations and consultancy work. In 1994, a plan was conceived between David White, Head of Biology and Alan Suggett of Smith and Nephew, to create a university group in the area by recruiting a Smith and Nephew chair in a relevant scientific area related to tissue repair or wound healing. When the Smith and Nephew position was announced, I called and spoke to David and subsequently applied and was selected after a seminar and interview process where I remember disconcertingly, the projector bulb blowing on my first slide!

At the time I was a lecturer in the University of Bristol, working on a 3-year research leave fellowship from the Wellcome Trust, in the area of cell-cell communication in bone, particularly in response to mechanical stimulation. Using an early and now largely discounted subtractive technique known as differential RNA display (DRD) we compared samples of material from bones loaded *in vivo* to a level that was the equivalent of a game of tennis in a human. DRD was performed by using sets of random hexamer PCR primers to amplify all the cDNAs in the control and experimental samples. When the PCR products were run out, bands present in one sample but absent in the other and vice versa represented regulated mRNAs. While the technique was prone to many false positive and negative results, it worked well in our hands and we identified several genes that were followed in detail. One of these was a glutamate transporter known to be expressed in the CNS, and this led to the identification of many synaptic molecules being detected in bone, and a field of "neurotransmitter" signalling in bone and cartilage and other non-neuronal tissues being established from our work and subsequent studies by others.

A second molecule, seen to be regulated in those early DRD studies, was known as RAMP3, a so-called Receptor Activity Modifying Protein. RAMPs were discovered in the 1990s and when we found one regulated in bone it led on to a series of studies that continue today showing how the molecules regulate bone mass and homeostasis by a variety of direct and indirect mechanisms. RAMPs alter ligand selectivity of a receptor for a ligand, so that for example a calcitonin receptor becomes a high affinity amylin receptor when in association with a RAMP. Furthermore RAMPs are obligate trafficking partners for some receptors and we have recently discovered a new RAMP partner receptor with the ability to alter ligand signalling by virtue of cell surface or intracellular localisation. We have also discovered a new function for RAMPs that we term intrinsic functional selectivity – the ability to alter the internal signalling G-protein activation profiles of the same receptor when in association with a RAMP. This appears to be a new level of complexity for endocrinology and has important therapeutic implications in cancer, bone disease, appetite control and sepsis.

The group in York grew from its inception in 1995 to around 20 staff supported by external funds and the work performed led to significant scientific discoveries, and career development of many staff. Around 20 postdoctoral scientists or PhD students who worked in the lab are now in academic positions in the UK or USA. While I left York in 2001, the infrastructure and several of the personnel remained to with my former postdoc Paul Genever, who is now a senior lecturer in Biology and still works with Smith and Nephew in tissue engineering. My group in Sheffield is reducing our research in neurotransmitter signalling in bone to focus exclusively on RAMP biology and we have patented antibodies to RAMP3 for oncology applications, and a spinout company Medella Therapeutics, which can trace its scientific roots back to those days in York.

The time in Biology was remarkable. I moved from a veterinary school to a first class biology department at a time of great enthusiasm and opportunity. Contact with colleagues such as Ron Cooke, the VC at the time, David White, Jo Milner, Dianna Bowles, Dale Sanders, Ottoline Leyser, John Currey and Justin Molloy changed my thinking about research completely. At the subsequent RAE, Biology moved from 4 grade to 5, and when the announcement was made of the JIF funding round, the department worked together to produce an outstanding application that led to the first of the large changes and new builds which dominate biology in York today.

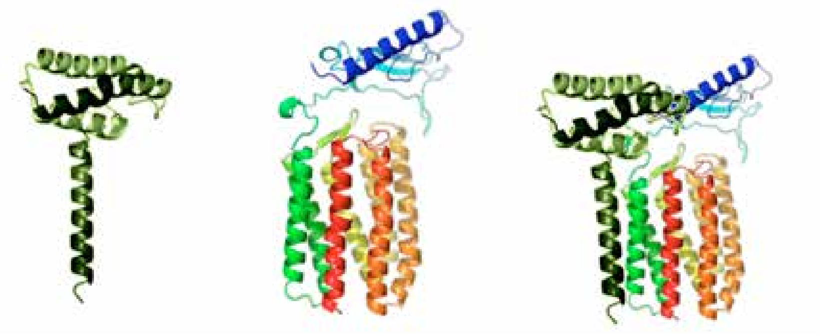


Figure 13.11
The receptors for some hormones in the calcitonin family are composed of two proteins, a G-protein coupled receptor, and a second accessory protein, known as a receptor activity modifying protein or RAMP. In this example, RAMP3 (left) forms a complex with the calcitonin-like receptor (centre) to make one of two high affinity receptors (right) for the hormone adrenomedullin, whose actions are a therapeutic target in cancer, osteoporosis and other diseases.

(Acknowledgement Professor Peter Artymuk, Department of Chemistry, University of Sheffield for homology modelling and images)

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now Head of Human Metabolism, School of Medicine, University of Sheffield.

THE CENTRE FOR NOVEL AGRICULTURAL PRODUCTS (CNAP)

1999 to date

Ian Graham

In 1996, Dianna Bowles, the Professor of Biochemistry in Biology, began to develop ideas for a new academic research centre: one at the interface of fundamental, curiosity-driven research and strategic, problem-solving research. The idea was to attract creative senior scientists who would follow their own areas of interest, whilst in parallel, work together to use biology to solve the many problems facing society. The vision focussed on developing new understanding and uses of plants and micro-organisms, enabled by advances in biochemistry, genetics and the applications of genomics and post-genomic technologies.

A key step in making CNAP a reality came with the offer of a substantial benefaction of £5 million from The Garfield Weston Foundation, providing matching funds could be obtained to ensure the continuing sustainability of the new research centre. These additional funds were successfully gained from two sources.

The Ministry of Agriculture, Fisheries and Food offered £2.1m in 1999, to set up a Plant Genome Facility in CNAP. This funding allowed the appointment of Ian Graham to a Chair in Biochemical Genetics. Success in applying to The Joint Infrastructure Fund, and the award of £21 million in 2000, subsequently provided new building, laboratories and infrastructure to house CNAP and together with the MAFF and GWF funds enabled CNAP to become established in the new JIF development of Biology. Dianna Bowles became the Founding Director of CNAP and Weston Chair of Biochemistry, Simon McQueen Mason was appointed to a Chair of Materials Biology; Neil Bruce to a Chair of Biotechnology and Pierre Broun to a Chair of Metabolic Engineering.

In 2003, Richard A. Dixon was appointed Chair of Phytochemical Genomics whilst on sabbatical from his post as Director of Plant Biology at the Samuel Roberts Noble Foundation, USA. This started a three year strategic alliance with the Noble Foundation on new health products from plants.

By the summer of 2003, just four years after its establishment, CNAP was at full operational capacity, working on research across the four themes of sustainable energy, food, health and clean technology. In June 2003, Dianna Bowles was awarded an OBE for services to plant sciences in the Queen's Birthday Honours List.

CNAP's substantial achievements were recognised by the award to the University of a Queen's Anniversary Prize for Further and Higher Education in 2006. The award commended CNAP for its mission of 'Biology to Benefit Society' and the Centre's excellence in world-class research and innovation, training, policy work and outreach.

CNAP's commitment to the use of plant biology to bring benefits to the developing world, led to the Centre approaching the Bill and Melinda Gates Foundation to support a plant breeding programme to improve yields of *Artemisia annua*, a source of artemisinin for malaria treatments world wide. A grant of $13.6 million was awarded in 2006 and co-directed by Dianna Bowles and Ian Graham. A further award was subsequently given to enable further development and delivery of the new *Artemisia* varieties to the community. In 2011 CNAP established a partnership agreement with the international seed company East West

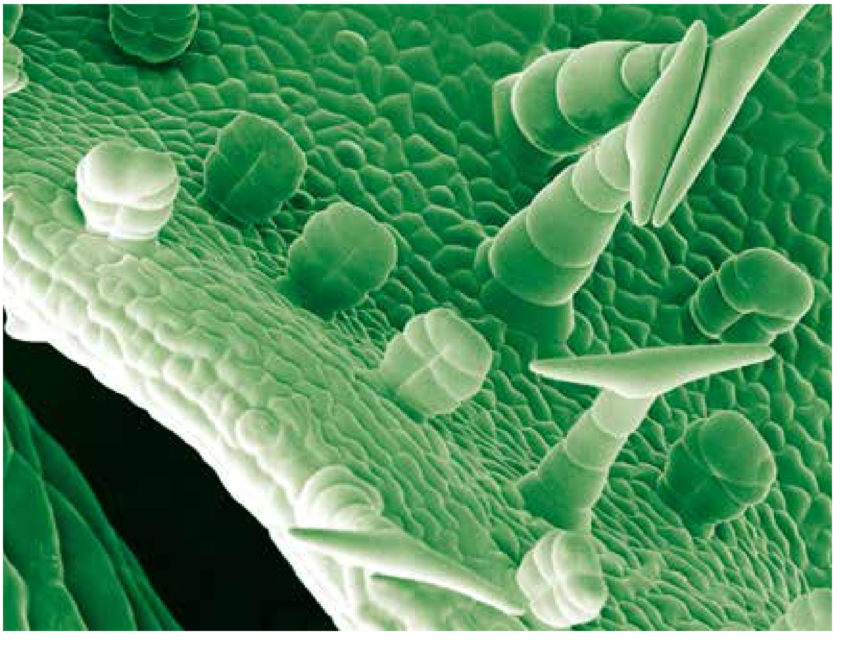


Figure 13.12

Applying the latest genetic and analytical technologies, the CNAP *Artemisia* Research Project has developed more robust, higher yielding varieties of an important medicinal plant *Artemisia annua*. *Artemisia* is a source of artemisinin, the most effective cure for malaria and the new varieties will help meet increasing demand for affordable malaria medicines. The image shows the highly magnified leaf surface where artemisinin is made in specialised cells called trichomes.

Seed to facilitate distribution of hybrid seed to developing world farmers.

Other notable longer term research programmes include the US Department of Defence funded work on phytoremediation of explosives such as TNT and RDX led by Neil Bruce, the BBSRC and EU funded work on bioenergy and plant cell walls led by Simon McQueen Mason and the GlaxoSmithKline Australia funded work on opium poppy breeding led by Ian Graham. Figure 13.14 illustrates Simon McQueen Mason's work to identify novel enzymes for digestion of wood using the gribble. This is part of BBSRC's Sustainable Energy Centre.

In 2007, Pierre Broun accepted a new role as Head of R&D at Nestle Tours in France, and work in the Noble Laboratory in CNAP was completed.

After ten years of developing and directing CNAP, Dianna Bowles continued as Professor of Biochemistry, but stepped down as Director of the Centre in 2008 and was succeeded by Ian Graham.

In 2010, Robert Edwards was recruited to a joint position as Chief Scientist at the UK's Food and Environment Research Agency (FERA) and as Chair of Crop Protection in CNAP; an appointment encouraging interdisciplinary research opportunities and closer interactions between the two centres.

The University was nominated in the 2010 Times Higher Education Awards' for International Collaboration of the Year for CNAP's work on the Artemisia Research Project.

The Biorenewables Development Centre (BDC) is a major new initiative that developed out of the need to fill the gap between CNAP laboratory scale research on high value chemicals from plants and industry requirement for larger amounts of these same chemicals for product evaluation. Launched in 2012 and based on the York Science Park, the BDC is a not-for-profit company that will provide an important conduit for translation of CNAP discoveries in the coming years.

Figure 13.13
Field trial of *Artemesia* in Madagascar

Today, CNAP continues to maintain its focus on 'Biology to Benefit Society'. Activities are dedicated to realising the potential of plants and microbes as green factories and developing new, renewable resources from them, with the help of gene discovery and germplasm development. CNAP research is published in major international journals and a rigorous process is in place to capture intellectual property. Competitive funding from a number of UK and overseas agencies supports an annual research spend averaging over £5 million per annum.

Figure 13.14
Limnoria quadripunctata (the gribble) is a voracious consumer of wood in the marine environment. This animal is unusual in having a digestive system devoid of microbial life, and this contrasts with other woodeating animals that largely depend on gut microbes to assist with the digestion of this recalcitrant material. As part of the BBSRC Sustainable Bioenergy Centre, we are investigating the enzymes and mechanisms employed by this animal for wood degradation to help identify new tools for biomass-based industries. We are also investigating what prevents microbial growth in the digestive system of the gribble.

Figure 13.15

Freeze-fracture transmission electron micrograph of single cream from the work of Ashley Wilson in CCTR. The continuous phase is whey, typically a mixture of β-lactoglobulin (~65%), α-lactalbumi (~25%), and serum albumin(~8%). Tiny clusters of casein protein micelles are distributed amongst the whey. The disperse phase is composed of droplets of crystalline milk fat. (φ = 0.5 ~ 2.0μm)

THE INSTITUTE FOR APPLIED BIOLOGY (IFAB)

1986-95

Tony Robards

Although there was commercial activity in many of the other units, IFAB was the only part of the Department given over entirely to commercial work.

Two early decisions were that (i) the new Institute would need to have its own building and (ii) it should be run along semi-commercial lines so that its financial performance could be closely monitored. Personally, I would have preferred to create a fully-owned, limited company with all the rigours that entails but that would have been a significant step too far for colleagues at that time. We therefore adopted a structure where there was a management committee (Board of Directors) and separate business units whose performance against specific goals could be independently measured.

At the University level there were also concerns at its relative lack of links and engagement with industry (although with one or two notable exceptions). To help with this, Berrick Saul, the Vice-Chancellor, had secured the services of Bill Kingston, Head of Borodin Communications in York, to engage with

Figure 13.16

The Macromolecules Unit: Sophia Cheng, Tony Robards, Eva Robards, Neil Atkin, Rukmal Abeysekera, Anna Gorostidi

The order from left to right are:

1. Ms Sophia Cheng – currently working at Biology Department
2. Professor Tony Robards – Professor Emeritus
3. Dr Eva Robards
4. Dr Neil Atkin – currently at Reckitt Benckiser (Neil's doctorate at Macromolecules Unit was sponsored by Smith & Nephew)
5. Dr Rukmal Abeysekera – currently the Knowledge Transfer Manager at University of York

research staff who had commercial ideas and aspirations. In fact, Bill had relatively little call on his services and I, and IFAB, therefore benefitted from having a personal business mentor during those crucial early days. It was Bill who insisted that, if we wanted to find external money to support a building, we would need to get the University to dip into its pocket first! It did, and this leveraged an equivalent sum (£250k) from Rowntree, very much thanks to the help and support of Ken Dixon who ushered the deal through just ahead of the Nestlé takeover in 1988. There were a number of reasons for needing a new building, including: it would provide much-needed new space; it would act as a focus for applied biology; it would provide a public image; it would be possible to create a more commercial environment; it would more easily facilitate implementation of GLP rules and other quality standards; and it would enhance the capability for confidentiality. In fact, the building was completed and opened in 1990.

The defined objectives were: (i) by improving industry's appreciation of our academic expertise, research, and teaching skills, to attract additional contract income; (ii) to identify more closely the needs and requirements of industry within applied biology and to help to provide these and (iii) to become a self-contained profit centre to the benefit of the Department.

It was important to the management committee that IFAB activities were closely monitored and this was done by creating the following discrete functional entities.

The Centre for Cell & Tissue Research (CCTR) 1980-2003

CCTR was established by Tony Robards and Ashley Wilson in 1980, preceding IFAB, but joined IFAB from the outset. It continued after IFAB ceased to exist in 1995. It was one of the first two commercial centres on campus, the other being York Electronics Centre, and provided 'a consultancy service for the development and use of microscopical equipment'.

The Centre's client base was broad, and included large and multi-national companies such as Rowntrees (Nestlé), Unilever Colworth House, Beecham Products, Glaxo Wellcome, Total, Shell Research, Johnson and Johnson, as well as medium and small businesses, many of them regional and local. CCTR made a small profit from the end of its first year, principally because of a large contract with Hazleton Laboratories (now Covance) in Harrogate for contract EM histology. That close relationship with Hazleton continued for 23 years.

CCTR work eventually involved more materials science than biology. Low temperature preparation methods allowed us to look at liquids, suspensions, emulsions and foams and ultimately, our real niche was found to lie at those interfaces of biology and materials science such as foodstuffs, and skin-care.

Macromolecules Unit

The Macromolecules Unit was established by Tony Robards and Rukmal Abeysekera in 1995. The Unit was set up to respond to demand by industry for research and commercial analytical services on macromolecular interactions relevant to food, healthcare, packaging and a wide range of other industries. The Unit was 100% funded externally, with half of Rukmal's time funded by Nestlé Product Technology Centre at York for nearly ten years. Undergraduate project students, PhD. students, Postdoctoral Researchers, technicians and overseas exchange students worked within the Unit.The Unit's work included numerous consultancies or research collaborations with over 25 companies across various sectors (Food, healthcare, commodity, pulp and paper, packaging etc.) and public understanding of science projects such as the EPSRC Partnership for Public Understanding Award (2000) and White Rose Packaging Partnership 'Friendly Packaging' (2001).

Major grants funded through the Unit, including £750k from DTI (1993-1996 joint with Nestlé, Unilever, Sanofi Bioindustries and Copenhagen Pectin); £1M from EPSRC/BBSRC (1999-2002 joint with the University of Leeds, National Starch, Solvay Interox, Rexam Plastic Packaging, Northern Foods, Sainsbury's and Pira International) and £600k from DEFRA (1999-2002 joint with the University of Nottingham, Nestlé, Mars, Cadbury, Firmenich, British Sugar and NeutraSweet Kelco)

IFAB Communications

IFAB Communications, run by Julian White, was formed in 1990 in order to liaise with industry and others, interpreting their needs and organising appropriate newsletters, training courses and conferences. A publishing deal secured by Tony with Springer-Verlag resulted in a number of seminars and associated books.

IFAB Communications also provided a Science Support Service and a Conference Management Service. The Science Support Service worked with other members of IFAB to deliver business developments contracts e.g. ICI Watercare (Bernard Betts) and supported EU concerted action events across Europe and supporting academic staff obtain funding to enhance research. The Conference Management Service not only supported colleagues in the Department to organise Society conferences at York and ran events for others across the university, the UK and into Europe.

IFAB Communications was closely involved in the department's Public Understanding of Science (PUS) activity with the City. They worked with Belinda Morris, appointed to organise our PUS activities and then to be York's Science Raids Co-ordinator, to run our Science Week for schools, and to produce the initial copies of Biology Matters, a publication of the Department's activities circulated to schools throughout Yorkshire and further afield. Belinda and Julian also worked together to contribute to departmental teaching and learning by delivering a module to the first MRes intakes.

Julian still maintains a connection to the Department through his role as the Chief Executive of the White Rose University Consortium with an active involvement in the White Rose Doctoral Training Partnership in Mechanistic Biology.

Figure 13.17
Bill Bald inserting a sample into the Departmental electron microscope.

Wolfson Unit

The Wolfson Unit, under Bill Bald, was funded by the Wolfson Foundation. It worked on the electron microscopical analysis of rapid freezing of cells, with the aim of achieving their preservation in as life-like a form as possible. Using methods such as finite elements analysis, Bill made great strides in designing and building new ultra-rapid freezing systems for electron microsopic preparation and also, later, worked with David Pegg in trying to improve the success rate in the cryopreservation of human cells and tissues, including blood.

Mycotech is described in a separate account (page 113). The Medical Cryobiology Unit, also described separately (page 120), was not formally a part of IFAB, though there was strong overlap of its activities with several of the IFAB activities.

THE CENTRE FOR IMMUNOLOGY AND INFECTION (CII)

2004 to date

Paul Kaye

The formation of the new Hull York Medical School (HYMS) in 2002 provided an opportunity for further investment in research. Following a strategic overview of research capability within the region, it was decided that HYMS would (i) focus its new research programs in just a few specialised areas along the medical research continuum and (ii) conduct its research using an embedded model, whereby researchers would benefit from well developed research infrastructure already in place at either the University of York or the University of Hull. At York, immunology and infection (with the Dept of Biology) and mental health research (with the Department of Health Sciences) were the first areas to be targeted (with neurosciences added more recently, in conjunction with the Department of Psychology).

In 2004, key staff were appointed to what would become the 'Immunology and Infection Unit', including Paul Kaye (an immunologist from the London School of Hygiene and Tropical Medicine) as director, Debbie Smith (a molecular parasitologist from Imperial College London) and Marjan van der Woude (a microbiologist from the University of Pennsylvania). With funding largely from the Joint Infrastructure Fund and a budget of around £3M, the old Institute for Applied Biology building located just outside the Department's new Biosciences Building was totally renovated to provide large open plan research space and a suite of high-containment pathogen laboratories. Further investment allowed the Department's animal unit to be transformed into a full 'micro-isolator' facility suitable for housing the genetically-modified mice required for immunological research.

Over the next three years or so, fuelled by investment from the University of York and HYMS in staff (Mark Coles, Marika Kullberg and Nathalie Signoret) and research equipment, and by the rewards from a healthy research grant income, the Immunology and Infection Unit (IIU) grew to house over 40 research scientists and postgraduate students.
Adrian Mountford and Alan Wilson, as the departments other immunologists, joined the IIU, as did Charles Lacey, the University's first appointed clinical Chair. The quest was on for expansion space, not only to accommodate new groups conducting fundamental research in biomedicine but also to promote translation of this research into human systems and to the clinic. With secured funding of more than £2M from the Wolfson Foundation and the Holbeck Charitable Trust, as well as further £3M commitment from the University and HYMS, plans were set in motion to transform the IIU into an official interdepartmental centre of the University of York, the Centre for Immunology and Infection (CII). After a year-long build, the CII officially opened its second research building in 2010, allowing it to extend its first class facilities to a new cadre of academic staff (Dimitris Lagos, Allison Green, Fabiola Martin, Paul Pryor and most recently, Pegine Walrad).

The founding aim of the CII, massaged a little over time but still ringing true today, was to integrate the study of basic and clinical immunology, microbiology and parasitology to develop a greater understanding of the processes underlying the development of chronic infectious and non-infectious diseases, and thus to develop new approaches to prevention and treatment. It was also the CII's ambition to provide a focus for translational research originating from across the University, and to create an environment that combines discipline-specific depth with the flexibility to foster creativity and create novel inter-disciplinary synergies. The CII's research portfolio has been kept deliberately broad in terms of disease interests and specialisms within immunology and microbiology, with this ambition in mind. Main current themes of research include infectious disease immunology, pathogen genomics and the study of pathogen populations, RNA biology, phagocyte cell biology, diabetes and inflammatory bowel diseases and clinical trials of vaccines and microbicides.

The CII is very well equipped to take on the challenges of research in the 21st Century. It has over 2,000 m^2 of first-class laboratory and office accommodation, with some of the best facilities in the UK for the study of pathogens. A translational immunology suite to facilitate working with human volunteers operates in conjunction with the HYMS Experimental Medicine Unit based at York Hospital, where first-time-in-man clinical trials are conducted. The CII has access to one of the best technology cores in UK academia (the department's Technology Facility) providing access to and user support for a quite remarkable range of equipment. Not surprisingly, a particular strength of the CII is imaging, with the ability to 'see' how the immune system works from the molecular through to the whole organism level (using fluorescent, bioluminescent and magnetic resonance imaging). Evidence of its collaborative spirit comes from new research programs in fields as far apart (or not?) as plasma physics, computational modelling and wound healing!

How much is down to strategic planning vs. the hard work and enthusiasm of the CII's research staff is hard to say, but the CII can certainly be proud of its first 8 years; publishing over 175 publications that span molecular and cellular science through to clinical trials, training 16 PhD students; helping to

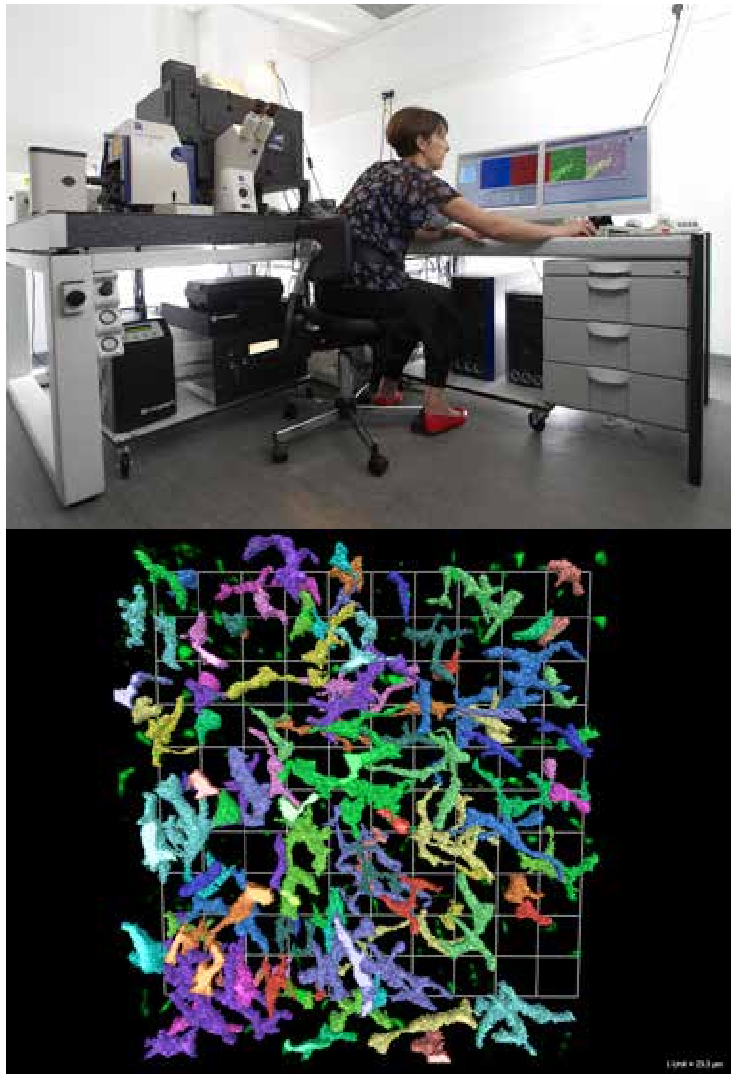


Figure 13.18

Identifying how the cellular composition of a tissue changes over time and how different cells ithin that tissue interact is central to understanding how the immune system operates in health and disease. However until relatively recently, our view of these interactions was informed mainly by the study of fixed tissue slices, loosing valuable temporal information. Multiphoton microscopy, as performed using our Zeiss LSM 780 has revolutionised how we can examine immune responses (and other processes!) in real time within living tissue. Combining multiphoton microscopy with the fluorescent cell labeling, we can now obtain excellent spatially and time resolved data on cellular interactions occurring deep within a tissue. We have used this approach extensively within the CII to understand the relationships between macrophages, neutrophils and stromal cells under different inflammatory conditions, to demonstrate for the first time how cytotoxic CD8+ T cells migrate into inflammatory foci to seek out *Leishmania*-infected cells, and to generate data for parameterising *in silico* simulations that are being used to assist in pre-clinical drug selection programs.

Multiphoton microscopy reconstruction showing shape and spatial position of Kupffer cells deep within the liver. Tracking over time (not shown) demonstates how these cells respond to infection and inflammation. From Beattie et al PLoS Pathog. 2010. 6(3):e1000805.

develop the University's first Wellcome Trust 4 year PhD program, and developing new vaccine candidates and drug leads for some of the world's most well known (HIV) and some of its most neglected (leishmaniasis, trypanosomiasis) diseases.

Looking to the future, the CII will almost certainly see an increase in research in human systems and involving patients and in the integrative discipline-spanning nature of its research. The facilities that have been developed for vaccine studies will help develop research programmes built on the fundamental science conducted across the University. CII is already building expertise and infrastructure (in collaboration with the Department's Technology Facility and cancer research groups) to exploit the power of histopathology and genomics to more fully understand human disease. In addition to infectious disease research, these developments are likely to centre on key chronic diseases such as diabetes and inflammatory bowel disease. However, the underpinning that is provided by strengths in fundamental mammalian and pathogen cell and molecular biology will always remain central to our mission.

YORK CENTRE FOR COMPLEX SYSTEMS ANALYSIS (YCCSA)

A hub for interdisciplinary research

2004 to date

Reidun Twarock

Many challenging problems in biology can more efficiently be addressed in close collaboration between different disciplines. The York Centre for Complex Systems Analysis (YCCSA) is a forum for interdisciplinary research at the University of York. YCCSA was established in 2004 as a grass roots initiative by Ottoline Leyser, a former member of the Department of Biology (see her FRS account, p 94), now at the University of Cambridge. She recognised the importance of such a centre for activities in the emerging area of Quantitative Biology, in which challenging open biological problems are tackled in close collaboration of a wide range of theoretical and experimental disciplines. In recognition of the importance of co-location of researchers from different disciplines, a core group of about 30 researchers moved into Biology S-Block in 2005 upon Ottoline Leyser's initiative.

Thanks to the YCCSA spokes person at that time, Leo Caves, YCCSA had a unique creative atmosphere, fostering new collaborations and attracting significant amounts of external funding. Activities were boosted by the appointment of two RCUK fellows (Jamie Wood (Biology/Mathematics) and Dan Franks (Biology/Computer Science)) to strengthen the YCCSA community. Via a £377k EPSRC Bridging the Gaps grant, in which a number of colleagues from different departments were involved, and for which Dr Leo Caves and Dr Jamie Wood from Biology were instrumental, YCCSA activities soon gained momentum. A visitor's fund and summer student programme placed YCCSA on the map, and the weekly YCCSA seminars attracted colleagues from across campus and beyond.

By 2010, YCCSA had grown out of its small premises, and the University decided to relocate YCCSA into the newly constructed Ron Cooke Hub on the Heslington East campus. Members of YCCSA were actively involved in designing and configuring the YCCSA space in the Hub, which was an ideal opportunity to custom-make a research environment adapted to YCCSA's mission. For example, the new premises include Hot Desking Space for visitors, that accommodates our regular flow of international visitors and provides office space for colleagues from Heslington West who wish to spend research time in YCCSA. YCCSA also harbours opportunities for interdisciplinary activities, for example poster showcase events on the Island of Interaction in the centre of the Hub. Our regular, Friday afternoon seminar series moreover attracts colleagues from across Heslington East and West, and informal YCCSA group sessions provide a forum for YCCSA members to present their research. An important part of the YCCSA mission is to foster discussions that lead to unexpected synergies between activities of YCCSA members from different disciplines, and a number of new research directions and solutions to open problems have sprung from these interactions.

Since 2012, Susan Stepney from Computer Science has been director of YCCSA, supported by a management team with representatives from Biology, Mathematics, Computer Science, Electronics and Management. Thanks to her initiative, YCCSA is by now firmly on the radar of major UK funding bodies and is growing in influence nationally and internationally. A testimony to this is the regular influx of scientists from outside the UK, who approach YCCSA to arrange a visit as part of their stay in the UK. For example, this includes visitors to the Isaac Newton Institute in Cambridge, or to other research institutions in the UK.

YCCSA also takes an active interest in teaching at all levels, and members of YCCSA are active in designing new degree schemes .YCCSA staff are, or have been, involved in several Masters courses across departments, including the MRes in Mathematics in the Living Environment (MILE), the MRes in Computational Biology, and the MScs in Chemoinformatics and Natural Computation. Moreover, YCCSA underpins interdisciplinary training of research students, and Reidun Twarock and Leo Caves from YCCSA have been key players in attracting the Wellcome-Trust-funded Doctoral Training Centre (DTC) on Combating Infectious Disease: Computational Approaches in Translational Science (CIDCATS) to York together with colleagues in the Centre for Immunology and Infection (CII). This programme is providing interdisciplinary research training in the area of infectious disease to a cohort of five PhD students annually, with a training programme that significantly involves YCCSA members and is inspired by the YCCSA ethos of interdisciplinarity in quantitative biology.

At present, YCCSA houses about 70 researchers, including members from Biology, Chemistry, Computer Science, Environment, Mathematics, and Management, and many members hold joint appointments across departments. YCCSA supports a wide range of interdisciplinary research, including the modelling and analysis of complex physical, biological, and social systems at multiple levels of detail, and the development of novel mathematical, computational, and hardware techniques to tackle such problems. As the founder member, Biology is an important stakeholder in YCCSA. YCCSA provides expertise in a number of theoretical disciplines that are important for Quantitative Biology, including mathematical modelling, network theory, biomolecular simulations, statistical mechanics and the computational aspects of complexity science, and members of YCCSA closely collaborate with experimentalists. Research in YCCSA is inherently interdisciplinary and has a wide scope of applications. Examples of projects with a biological theme include: the development of models for virus structure and assembly with applications in bionanotechnology; strategies for sustainable fisheries and marine reserves; dynamics and control strategies for infectious diseases; collective movement and cooperative behaviour of animals, including hunting in packs and bird-friendly wind farm design; self-regulating systems in ecology and the evolution of growth; phenotypic heterogeneity in clonal populations of bacteria and their applications to antibiotic resistance and biofilms; models for immune system function; algorithms inspired by biological processes for computer science and engineering; the development and application of new image and data analysis methods in biology, bioarchaeology and chemistry; computational modelling and simulation of mechanisms underpinning prostate cancer.

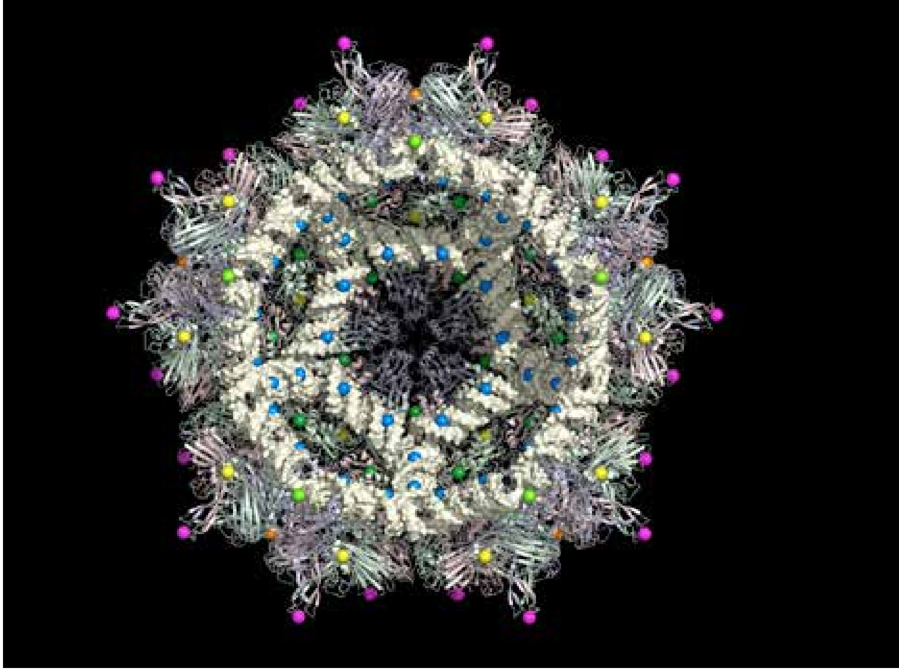


Figure 13.19

This image of Pariacoto virus is taken from recent work by the Twarock group (Acta Cryst A (Acta Crystallogr A. 2013 Mar;69(Pt 2):140-50) on predicting the structure of viruses and shows a mathematical model (point array) superimposed on the crystal-structure of Pariacoto virus (available from the protein data bank or ViPER). They have shown that Caspar & Klug's 1962 quasi-equivalence theoriy is part of a wider set of structural constraints on virus structure. These constraints can be formulated using an extension of the underlying symmetry group and this is demonstrated with a number of case studies. This new concept in virus biology provides for the first time predictive information on the structural constraints on coat protein and genome topography, and reveals a previously unrecognized structural interdependence of the shapes and sizes of different viral components. It opens up the possibility of distinguishing the structures of different viruses with the same T-number, suggesting a refined viral structure classification scheme. It can moreover be used as a basis for models of virus function, e.g. to characterize the start and end configurations of a structural transition important for infection.

YCCSA is an evolving research environment that readily absorbs and adapts to new ideas and processes, making it an excellent testbed for experiments in bold and innovative cross-disciplinary working (see www.yccsa.org). YCCSA has proven to be a highly successful model for nurturing and exploiting interdisciplinary research attracting substantial research grant income (about £6.1M currently active) from a wide range of funding agencies, including EPSRC, BBSRC, NERC, ESRC, MRC, the Leverhulme Trust, the Wellcome Trust, and EU FP7. YCCSA's ethos is collaborative and collegiate across the whole university, maintaining low barriers to engagement. It provides an opportunity for colleagues across the University to engage with an established interdisciplinary base, and underpins the department's mission in Quantitative Biology.

YORK ENVIRONMENTAL SUSTAINABILITY INSTITUTE (YESI)

2011 to date

Susan Hartley

Environmental research developed at York in a distinctive manner. The initial focus was on ecology and in the Biology Department; other areas of environmental research developed independently, including in Chemistry, Archaeology and some of the social sciences. In 1991 the Environment Department was formed (initially as Environmental Economics and Environmental Management) in close collaboration with both Biology and Economics (see p. 40). Consequently – as in most universities – environmental research was well scattered on campus. Recognising that we were missing tricks to get greater coherence and enhance the interdisciplinary interactions that environmental research offered, Brian Cantor as Vice-Chancellor agree to fund an initiative to stimulate inter-departmental interactions and subsequently (in 2011) to fund the appointment of a professorial post to act as Director of a virtual institute - YESI. The goal was to support world-leading interdisciplinary research on environmental sustainability and so help to provide the evidence base for sustainable solutions to global environmental problems.

YESI's innovative approach is based on an equal partnership between the physical, natural and the social sciences, which is essential to address global environmental challenges effectively. To facilitate these interactions YESI focuses on critical societal challenges which have significant potential for research impact and on environmental priorities where York has recognised and distinctive excellence.

YESI involves over 100 environmental researchers, drawn from both its component departments (Biology, Chemistry, Environment and SEI-Y, Sociology, Social Policy and Social Work, Politics and Law) and other departments and centres with environmental interests (Archaeology, Computer Science, Electronics). YESI also collaborates with external organisations such as the Food and Environment Research Agency, the Centre for Low Carbon Futures and Science City York. The YESI approach of building explicit linkages between such a wide range of disciplines, including ones that do not usually engage with each other, is very distinctive.

YESI research is centred on three key themes: (1) Global Change, including work on greenhouse gases and atmospheric processes, on past environments and human adaptation and on climate change and biodiversity conservation; (2) Sustainable Environments, including the development of sustainable cities and management of anthropogenic impacts; and (3) Future Food and Fuel, including making food production more resilient to climate change and developing novel fuels and services from plants. This research programme is supported by research councils (NERC, BBSRC, EPSRC) and other organisations (e.g. Joseph

Rowntree Trust). As examples of the breadth and inter-disciplinarity of its work, current research highlights include:

- "SkyGas" - development of a new technique for determining watershed/airshed gas fluxes: researchers from Biology, Chemistry and Electronics are building a new type of automatic greenhouse gas (GHG) measurement system based on 'fly-by-wire' technology and using it to make automated GHG source-sink measurements over complicated landscapes.
- Building design, human behaviour and saving energy: 42% of UK CO2 emissions result from actions by individuals linked to housing, food, energy and personal travel. Researchers from SEIY and the Centre for Housing Policy are using a new housing development in York, Derwenthorpe, as a case study to understand why low-energy housing has failed to deliver the expected energy savings.
- Using wild ancestor plants to make rice more resilient to increasingly unpredictable water availability: researchers from CNAP, Biology and Environment are collaborating with Cornell University and The Central Rice Research Institute in India not just to produce improved drought- tolerant rice varieties but importantly ones that are accepted and adopted by local farming communities, as well as breeding tools to enable rapid development of new rice varieties in future.

Figure 13.20

YESI aims to provide the evidence base for sustainable solutions to global environmental problems, such as producing enough food for a growing population in the face of climate change.

YESI was formally launched at a highly successful international meeting in the Berrick Saul building on campus in April 2013, which also commemorated the University's 50th anniversary and the centenary of the British Ecological Society.

The Biology Atrium on Degree day (2009).

ANNEX 1

Academic Staff List

The Table shows academic staff appointments during the Department's fifty years. We have adopted the following conventions:

The list shows assistant lecturers, lecturers, senior lecturers, readers, professors, teaching fellows, senior teaching fellows, all on the department roll and those members of units who are/were also professors. The list also includes those members of the Hull-York Medical School (HYMS) who are associated with the department. The diagram only shows whole years. Staff arriving or ending part-way through a year are shown as being present in that year. This means that those holding Research Fellowships (such as Royal Society University Research Fellowships) are excluded.

The text on page 82-83 and the caption to Figure 9-3 discusses our definition of 'traditional' academic staff. Pages 1 and 2 of the Table are of such 'Traditional' academic staff. Page 3 shows the additional academic staff as defined in 2013.

A key is appended. For most people, an 'x' in a grey box indicates presence during that year.

Some staff have taken unpaid leave, e.g. for maternity leave or research, and have been replaced during this time by new appointments for that period. For these occasions, the academic staff have an 'L' in a light blue background during these years, and their replacements are indicated with a 'y' in a light blue box. The replacements are positioned directly under the relevant member of staff, except for John Beddington who came in as a replacement lecturer when Michael Usher took leave, but was then appointed in his own right. Judy Metcalf took maternity leave during her final year, and Barbara Farrar replaced her for that year.

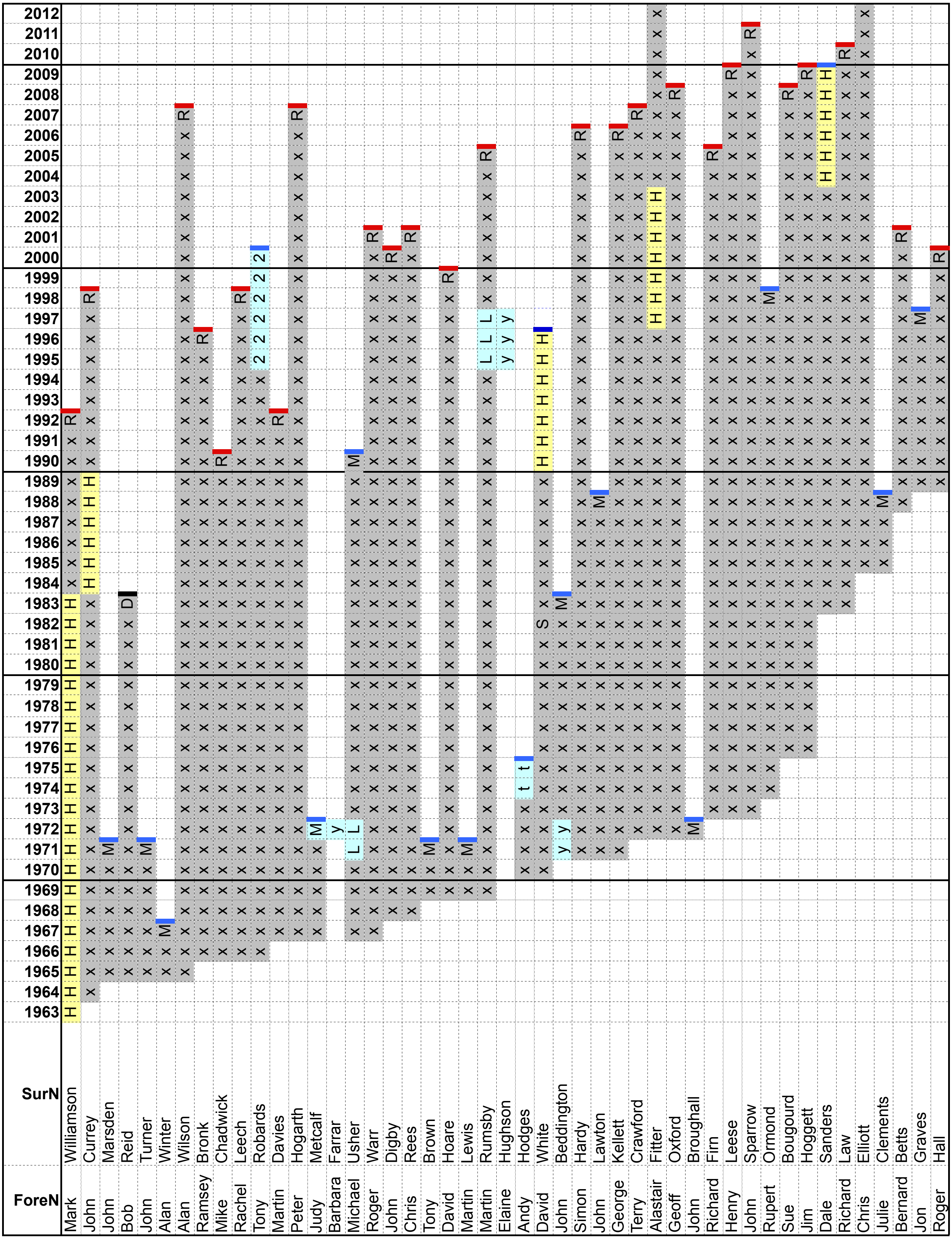
Staff leave for a variety of reasons. Some resign and take up careers elsewhere, and these are designated by an M (for Move) in their final year with a blue bar. Some retire (R for Retire) and a red bar. Bob Reid was the only academic to die in post, indicated with a D in his final year.

A number of staff have taken retirement under an agreement that they return for a few years on part-time contracts. This has often been three years for one-third time, normally but not always to undertake teaching duties. By this means, the Department can recruit new staff and still keep continuity with teaching. Such staff continue to be shown as present, i.e. we have not attempted to indicate such part-time contracts.

Recently a number of staff have been appointed to joint appointments with other departments. These are indicated with a green box and a letter to denote the partner department (see the Key). Members of HYMS have a darker grey box with the letters 'h'.

The list simply shows which years staff are present.

Figure 9-3 shows the data of this Annex in graphical form. Those with joint appointments with other departments are all 50:50 with those other departments and count as 0.5; we have counted HYMS staff count as 0.5; two members of staff are 20% within the department and have other duties elsewhere and count as 0.2. Members of staff on Leave count as 0 and their replacements count as 1. However, members of staff who retire and return on part-time contracts have all been counted as 1 for the duration of their return.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Wilson Alan
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Leech Rachel
Robards Tony
Davies Martin
Hogarth Peter
Metcalf Judy
Farrar Barbara
Usher Michael
Warr Roger
Digby John
Rees Chris
Brown Tony
Hoare David
Lewis Martin
Rumsby Martin
Hughson Elaine
Hodges Andy
White David
Beddington John
Hardy Simon
Lawton John
Kellett George
Crawford Terry
Fitter Alastair
Oxford Geoff
Broughall John
Firn Richard
Leese Henry
Sparrow John
Ormond Rupert
Bougourd Sue
Hoggett Jim
Sanders Dale
Law Richard
Elliott Chris
Clements Julie
Betts Bernard
Graves Jon
Hall Roger

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2006		X	X	X			X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X															
2005		X	X	X			X	X	X	X	X	X	X		X	X	X	M	X	X	X	X	X	X	X	X	X	X	X	X																	
2004		X	X	X			X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X																			
2003		X	X	X			X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X																						
2002		X	X	X			X	X	X	X	X		X		X	X	X	X	X	X	X	X	X																								
2001		X	X	X			X	X	X	X	X		X		X	X	X	X	X																												
2000		X	X	X	X		X	X	X	X	X		X		X	X																															
1999		X	X	X	X		X	X	X	X	X	X	X	M																																	
1998		X	X	X	X		X	X	X																																						
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SurN	Reavey	Young	Dytham	Searle	Bowles	Denecke	Leyser	Douglas	Mayhew	Atkin	Pownall	Isaacs	Schultz	Stapp	Ineson	Baldauf	Hill	Knäuper	Waites	Jones	Kleanthous	Moir	Thomas	Baumann	Genever	Helgason	Sweeney	Thomas	Chong	Potts	Hodge	Evans	Barillà	Coverley	Ungar	Redeker	Hofreiter	Ferrari	Blanco	Chawla	Maathuis	Brockhurst	McGlynn	Smith	Beale	Dasmahapatra	Plevin
ForeN	Duncan	Peter	Calvin	Jeremy	Dianna	Jurgen	Ottoline	Angela	Peter	Owen	Betsy	Harv	Michael	Paul	Phil	Sandy	Jane	Vera	Richard	Louise	Colin	James	Gavin	Chris	Paul	Thorunn	Sean	Chris	James	Jennifer	Angela	Gareth	Daniela	Dawn	Daniel	Kelly	Michael	Julia	Gonzalo	Sangeeta	Frans	Mike	Peter	Maggie	Colin	Kanchon	Michael

ForeN	SurN	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
TEACHING FELLOWS																																																			
Emma	Rand																																				t	t	t	t	t	t	t	t	t	t	t	t	t	t
Dale	Taneyhill																																						t	t	M									
Debbie	Girdlestone																																								M									
Adrian	Harrison																																					5	5	5	t	t	t	t	t	t	t	t	t	t
Set	Chong																																									t	t	t	t	t	t	t	t	t
Anje-Mar	Neutel																																										m							
Olivier	Missa																																											t	t	t	t	t	t	t
Gloria	Oikelome																																												M					
Mike	Thom																																													t	t	t	t	t
James	Edwards																																															t	t	t
CII																																																			
Adrian	Mountford																																							x	x	x	x	x	x	x	x	x	x	x
Paul	Kaye																																									h	h	h	h	h	h	h	h	h
Charles	Lacey																																									h	h	h	h	h	h	h	h	h
Debbie	Smith																																									x	x	x	x	x	x	H	H	H
Marjan	van der Woude																																									h	h	h	h	h	h	h	h	h
Marika	Kullberg																																										h	h	h	h	h	h	h	h
Mark	Coles																																											h	h	h	h	h	h	h
Nathalie	Signoret																																											h	h	h	h	h	h	h
Dmitrios	Lagos																																															h	h	h
Fabiola	Martin																																															h	h	h
Allison	Green																																																h	h
Paul	Pryor																																																h	h
Pegine	Walrad																																																	h
YCCSA																																																			
John	Pitchford																																						m	m	m	m	m	m	m	m	m	m	m	m
Leo	Caves																																							x	x	x	x	x	x	x	x	x	x	x
Reidun	Twarock																																										m	m	m	m	m	m	m	m
Elva	Robinson																																															x	x	x
Daniel	Franks																																																cs	cs
Jamie	Wood																																																m	m
YESI																																																			
Sue	Hartley																																															x	x	x
Joint Biology-Physics																																																			
Mark	Leake																																																	p
CNAP																																																			
Dianna	Bowles (see above)																																						x	x	x	x	x	x	x	x	x	x	R	
Ian	Graham																																				x	x	x	x	x	x	x	x	x	x	x	x	x	x
Simon	McQueen Mason																																						x	x	x	x	x	x	x	x	x	x	x	x
Neil	Bruce																																							x	x	x	x	x	x	x	x	x	x	x
Pierre	Broun																																								x	x	x	x	M					
Robert	Edwards																																															2	2	2

ForeN	SurN	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
CRU																												
Norman	Maitland																											
CRU p53																												
Jo	Milner																											
JBU																												
Colin	Garner																											
Jenny	Southgate																											
Smith & Nephew																												
Tim	Skerry																											

ForeN	SurN	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CRU																								
Norman	Maitland		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CRU p53																								
Jo	Milner		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	R			
JBU																								
Colin	Garner		x	x	x	x	x	x	x	x	x	M												
Jenny	Southgate										x	x	x	x	x	x	x	x	x	x	x	x	x	x
Smith & Nephew																								
Tim	Skerry						x	x	x	x	x	M												

KEY

x	Present		
H	Head of Department	H	HoD moved elsewhere
M	Moved elsewherere		
R	Retired		
L	Leave of absence elsewhere		
D	Died		
t	Teaching Fellow		
y	Lecturer as temporary replacement (see text)		
2	20% time		
5	50% as lecturer		
m	Half Maths / half Biology	m	Half Maths / half Biology moved elsewhere
p	Half Physics / half Biology		
cs	Half Computer Science / half Biology		
h	HYMS		

ANNEX 2

ABBREVIATIONS

AEB	Applied and Environmental Biology
AFRC	Agriculture and Food Research Council
AML	Ancient Monuments Laboratory
APINA	Air Pollution Impacts Network for Africa
ARC	Agricultural Research Council
BBSRC	Biotechnology and Biological Sciences Research Council
BCPG	Biology-Chemistry Planning Group
BDC	Biorenewables Development Centre
BICRAM	Beijer Institute Centre for Resource Assessment and Management
BMGF	Bill and Melinda Gates Foundation
BM (NH)	British Museum Natural History
BMS	Biomedical Sciences
BoS	Board of Studies
BTG	British Technology Group
CASM	Co-ordinated Abatement Strategy Model
CCAC	Climate and Clean Air Coalition
CEH	Centre for Ecology and Hydrology
CHE	European Centre for Higher Education Development
CIDCATS	Combating Infectious Disease: Computational Approaches in Translational Science
CII	Centre for Immunology and Infection
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CLASP	Consortium of Local Authorities Special Programme
CNAP	Centre for Novel Agricultural Products
CNS	Central Nervous System
CRU	Cancer Research Unit
CSL	Central Science Laboratory
CT Room	Constant Temperature Room
DAMHB	Directorate of Ancient Monuments and Historic Buildings of the Department of the Environment
DEFRA	Department for Environment Food and Rural Affairs
DEP	Dielectrophoresis
DGRC	Director General of the Research Councils
DIF	Director of Infrastructure and Facilities
DRD	Differential RNA display
DSIR	Department of Scientific and Industrial Research
DVC	Deputy Vice Chancellor
EAU	Environmental Archaeology Unit
EEEM	Environmental Economics and Environmental Management
EEM	Ecology and Environmental Management
EH	English Heritage
EMBO	European Molecular Biology Organisation
EU-FP7	The 7th Framework Programme of the European Union
FC	Funding Council
FEC	Full Economic Cost
FERA	Food and Environment Research Agency (followed CSL)
FRS	Fellow of the Royal Society
GAB	General Academic Board

GEO	Global Environment Outlook (UNEP publication)
GLP	Good Laboratory Practice
GWF	Garfield Weston Foundation
HoD	Head of Department
HE	Higher Education
HEFCE	Higher Education Funding Council for England
HMG	Her Majesty's Government
HR	Human Resources
HUBS	Heads of University Biological Sciences
HYMS	Hull York Medical School
IFAB	Institute for Applied Biology
IT	Information Technology
ITE	Institute of Terrestrial Ecology
IIU	Immunology and Infection Unit
JBU	Jack Birch Unit
JBUEC	Jack Birch Unit for Environmental Carcinogenesis
JHL	John Lawton
JIC	John Innes Centre
JIF	Joint Infrastructure Fund
LEA	Local Education Authority
LSE	London School of Economics
MAFF	Ministry of Agriculture Fisheries and Food (now DEFRA)
MILE	Mathematics in the Living Environment
MRC	Medical Research Council
MRU	Microbiology Research Unit
NERC	Natural Environment Research Council
NHS-BT	National Health Service – Blood and Transplant Tissue Service
NMR	Nuclear Magnetic Resonance
OPAL	Open Air Learning
PB	Professorial Board
PC	Planning Committee
PCR	Polymerase chain reaction
PFA	Pulverized fuel ash
PI	Principal Investigator
PRS	Palaeoecology Research Services
pwc	Price Waterhouse Cooper
QR	Quality of Research
RA5, RA6	Sections 5 and 6 of the RAE submission
RAE	Research Assessment Exercise
RAINS-Asia	Regional Air Pollution Information and Simulation)-Asia
RAM	Resource Allocation Model
RAMP	Receptor Activity Modifying Protein
RAPIDC	Programme on Regional Air Pollution in Developing Countries
RC	Research Council
RCUK	Research Councils UK (the umbrella organisation of the RCs)
RDX	Research Department Explosive (an explosive nitroamine)
REF14	Research Excellence Framework 2014
RNIB	Royal National Institute of Blind People

ABBREVIATIONS cont...

ROPA	Realising Our Potential Awards
RS	Research Student
RSE	Research Selectivity Exercise
S&N	Smith and Nephew
SAB	Science Advisory Board
SCUBA	Self-contained underwater breathing apparatus
SEI / SEIY	Stockholm Environment Institute (York)
SERC	Science and Engineering Research Council
SET	Science Engineering and Technology
SRC	Science Research Council
SRIF	Science Research Infrastructure Fund
SSRC	Social Science Research Council
TF	Technology Facility
TFel	Teaching Fellow
TNT	Trinitrotoluene (explosive)
TQA	Teaching Quality Assessment
UCCA	Universities Central Council on Admissions
UCL	University College London
UFC	University Funding Council
UFERA	Unit for Environmental Research in Archaeology
UGC	University Grants Committee
UNEP	United Nations Environment Programme
UoA	Units of Assessment
URF	University Research Fellow (of the Royal Society)
YAC	York Against Cancer
YAT	York Archaeological Trust
YCR	Yorkshire Cancer Research
YCRC	Yorkshire Cancer Research Campaign
YCCSA	York Centre for Complex Systems Analysis
YESI	York Environmental Sustainability Institute
YSBL	York Structural Biology Laboratory

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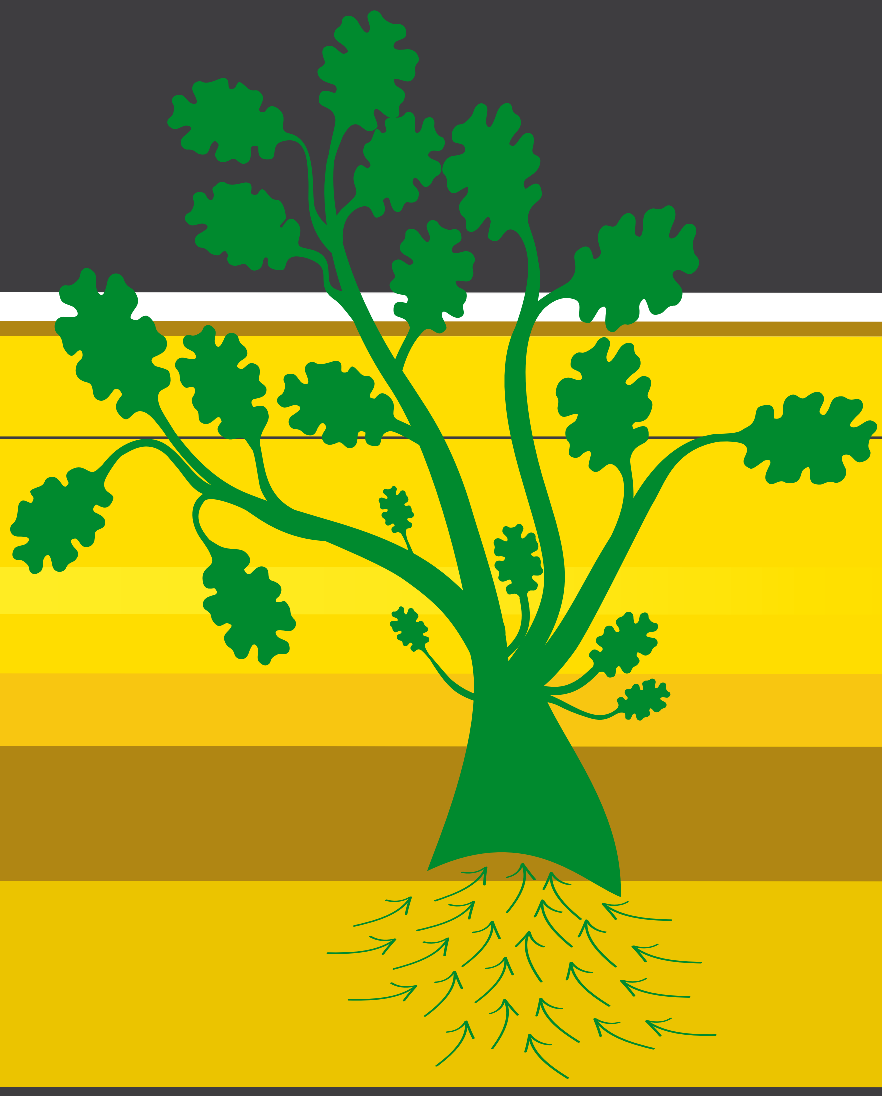
SUPER

1963



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