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The Unification of Oxford Physics

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Oxford physicists under 60 may be surprised to learn that in the mid-1980s Oxford had four sovereign Departments of Physics, and a separate Department of Astronomy. This article describes how they were united.

How did this situation arise[1]? Astronomy had always been a separate Department, with roots going back to Henry Savile's creation of a professorship of Astronomy in 1619[2]. In the 19th century there was a single Physics Department, housed in the Old Clarendon Laboratory. In 1900, however, the University established a separate Electrical Department under John Townsend, housed in what is still called the Townsend building, which was only absorbed in the Clarendon, by then housed in the 'new' Clarendon laboratory adjacent to the Parks, when Townsend died in 1941. This relatively simple state of affairs was ruptured when Nuclear Physics, Theoretical Physics and Atmospheric Physics became separate Departments in the 1960s[3].

These five Departments, which formed the sub-faculty of Physics and co-operated in matters of teaching, admissions and examining, competed with each other, as well as with the Departments of Chemistry, Metallurgy (later Materials) and Engineering, for funding that was provided directly by the

[1] For a history of Oxford Physics, or natural philosophy as it was originally called, from the days of Roger Bacon and William of Ockham in the 13th and 14th centuries respectively, through Robert Hooke and Robert Boyle in the 17th century, and Harry Mosely in the 20th century to today, see Oxford Physics and the Modern World: Tales of How a Great Research School Emerged, Timothy M M Baker (to be published by World Scientific Press). Physics in Oxford 1839-1939, ed Robert Fox and Graeme Gooday (Oxford University Press, 2005), contains scholarly articles that explore different aspects of physics in Oxford in that period and, according to the dust jacket 'offers a challenging new interpretation of pre-war physics…, which was far more dynamic than most historians and physicists have been prepared to believe'. My thanks to Timothy Baker for providing the details in footnotes 2 and 3. I am very grateful for input from Nick Jelley, who was a co-opted member of the Physics Management Committee from 1987 – 1989, and Wade Allison, who joined the Committee in the new position of Associate Chairman following unification in October 1990, and earlier played important roles in unification as described below. Thanks also to Ian Aitchison, Keith Burnett and Claire Held (who, as Claire Earnshaw, was my PA when I was Chairman of Physics) for helpful comments. I am indebted to Steve Davies for providing the information in footnote 11.

[2] In 1779 the Savilian Professor Hornsby founded the Radcliffe Observatory, but the Radcliffe Trustees withdrew it from the Savilian Professor's use in 1839. The Trustees' attempt to resume cooperation in 1859 was blocked by Savilian Professor Donkin. The University Observatory at the east end of the science area, where the domes that covered the telescopes are still in place, which housed astronomy, was established by Savilian Professor Pritchard in 1872. Astronomy is described in University Calendars as University Observatory until 1964, it was then described as Astronomy until it became Astrophysics in 1988.

[3] Denys (later Sir Denys) Wilkinson arrived in Oxford in 1957 to lead work on nuclear physics, on the understanding that it would become a separate Department. Nuclear work moved from the Clarendon to the old High School, 21 Banbury Road, which is today part of Materials, in 1959 and then into what is now called the Denys Wilkinson building as it was completed in the mid/late-1960s; the University Calendar lists the Nuclear Laboratory separately from the Clarendon from 1963, and then as the Nuclear Physics Department from 1972. Theoretical Physics moved out of the Clarendon into a new Department of Theoretical Physics in 12-13 Parks Road after Rudi (later Sir Rudolf) Peierls came to Oxford in 1963. Theoretical and Atmospheric Physics are listed as independent entities in the Calendar from 1964 onwards, although the latter did not move out of the Clarendon to Old Zoology until 1971.

General Board of Faculties[4], which took advice from Physical Sciences Faculty Board. To ameliorate some of the difficulties caused by this situation, an Inter-Departmental Committee for Physics was established in 1976. Its main concern was the allocation of vacant academic posts, its role in relation to other issues being purely advisory. In 1985/86 Sir Peter Hirsch FRS (Head of Metallurgy) initiated a discussion of unifying the physics Departments in both the Faculty Board, of which he was Chair, and the General Board, of which he was a member. This suggestion was strongly supported in principle by the physicists on the Faculty Board (Bill Hayes, Wade Allison, and Mary O'Brien), where how far unification could go was debated[5]. After a discussion of the pros and cons and feasibility of different options, in June 1986 the General Board set up an Ad Hoc Committee on Physics chaired by Sir David Smith FRS, the Sibthorpian Professor of Rural Economy (later Vice Chancellor of the University of Edinburgh), to consider the overall organisation of Physics in Oxford.

After extensive consultations within and outside Oxford, the Smith committee, which reported in January 1987 concluded[6] that "changes in the organisation of the subject were required to enable it to maintain the quality both of research, which had led to the subject being classified as outstanding by the University Grants Committee, and of teaching, where student numbers and the quality of undergraduate entrance provide a firm basis for continuing a comprehensive, detailed, and modern treatment of the subject. The ad hoc committee considers it necessary to establish a means by which Physics can be looked at overall, both to determine a strategy for research and teaching and to determine the most appropriate allocation of resources (including space) at a time of major change caused by, *inter alia,* the general financial problems of the University… [and] actual or impending vacancies in a large proportion of academic posts in the subject (including the headship of two departments), and decisions taken by the Science and Engineering Research Council".

After further consultation, the General Board agreed[6] to adopt these proposals "in broad outline" and proposed legislation to the Hebdomadal Council, which came into effect on 3 April 1987, that set up a federal structure for the period October 1987 to September 1990, led by a Chairman of Physics supported by a Physics Management Committee (PMC). The accompanying explanatory note outlined some tasks that the Chairman and PMC should tackle immediately, and charged them with effecting a gradual move towards the centralisation of some support services and other facilities. The Smith Committee had recommended that a federal phase should be "followed by a reorganisation in which the major research groups become the principal academic units within a single Department of Physics". The General Board noted, however, that "this would be a fundamental change and that reservations existed about the extent to which it could or should be pursued", and asked the Chairman and PMC to report on their operations and the possibility of further integration after two years.

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[4] Prior to the 2000 reforms, which established the present Divisions, the University's academic affairs were managed by the General Board of Faculties, to which Departments and Faculty Boards answered directly, under the authority of the Hebdomadal Council, which was the chief executive body for the University from its establishment by the Oxford University Act of 1854 until its replacement by the new University Council in Michaelmas term 2000.

[5] Parts of this account are based on the memories of Wade Allision who was a member of the Smith Committee as well as the Faculty Board.

[6] The following quotes are taken from the explanatory note that accompanied Hebdomadal Council's decree, published the University Gazette on 19 March 1987, that set up the Physics Management Committee (PMC) and established the position of Chairman of Physics, which came into effect on 3 April 1987. The explanatory note and the decree are reproduced as Annex 1 of the report on the Future of Physics, which the PMC submitted to the General Board in October 1989.

The explanatory note that accompanied the Decree that established the federal structure reported that "Consultation (involving each established member of the academic staff of the Sub-Faculty of Physics at present in Oxford) is proceeding about the identity of the first Chairman of Physics" (it seems that the possibility that the Chairman might be a woman was not considered, which would of course be unthinkable today). I was one of a minority who favoured full unification, but I had no wish, and having no management experience had not expected, to be directly involved in the process. Indeed, I was keen to make research my priority at the end of a bruising two-and-a-half years during which I had given priority to defending the UK's membership of CERN[7]. While catching breath by taking Hilary term 1987 as a sabbatical in Adelaide, I was very surprised to receive a phone call from the Chairman of the General Board, Brian Smith (later Sir Brian, Vice-Chancellor of the University of Wales, Cardiff) asking me to become the first Chairman of Physics[8].

This was before the Decree that established the federal structure was published, and Brian told me that it was proposed that allocation of vacant posts and division of University funding between the different Departments would require majority support from the PMC. I told him that I would not take the job under that condition which, it seemed to me, would lead to internal politicking, 'buggins' turn' outcomes and/or different barons colluding to divide the spoils. In further calls, I persuaded Brian that the Chairman would in principle need the power to say to the PMC "I have heard what you have to say but I am going to override your views and do something else", and that if he or she acted judiciously that power would never have to be used, which proved to be the case. This was agreed in further discussions with Brian Smith (it was in fact what had been recommended in the penultimate draft of the Smith report).

In my discussions with Brian Smith, I divined that the lot had fallen on me because the barons on each side of Parks Road, who unlike me had management experience, did not trust those on the other (I have no direct evidence for this conjecture, and Ian Aitchison told me it would be better to say that a theorist was seen as possibly a fairer, more even-handed, Chairman, than any particular experimental professor). As a strong believer in the benefits of unification, I agreed to take the job when I realised that there were no other widely acceptable candidates with the required standing to face the outside world, which I was perceived to have as a Fellow of the Royal Society since 1984 and Reader since 1980 (the Smith report had argued that those eligible for the post would normally be professors and readers in the physics departments, but in the light of the acute shortage of readerships it recommended that other academic staff be eligible 'for the time being').

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[7] Just after giving the first major talk at CERN on the case for the Large Hadron Collider, following a workshop in Lausanne in April 1984, I became deeply involved in defending CERN. First from April 1984 as advisor to a Committee, chaired by Sir John Kendrew, charged with recommending whether the UK should continue to be a member of CERN – a job I could not refuse since John told me that if I did not agree there would be no advisor. Second, from June 1986 to December 1987, as advisor to the Committee chaired by Anatole Abragam, a Clarendon alumnus, charged with studying whether the 20% reduction in CERN's budget recommended by Kendrew et al as a condition for the UK's continued membership could be found. The Abragam Committee answered 'no' in December 1987, although it thought a more modest reduction would be possible. The UK remained in CERN anyway when Margaret Thatcher overruled the majority view of a cabinet sub-committee.

[8] Wade Allison tells me that "Unsurprisingly names were considered when discussing what might work" and, that, unknown to me, my name had been mentioned earlier. Ian Aitchison recalls that my name was doing the rounds not long after Peter Hirsch's original suggestion, which was quickly and widely discussed (I aware of - and supported - Hirsch's proposal, but not of discussions of names). Wade also tells that there was a move headed by Peter Hirsch that the University should make an outside appointment, but the three physicists on the Smith Committee held that this was unnecessary, and the General Board baulked at the cost.

The reservations, identified by the General Board, about the extent to which the goal of creating a truly integrated Department could or should be pursued had two sources. First it was feared that the Heads of the existing Departments who were appointed for life, with the exception of Nuclear Physics (where the position rotated between Ken Allen and Don Perkins following Denys Wilkinson's departure to become Vice-Chancellor of the University of Sussex in 1976), might resist giving up their powers. In the event this was not a big issue. As noted in the Smith report, Bill Mitchell had left to become Chairman of the Science and Engineering Research Council in 1985, and the Dr Lees Professorship that he held, which was then associated with Headship of the Clarendon, was vacant, and Donald Blackwell retired as Savilian Professor (and Head) of Astronomy in 1988. Roger Elliott, I learned later, was thought to want the job of Chairman and was unhappy when he learned that he was not the favoured candidate. In any case he vacated the Wykeham Chair/Headship of Theoretical Physics to become Secretary of the Delegates (i.e. CEO) of the Oxford University Press in 1988, while Don Perkins (who then headed Nuclear Physics) was in favour of unification, and more than happy to shed some of his responsibilities. Fred Taylor who led Atmospheric Physics, dug his heals in initially, but accepted the situation when the University made him a Professor in recognition of his merits and to assure him that he would still carry his old authority within Atmospheric Physics.

Second, some of the older physicists, especially in the Clarendon, were set in their ways and were fearful that change might lead to them losing the support they then enjoyed. As it was, although I think that at the outset a majority opposed full integration, the sub-faculty voted *nem con* to support the 56-page report on the Future of Oxford Physics (henceforth FoOP[9]) that the PMC submitted to the General Board in October 1989, which recommended complete integration, proposed a new structure, and described the rationale behind it and the benefits that federation was already bringing and others that would follow from full unification. When in the following year the University introduced a scheme to encourage early retirement, I recall that there were five takers from Physics, which I believe was more than from the whole of the rest of the University: they were almost without exception people whose research had run out of steam, who told me that they supported unification, but rather than adapt to new circumstances they thought it best to make way for younger people.

The PMC decided that in the light of the size and diversity of Oxford Physics, the Smith report's vision of the major research groups becoming the principal research units answerable directly to the Chairman in a unified Department was not realistic, unless 'groups' was interpreted as 'groupings'. In order not to create units whose size was grossly disparate, we recommended splitting work in the Clarendon into Condensed Matter and Atomic and Laser Physics, and creating six Sub-Departments (although commensurate with their size and standing, we decided that calling each a Department would give a highly misleading impression of the fully integrated Department we envisaged). Two members of the PMC argued for splitting up Theoretical Physics, and re-locating all theorists to Sub-Departments that carried out experimental work related to their interests: this would have caused a riot among the older theorists who were brought up in the Peierls tradition to believe in the unity of theoretical physics

What were the advantages of unification that won over a majority, and how were they sold to what became a majority? Six advantages, which are fleshed out with a few examples below, were identified in FoOP:

[9] FoOP provides a good snapshot of the state of physics at the time and plane then under discussion. It is held in the archives of the Physics Department and a copy can be obtained on reasonable request to communication@physics.ox.ac.uk

i) The mechanisms and flexibility needed to implement 'strategic planning' for Physics as a whole.

ii) Improved support for teaching.

iii) A single 'voice' for Oxford Physics.

iv) Flexibility in deploying and using the talents of academic-related and non-academic staff.

v) Flexibility in deploying resources.

vi) Improved services.

Formally, undergraduate teaching was the responsibility of the Sub-Faculty of Physics, but teaching practical physics, which mainly took place in the Clarendon, was a bit of a Cinderella since the necessary resources were in the hands of the Heads of Departments. There was an Academic Committee which proposed changes in the syllabus. However, the Chairman of the Sub-Faculty was a member of the Faculty Board and the PMC, but not a member of the Academic Committee, which acted mainly in responsive mode and was frequently overridden at Sub-Faculty meetings. The reforms proposed in FoOP resolved these difficulties. After they were adopted, the PMC decided (in competition with some other proposals that are described in FoOP) to move the practical course to the basement of the Nuclear Physics building, which had housed experiments for the tandem van de Graff which closed in 1988, and use the space that this move freed-up on the top floor of the Clarendon to house centralised parts of the administration. Access to the nuclear Physics basement was by a narrow staircase or a lift. The Deputy Chairman (Wade Allision) and the University Surveyor asked Oxford Brooks Architecture Finalists to study, as a project, how safe access could be provided for a large number of people. It was they who proposed making a new entry directly from Keble Road.

The flexibility to plan for physics was enhanced by the prospect of the closure of the van de Graff, and the fact that a number of physicists who used it for their research were due to retire in the relatively near future. The primary beneficiary in the short run was Astrophysics. The PMC endorsed the idea of moving astrophysics from the Observatory to the Denys Wilkinson building, which took place in the summer of 1988 (this was already under consideration, but would have been much harder to agree and implement without the new federal structure). The prospect of this move helped Oxford recruit George Efstathiou as Savilian Professor and Head of Astrophysics. Appointing George, which raised some eyebrows as he was I believe the youngest statutory Professor in the University, was in line with a 1984 Review which had recommended a move to extra-galactic astronomy. During the academic year 1987/88, while he was still in Cambridge, George initiated a bid for the Large Telescope Project, which required committing resources from across Physics and could not have been made in a form that was likely to succeed before the federal structure was created: we recruited Roger Davies as the Project Scientist, and shifted a post to Astrophysics which we planned to use to recruit an observer working in high re-shift objects and/or near infrared astronomy.

The PMC's decision that, following unification, all services (mechanical and electronic workshops, computing, stores, finance, purchase, building services, drawing office, glass blowing etc.) should be brought under common management provides an example of the anticipated improved deployment of resources. We argued that *inter alia* it would smooth the variable workload connected with supporting big projects in particle and atmospheric physics, and provide economies as it had the potential to decrease the use of overtime when one of the existing Departments carried out work for another. The unification of electronics met some resistance from the professional engineers, but was pushed through by the Deputy Chairman, Wade Allison, while I was away.

The provision of a single voice for Oxford Physics certainly helped represent the subject inside the university, nationally and internationally. We foresaw this becoming increasingly important in the future when we correctly anticipated increasing demands to produce plans and statistics, which was difficult to do with five Departments which kept separate records in different formats.

In the first (1992) Research Assessment Exercise, Oxford Physics and four other Physics Departments were given the then top ranking of 5[10] (defined as "Research quality that equates to attainable levels of international excellence in up to half of the research activity submitted and to attainable levels of national excellence in virtually all of the remainder"). In the 1996 exercise Oxford Physics was one of only two physics Departments (the other was Cambridge's) to have its research awarded the new top ranking of 5*, defined as "research that equates to attainable levels of international excellence in more than half of the research activity submitted and attainable levels of national excellence in the remainder". While I am not an unbiased observer, I find it hard to imagine that this would have happened without the merger.

At the outset, I decided that the Chairman's office should be in the Clarendon - the traditional centre of Oxford physics – on the east of Parks Road, as I knew much less about the people and activities there, and was myself less known, rather than on the west side, where I was based in Theoretical Physics which was then housed in Keble Road. The PMC were anxious to ensure that the case for the reforms we planned to propose were well understood and would be widely accepted. Its activities in its first year of operation were reported in a meeting of all academic staff in October 1988, during which the options being studied for the future were described and discussed. They were also presented in a second such meeting in late June 1989, and presented to all non-academic staff in meetings in each of the then existing Departments in early July 1989. Many very useful comments and suggestions were received during and following these meetings. I discussed the proposals one-on-one with almost all the academic and senior research staff, many on more than one occasion as I toured labs and offices, and with many of the technical and clerical staff, and the Heads of the separate Departments also discussed them widely with their staff.

As recorded above, a meeting of the Sub-Faculty of Physics endorsed the proposals in FoOP *nem con* in a meeting on 4 October 1989. The General Board of Faculties accepted FoOP's recommendations, although unsurprisingly not all our requests for extra resources were accepted[11], and appointed me as Chairman for five years from 1 October 1990 when the new unified Department replaced the federal structure. Following the merger, Physics became a normal – if very large – Department, but it

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[10] This was a relief, but perhaps not a surprise as Oxford Physics had been ranked 'Outstanding' in the earlier, more coarse-grained, 'research selectivity exercise', which was ended following the abolition of the distinction between universities and polytechnics and the creation of the Higher Education Funding Council in 1992. HEFCE allocated research funding to universities on the basis of the rankings awarded for each Unit of Assessment (physics, chemistry, etc) and the number of academics whose research was submitted for assessment. Universities were free to decide which academics' work to submit, and had to balance submitting a large number, thereby increasing a driving factor in the funding formula, against the risk of lowering the grade if too many were submitted whose research was not strong. As a consequence, the REF was not an ideal way to compare the overall research strengths of different Departments. The RAE was reformed over the years to deal with this and various other real and perceived weaknesses (see https://en.wikipedia.org/wiki/Research_Assessment_Exercise). It was replaced by the Research Excellence Framework in 2014.

[11] As well as plans that were realised, FoOP describes others (some competing) that were under consideration, which were discussed in a series of open meetings. Citing a question raised by a character in a play by Georges Courteline (1858-1929): "Pourquoi irai-je payer un parapluie quinze francs quand je peux avoir un bock pour deux sous?", FoOP gave arguments why simple-minded comparisons, which were often used to allocate funding between different sciences, treated physics unjustly.

was not until much later that the then Chairman (John Wheater) proposed that the title Chairman of Physics should be replaced by Head of the Department of Physics, which the University agreed with effect from 1 October 2013[12].

In September 1992 I was elected to replace Carlo Rubbia as Director General of CERN, starting on 1 January 1994. I decided to resign as Chairman of Physics, and spend the calendar year 1993 on sabbatical at CERN. I liked to say that being Chairman of Physics had made me an expert in management according to Niels Bohr's definition that an expert in a given field is someone who has made every possible mistake, and it was time to leave before I fell foul of Wolfgang Pauli's more stringent definition that a real expert only makes each mistake once. Being Chairman of Physics taught me that wide consultation breeds consent and leads to better outcomes. Although I did not have time to practise what I learned was called 'Management by Walking About' to the extent I would have liked, this lesson stood me in good stead as DG of CERN.

[12] The three Oxford Chemistry Departments, Physical (which had earlier subsumed Theoretical), Inorganic, and Organic, took a step down the path followed by Physics in 1997 when Graham Richards was appointed Chairman of what remained three essentially autonomous sub-departments. In 2006 he was followed in the same role by Steve Davies. In 2011 when Tim Softley replaced Steve, the title miraculously, without consultation, changed to Head of Chemistry, but nothing else changed. To date there has not been a full merger: Chemistry still has Heads of now 4 sub-departments of Organic, Physical and Theoretical, Inorganic, and Crystallography.