



*Thirty Years  
of Astronomy at Sussex*

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This is a slightly revised account of a seminar given on  
Friday December 15<sup>th</sup> 1995

## *Introduction*

October 1995 was the thirtieth anniversary of the start of astronomy at the University of Sussex. With the agreement of my colleagues, I organised a series of seminars to celebrate this anniversary. The first six seminars were given by former students who obtained doctorates in the Astronomy Centre; one from each period of five years since the start. What follows is a slightly revised version of the final seminar<sup>1</sup>.

Autumn 1995 was a good time to be celebrating astronomy at Sussex. Most of those who have been involved with the Centre during the past 30 years are still alive and it was not difficult to provide a comprehensive account of its development. In the past year four of our former students, including two of the speakers in the seminar series were appointed or promoted to professorships or posts of professorial status in the United Kingdom. The Astronomy Centre has clearly come of age.

The Astronomy Centre must now take strength from its successful past to face the challenges of a demanding future. Inside the University there is the impending regrouping of subjects in the School of Chemistry, Physics and Environmental Science. Outside the University there is an increasing number of astronomy groups competing for a decreasing quantity of research funds.

There is one thing which I did not mention in my lecture but which should not go unsaid. What has made being a member of the Astronomy Centre so enjoyable and rewarding has been the fact that my colleagues have been such reliable and thoroughly nice people. I could not have hoped to work in a happier environment.

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<sup>1</sup> This particular version was prepared in June 2007 by Robert Smith by scanning the 1996 document, which no longer existed in electronic form. The formatting is not identical, but no updating has been attempted; some minor typographical errors have been corrected.

## *Prehistory and personal recollections*

In 1960 I was working for the United Kingdom Atomic Energy Authority at Harwell and Fred Hoyle and Leon Mestel were trying to persuade me to return to Cambridge and to astronomy. Eventually I applied for a lectureship in applied mathematics which I did not get (Dennis Sciama was appointed), but Fred Hoyle obtained a six year grant from the Department of Scientific and Industrial Research (DSIR, predecessor of current research councils), which would support me as a senior research assistant. One thing that he said to me while trying to persuade me to join him was "There is probably going to be a National Institute of Theoretical Astronomy at Cambridge and you will be well placed if you are already here." Luckily I did not take this remark very seriously.

Although I did not know it at that time, there had for some years been a discussion about having such an Institute. Britain had been strong in theoretical astronomy (astrophysics) since the subject came into being. In the 1920s and the 1930s the names of Eddington, Jeans, Milne, Chandrasekhar, McCrea, McVittie, Cowling and later Hoyle and Lyttleton made the UK pre-eminent in the field. After the second world war, the growth of the new astronomies such as radio astronomy and space astronomy made astronomy, both nationally and internationally, a very much larger subject<sup>2</sup>. It also caused UK astronomers to ask whether they could retain their position in theoretical astronomy.

The cause for concern was that, with few exceptions, the UK theoretical astronomers were in mathematics departments. They were employed to teach and administer mathematics, but they chose to research in astronomy<sup>3</sup>. A university looking for a new professor of mathematics had no obvious reason to choose an astronomer. Indeed in Oxford in the 1950s, when Milne died and Chapman (who was primarily a geophysicist but who also had astronomical interests) retired, they were replaced by distinguished scientists who had no interest in astronomy. In addition even if departments did appoint astronomers, they might find that teaching and administration left them little time for research. It was against this background that plans were made for a National Institute of Theoretical Astronomy to safeguard and enhance the UK position in the field. The University of Cambridge was offered the Institute but turned it down. I was too junior to be involved in the discussions and I can only speculate about the reason. I suspect that the proposal was that the DSIR would set up and fund the whole institute initially but that Cambridge would gradually have to take it over and that the university was not prepared to see so much of its income going into theoretical astronomy. At this time the University of Sussex had just opened and, as the Royal Greenwich Observatory at Herstmonceux was quite near and was soon to get the Isaac Newton Telescope, it was decided that Sussex should be the next choice. The University of Sussex accepted with enthusiasm and in 1962 it was announced that the National Institute of Theoretical Astronomy would be at

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<sup>2</sup> In 1939 there were just five professors of astronomy in the UK at Cambridge (2), Oxford, Edinburgh and Glasgow plus the Astronomer Royal and some professors of mathematics researching in astronomy.

<sup>3</sup> From 1936 to 1966 Bill McCrea successively headed departments of Mathematics at Queens University Belfast and Royal Holloway College and Leon Mestel served a term as head of the mathematics department at Manchester.

Sussex. I can remember Leon Mestel and I wondering at the time whether that would be where our future would lie.

In October 1964 I heard that Sussex was about to put its definitive proposals for the Institute to the DSIR, with the expectation that the Institute would get under way the following year. I have since seen the detailed proposals which envisaged a gradual build up to 12 faculty members, mainly of the status of senior lecturer and above. Only a few days later at Cambridge, Fred Hoyle said to me "We have got to have an Institute in Cambridge" whether or not there was also one in Sussex. Again I was not privy to what went on in the next few months. I do remember Fred having a letter of support from a Conservative minister, which became irrelevant because there was a general election won by Labour. I can also remember headlines in national papers saying that a leading astronomer is threatening to emigrate, if he is not properly supported.

Whatever happened behind the scenes, Sussex lost the National Institute. I have some correspondence of the first Vice-Chancellor, Lord Fulton, with Sir Harry Melville, Secretary of the DSIR, and Lord Bowden, Minister of Technology, from which it is clear that the DSIR, The Ministry and the University of Cambridge wished to retain Hoyle in the UK. Harold Wilson's aim to build up UK science and technology probably had something to do with this. As a result Cambridge gained not a National Institute but an Institute of Theoretical Astronomy specific to Fred Hoyle. The DSIR felt bad about what had happened and the University of Sussex was promised a grant for a much smaller research group in theoretical astronomy, provided the university created its own chair of astronomy.

### *The start of astronomy at Sussex*

Professor McCrea agreed to move to Sussex to head the research group in theoretical astronomy and he arrived part-time in January 1966 and full-time later that year. By that time the DSIR had been succeeded by the Science Research Council, which had also taken over the Royal Greenwich Observatory, which had previously been run by the Admiralty. January 1996 will not however be the thirtieth anniversary of the start of astronomy at Sussex. That was in this past October because it was then that a formal collaboration started between Sussex and the Royal Greenwich Observatory, which lasted almost 25 years until the RGO moved to Cambridge in 1990. In October 1965 the Astronomer Royal, Sir Richard Woolley, was appointed a visiting professor at Sussex and Drs Donald Lynden-Bell and Bernard Pagel visiting readers. The first full-time research student was admitted with an SRC studentship – a Sussex graduate Derek Fawell supervised by Bernard Pagel. At the same time it was arranged that members of the RGO staff, who did not already have higher degrees, could study part-time for Sussex degrees. This was very strongly encouraged by Woolley. One of the first part-time DPhil students was Michael Penston, who had already done one year under my supervision in Cambridge but who moved to Herstmonceux when Lynden-Bell moved there from Cambridge.

The MSc course also started in 1965. There were no full-time students, all of those attending being part-time students from the RGO. The original course was planned by visiting faculty and by faculty members in Mathematics and Physics at

Sussex such as Roger Blin-Stoyle, Douglas Brewer, Ken Smith and Gilford Ward. At that time there were two lecturers in mathematics, Frank Clifford and Michael Cummings, who had doctorates in astronomy. Although the basic astronomy teaching was given by RGO staff, all of the lectures took place at Sussex, the faculty and students coming over for the occasion. Because there were not initially enough astronomy lectures for a full MSc course, students also had to select some physics or mathematics postgraduate courses and in this first year the physics MSc external examiner also dealt with the astronomy MSc.

Almost exactly thirty years ago in December 1965 the University advertised its own chair of astronomy in fulfilment of its agreement with DSIR/SRC, the chair to be occupied in October 1966 or as soon after as possible. I was appointed to the chair informally in April 1966 and formally by Senate and Council in June 1966. I did not take up the chair until April 1967, because of existing commitments at Cambridge, but from May 1966 I was fully involved in the planning of the development of astronomy at Sussex and was in constant touch with Bill McCrea. As a result everything that I mention later is from direct personal knowledge.

From the academic year 1966-67 astronomy at Sussex was fully operational. The SRC was very positive in its attitude to the group and was initially generous in its allocation of advanced course and research studentships. Ian Roxburgh joined the research group as a reader in October 1966 but he only stayed one year because he was then appointed Professor of Applied Mathematics at Queen Mary College, London. The first intake of full-time MSc students included the well-known author and current visiting fellow in the Astronomy Centre, John Gribbin, while the full-time DPhil students who started in 1966 included David Moss, now a reader in mathematics at Manchester, and Bob Carswell, now at the Institute of Astronomy at Cambridge, who gave the first seminar in our celebratory series.

### *Early developments*

I shall not continue such a detailed account of the history of Sussex astronomy but will give a review of its development pointing out particular highlights and difficulties. The initial SRC grant lasted from 1966 to 1970. At that stage one member of the research group (which then numbered three), Dr J Hazlehurst, was taken on to the university staff as a reader. He joined me as the second astronomer in an established post on general university funds. The grant was extended at a reduced rate until 1972 with the understanding that at least the professorship would then be taken over. Funds for the second chair were provided in the quinquennial grant for 1972-77 from the University Grants Committee. The takeover preceded Professor McCrea's retirement by two months and Martin Rees was then appointed as the University's second professor of astronomy and Robert Smith, who had been in the research group since 1968, became (initially) a temporary lecturer. At this point in my account I should pay tribute to Roger Blin-Stoyle. Research Council rules do not allow anyone to be employed on their own research grants. As a result Roger Blin-Stoyle was the holder of the grant which employed Bill McCrea and his group. He took this seriously and when I came to Sussex I found him an extremely supportive Dean of the School of Mathematical and Physical Sciences.

In 1968/69 the astronomers at Sussex, or more accurately they and the physicists and engineers, had a great disappointment. The then chairman of the SRC (Brian Flowers, now Lord Flowers) decided that, if astronomers were to expect to receive a large amount of public money for new optical telescopes, they ought to pay more attention to their instrumentation. At that time optical astronomers were only just escaping out of the photographic plate era and were taking photoelectric devices seriously. I remember Roger Blin-Stoyle, who sat on the SRC Royal Greenwich Observatory Committee, contrasting the expenditure on instrumentation by astronomers with that by particle physicists. Flowers thought that there should be an astronomical instrumentation centre and that, because of the nearness of the RGO, Sussex would be the best place for it. He encouraged Sussex to put in a grant application.

Douglas Brewer put in a large amount of work and it was agreed that Alec Boksenberg (then at UC London but much later Director of the RGO) should head the group. The application was submitted by Brewer and Dick Grimsdale from engineering. Unfortunately SRC committees, which award grants, do not have to take notice of their chairman and the grant was not awarded. Sir Richard Woolley was not in favour and that ensured the result. I think that this was the only occasion when he did not give what we would have regarded as full support to our collaboration. I shall have more to say about chairmen of the SRC/SERC later. I think that there were probably several factors involved in the rejection of the grant. Although Woolley was not in the forefront of instrumental development, he probably felt that if the work had to be done it should be at Herstmonceux. At the same time plans were being laid for a new Northern Hemisphere Observatory (ultimately on La Palma) and there were those who thought that should be run from a third centre independent of the RGO and the Royal Observatory Edinburgh. Any funds which might have come to Sussex would have been needed for the new centre.

In 1970 Sussex really made its mark on the international astronomical scene because in August of that year the International Astronomical Union held its General Assembly in Brighton and at the University. The IAU holds such a General Assembly every three years and, when I arrived at Sussex in 1967, I discovered that the Royal Society, on behalf of UK astronomers and with the agreement of the University, the RGO and the Borough of Brighton, had offered to host the 1970 meeting. This dominated my life for much of my first three years at Sussex and particularly the final one<sup>4</sup>. I was a member of the National Organising Committee chaired by Sir Bernard Lovell, chairman of the Finance and Policy Committee and deputy chairman of the Local Organising Committee, chaired by Dr Donald Sadler of the RGO. The Registrar, Ted Shields, was also a full and active member of the Local Organising Committee. With an attendance including guests of 2300, it was the largest IAU at that time; it still is unless it was exceeded by the attendance at The Hague in 1994. The meeting was a great success both scientifically and socially and we ended with a surplus of £800 or about 7/- (seven shillings) per participant.

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<sup>4</sup> It is very difficult to see how such a thing could happen now with the pressures of research selectivity exercises and funding in general.

Much later astronomy at Sussex was on the international astronomical map again when Leon Mestel, John Barrow and Peter Thomas organised the 15th Texas Symposium on Relativistic Astrophysics (which was joint with the 4th ESO/CERN Symposium) at the Brighton Centre in December 1990. On this occasion there were over 500 participants.

### *Support for theoretical astronomy*

From 1972 onwards the Astronomy Centre had no special relationship with the SRC although it was free to apply for research grants like any other astronomy group. The Institute of Theoretical Astronomy at Cambridge also ceased to have automatic SRC support at the same time and the University of Cambridge decided that its best future lay in a new Institute of Astronomy including also the Observatories, whose Director, Professor R O Redman, retired in 1972. The loss of independence for IOTA did not please Fred Hoyle and, following the appointment of Donald Lynden-Bell to succeed Redman, he resigned his chair and retreated to the Lake District. His resignation had several repercussions. Margaret Burbidge, who had been chosen to succeed Woolley as Director of the RGO but who did not arrive until 1972, only stayed one year and then returned to the USA and Martin Rees was appointed to succeed Hoyle at Cambridge. In a very short period Sussex lost Burbidge and Lynden-Bell as visiting professors as well as Rees as an ordinary professor. The loss of Rees was rapidly made good with the appointment of Leon Mestel to succeed him in October 1973<sup>5</sup>.

The loss of the special SRC grants to the Institute of Theoretical Astronomy and to Sussex caused some concern to theoretical astronomers. There never had been a National Institute of Theoretical Astronomy and now we were back to the position that we were in earlier, except that there had been some expansion in the overall funds available to astronomy. In 1972, after consultation with some other theoretical colleagues, Dennis Sciama (who had moved from Cambridge to Oxford some time earlier) and I, who were the two theoretical astronomers who were at that time on SRC committees, put forward a proposal that there should be some assured sum for theoretical astronomy which would provide research assistant support for a few strong groups. There should also be an opportunity for theoreticians from outside the groups with guaranteed support to apply for grants.

Our papers were adopted by the Astronomy Policy and Grants Committee and by the Astronomy Space and Radio Board of SRC and in 1973 block grants were awarded to Cambridge, Oxford and Sussex. We have had substantial support from SRC (SERC, PPARC) ever since. The grants subsequently became rolling grants awarded for four years but reviewed every two years. The overall position did not change until the late 1980s, except that at some stage Oxford lost its rolling grant and was replaced by QMC London. Then another SERC chairman,

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<sup>5</sup> Rees heard of his appointment to Cambridge on the last Monday of the autumn term of 1972. On the Tuesday I persuaded him to hand in his resignation to the Vice-Chancellor, Asa Briggs (now Lord Briggs), and I then asked the Vice-Chancellor to set up an appointing committee for his successor at Senate the next day. To this he agreed and the post was advertised and applications were being considered by the beginning of the next term. At this stage a less good than expected UGC grant caused some colleagues to ask whether the agreement to refill the chair had been over-hasty.

Bill Mitchell (now Sir William), enunciated the view that there should be more rolling grants (not specifically in astronomy), so that groups had more assured support and could plan their research better. As a result the division between those groups with and without rolling grants became less clear. In addition competition for funds became more severe.

### *Observational astronomy at Sussex*

When the Astronomy Centre was set up it was entirely composed of theoretical astronomers at the senior level. I have already explained that it grew out of plans for an Institute of Theoretical Astronomy and it was meant to complement the RGO, which was largely composed of observers and instrumentalists. From the outset it was possible to have students doing observational doctorates, because they were supervised by visiting faculty from the RGO. Initially Woolley and Pagel were the supervisors but more visiting faculty members were appointed as time went on. In addition some MSc students also did observational projects supervised by RGO staff members. In the mid 1970s there was another development. Applications were made for grants to support observational research fellows jointly by a Sussex staff member and a visiting faculty member. We had a succession of very able postdocs; the first, Andrew Wilson, is now a Professor at Maryland and the last was Andrew Collier Cameron, who only left us at the end of 1994. One of the more bizarre events in this collaboration was when I put in a grant application in which I referred to the successful work by our past postdocs. I was told off by the SRC committee for dropping names; our contribution to their training and success apparently counted for nothing.

In 1978 another chairman of the SRC (Geoffrey (later Sir Geoffrey) Allen) had an idea. He summoned the director of the RGO (Professor Graham Smith, now Sir Francis) and the Vice-Chancellor of Sussex (Sir Denys Wilkinson) to a meeting at which he expressed his concern that the UK was in the process of spending a large amount of money on optical telescopes but that there were virtually no professors of astronomy in the UK in this field. He said that he thought that the SRC would probably finance one or more such professorships for a number of years provided that the universities concerned eventually took them over. He thought that Sussex would be an ideal place for such a professor. The Vice-Chancellor was enthusiastic in principle but said that the School of Mathematical and Physical Sciences would have to give its support by putting such a post high on its future priority list. On this occasion it was not an SRC committee that finished off the project. In May 1979 the MAPS School Meeting voted by a large majority that it could not support the proposal. Considering the number of posts which mathematics and physics had to lose in the next few years, when the 1980s cuts came, the result was not really surprising. It was in fact Cardiff that immediately got an SRC funded professorship.

### *Astronomy Centre Staffing*

Throughout its history the Astronomy Centre has been struggling to have enough faculty members to be fully viable. The help from RGO staff was crucial in the early years. As long ago as 1969, when the end of initial SRC support was in sight, the University Planning Committee set up a working party to consider the



future of the Astronomy Centre. The working party took external advice and concluded that astronomy had made a good start at Sussex and that five faculty members were needed for viability. At the time the additional faculty members could not have been justified by the teaching needs in astronomy. I argued that we should get additional appointments in return for teaching mathematics and physics. Unfortunately these subjects were deemed to be overstaffed and they made essentially no new appointments until the 1980s.

In fact to date there have only been two periods when five faculty members have been paid out of university funds (1989-92 and autumn 1994) but in each of these cases one faculty member has been early retired and on one third pay. In July 1974, when I became Dean of the School of Mathematical and Physical Sciences, I said that I could not do the job unless astronomy had a temporary lecturer. This was accepted by the Vice-Chancellor, Asa Briggs. As a result we had a temporary lecturer for 5 years. The temporary lectureship was extended when Leon Mestel had a year's unpaid leave in 1979-80 and again when Leon obtained an SRC Senior Fellowship for 1980-85. When the latter occurred, I renewed my attempts to obtain a permanent lectureship and was successful for 1981. It was then that John Barrow joined us. We now had four permanent faculty members in astronomy for the first time, although it would be four years before there were four actually paid by the University, when Leon's senior fellowship ended. John's arrival changed the balance of the Centre. Leon, Robert and I were all stellar astronomers by training, although we had branched out somewhat; for example I had done cosmology and Leon had worked on quasars. John was very much an early Universe cosmologist with links to particle physics.

### *The move of the RGO*

The next important development occurred in 1984; much more important than would have been imagined at the time. Robert Smith decided to devote some of his research time to observational astronomy. He decided that with modern instrumentation it was not necessary for an observer to understand the insides of all the devices he used. It would be quite possible for him to observe binary stars in whose theoretical properties he was already interested. He rapidly became accepted as an observer and had students working on observational doctorates.

His decision proved to be very important because also in 1984 another chairman of SRC (or was it SERC by then?) decided that he was unhappy with the Royal Observatories and he set up a committee to look into their future. This was not the first such committee; nor was it to be the last as several more such committees have been at work in the past year or two. The impression that the outsider got was that Sir John Kingman would have liked to move the RGO to Edinburgh and to amalgamate it with the ROE. Bill McCrea, who was on the Kingman Committee and who tried to make a minority report objecting to the committee's conclusions, could no doubt provide more accurate information. When the committee reported another Chairman was in place (Bill Mitchell). The SERC Council decided that the RGO had to move and a number of universities were asked to put in bids for it to be associated with them.

This was awkward because those of us who saw no reason for the RGO to move from Herstmonceux had to put in bids because, if it had to move, we would like it. In the upshot a Sussex bid got nowhere and Cambridge, Edinburgh and Manchester were short-listed. Eventually the decision was taken to move the RGO to Cambridge and it moved in 1990. Obviously we were very sorry to see the end of a collaboration that had lasted 25 years. What hurt us as much as the loss of the RGO was an off-the-cuff remark from Bill Mitchell that nothing much had come out of the Sussex/RGO collaboration. This was patently untrue. It was true that there were no joint papers authored by Mestel and Penston or Pagel and Tayler (say), but the productivity of the research students and research fellows involved in the collaboration and their subsequent positions demonstrated the falsity of Mitchell's remark. When I gave a memorial address for Michael Penston, I stated that his contributions to the collaboration alone were enough to justify it. In fact the greatest contribution was that of Bernard Pagel who gave many lecture courses, supervised MSc and DPhil students and research fellows and shared his encyclopaedic knowledge of astronomy with us. Bernard is still a visiting professor although he has a full-time appointment as a professor at NORDITA in Copenhagen.

### *Recent developments*

It was at the time of the move of the RGO that Robert Smith's decision to move into observational astronomy was so important. We had a foot hold in observational astronomy with or without the RGO. The SERC felt a bit guilty about what it had done to Sussex and Mitchell hinted that an application for a STARLINK node and additional support for observers would be forthcoming if the University made clear its continuing support. I persuaded the Vice-Chancellor (Sir Leslie Fielding) and the Planning Committee to provide an additional lectureship in observational astronomy, provided four years initial support for the post was provided by SERC. As a result, Andrew Collier Cameron was appointed to a lectureship early in 1990. As he was in his first year of a five year SERC advanced fellowship, he did not come on to the payroll until October 1994 and he left us to take up a readership at St Andrews at the end of December 1994.

This historical account is almost up to date. In 1988 Leon Mestel agreed to take early retirement and part-time re-employment with the condition that he could be replaced immediately and Peter Thomas took up that post in 1989. I also took early retirement and part-time re-employment for 18 months in March 1994 but on this occasion we were only allowed to appoint someone who would not come on the payroll immediately. Andrew Liddle, who was already here as a Royal Society Research Fellow, will hold that fellowship until October 1998. After a long battle in 1995, we were finally allowed to appoint an observer to replace Andrew Collier Cameron and Carole Haswell will be arriving in February 1996. We have two temporary lecturers at present; Paul Roche replaces John Barrow who is a PPARC Senior Fellow for 1994-99, and Pierre Maxted replaces Peter Thomas, who holds a Nuffield Fellowship for one year. As a result of all of these changes we have a vigorous largely observational group working mainly on binary stars and an emphasis on large scale structure and cosmology amongst the theoreticians.

In my chronological account I missed out one important item. When I was first at Sussex, the Astronomy Centre was primarily a research grouping and I was the only person paid to teach; of course the research faculty did do some teaching. As such I was a member of the Physics Subject Group. In 1972, when we had three university teaching faculty, we became an independent subject group and we remained that until 1989. At that time there was a perception that small subject groups were a bad thing and we were amalgamated with Physics to form a Physics and Astronomy Subject Group. On balance I think that has been to our advantage even though astronomy has lost its guaranteed voice in the university. One positive point is that three physics faculty members are also regarded as members of the Astronomy Centre; Ed Copeland and Mark Hindmarsh with cosmological/particle physics interests and Richard Rijnbeek in space physics. With the impending school amalgamation with Chemistry, Environmental Science and Physical Geography, we shall certainly try to welcome at least Professor Sir Harry Kroto into the Astronomy Centre; he has been involved in the discovery of several interstellar molecules as well as  $C_{60}$ , which might be important in interstellar space.

### *Astronomy Teaching*

I have so far said very little about the development of astronomy teaching. Initially we taught one third year option course in Stellar Structure, which was available to all students in the School and which was extremely popular. I, as the only teaching faculty member, also supervised third year projects in astronomy for physicists. In 1973 we introduced an undergraduate course called Physics with Mathematics and Astronomy, which had three third year courses in astronomy and a third year project in astronomy. Soon afterwards we introduced a parallel course in Mathematics with Physics and Astronomy, but that was short-lived because of lack of demand. We were in the forefront in England (but not in Scotland) in introducing astronomy into physics degrees. I had very high ideals at that stage arguing that it was not possible to study serious astronomy until the third year because of the amount of physics and mathematics that the students needed to learn first.

This proved not to be the view of our rivals, who started introducing astronomy options in increasing numbers. Nor was it the view of all of my colleagues and as time passed astronomy was introduced first into the second year and then into the first year. The title of the course was also changed to Physics with Astrophysics, which was thought to be a more attractive and also more accurate description. Physics departments all over the country have found that, in order to attract anything like the number of students that they want, they have to have an astronomy option. Many of them are now departments of physics and astronomy. At Sussex in the last few years, Physics with Astrophysics has been the most popular course for undergraduate physicists. The astronomy faculty now find themselves in a rather strange position. If we were still an independent subject group, our full-time equivalent undergraduates and postgraduates would probably earn us three faculty members rather than the four who will be on the pay roll in February and the five there should be by 1998. On the other hand, if we were not here, physics would lose all the astronomy undergraduates and that would make them vulnerable to more faculty losses. The marriage of physics and astronomy

works. Of course the astronomy faculty have to do some teaching and administration in physics to make up their full load.

The MSc course now has its thirtieth full-time intake and our tenth external examiner is now in his first year. It is widely acknowledged in the UK astronomical community, although not universally so, that it has been a great success. We have had an average intake of about 9 students a year over the thirty years. We had our maximum research council support in the late 70s and early 80s but suffered a significant cut about ten years ago; this was not personal to us but represented a reaction against advanced courses. There is a threat in the PPARC forward plan that its support of advanced courses will be reduced further. I hope that the MSc course will survive but we cannot be complacent and any significant reduction in class size would make it unviable. It is quite remarkable how frequently our former MSc students tell me what a good start in an astronomical career has been provided by our course.

We have always prided ourselves that the Astronomy Centre has not been inbred. Only a small minority of our MSc and DPhil students have had Sussex first degrees. In addition most of our MSc students who have gone on to do doctorates have done so at universities other than Sussex. Finally most of our research fellows have done their doctorates elsewhere. For the first time this year we have a faculty member who was previously at Sussex, as Pierre Maxted was an undergraduate here; however he took Mathematical Physics not Physics with Astrophysics. Our MSc course has provided an entrance into astronomy for students whose first degree result did not immediately permit them to carry on to doctorates. We regard this as one of the main contributions of the Astronomy Centre. In 1995 two such former students were appointed to professorships and another to a post of professorial status.

### *Research*

I cannot attempt to discuss what research has been carried out in the Astronomy Centre in the past 30 years. Each year we publish an Annual Report of the Astronomy Centre in the *Quarterly Journal of the Royal Astronomical Society* and this occupies about ten pages. The average annual number of publications by members of the Centre in the five years 1990 to 1994 has been 66. It does not make sense to add up all of the sums spent from research grants in the last thirty years because a 1965 pound is very different from a 1995 pound. All that can be said is that the actual expenditure from research grants has been in excess of a million pounds and that in constant 1995 pounds this would convert to several or many millions of pounds. Research grants which are currently in place including those supporting faculty members on personal fellowships exceed a million pounds.

Apart from these few comments I will just list some topics upon which active research has been carried out in the past few years:

Cosmology, the early Universe, relation to particle physics, phase transitions and defects, inflation, gravitational waves, primordial density perturbations black holes, the cosmic microwave radiation;

Gravitation theories, generalisations of general relativity, scalar-tensor theories;

The large scale structure of the Universe, formation and clustering of galaxies and galaxy clusters, determination of basic cosmological parameters, Hubble's constant, density parameter, cosmological constant;

Galactic structure and evolution, the chemical evolution of galaxies;

Cosmic magnetism, star formation, pulsars, magnetic stars;

Solar-stellar connection, stellar activity;

Non-spherical stars, rotating, magnetic, close binaries, cataclysmic variable stars, contact binary stars.

### *The future*

I hope the next thirty years will be as successful as I hope that I have demonstrated the last thirty years have been. The tables which follow contain more detailed information about the Astronomy Centre and its members. I believe that they indicate an extremely good record for a group with a very small number of permanent faculty members. In looking to the future it has to be recognised that there have been some very big changes since the Astronomy Centre was set up. There was initially a significant expansion in the resources available to astronomy and an increase in the number and size of the departments working in astronomy. The latter point has been influenced by the need already mentioned for physics departments to obtain students. Resources from both the research council and the funding council are probably declining in real terms, with more groups competing for research council funds. Despite our success that I have described, we have not obtained high grades in research selectivity exercises either separately as astronomy or combined with physics.

In the past few years new professorships of astronomy have been created or old ones unfrozen at universities such as Edinburgh, St Andrews, Bristol, Leeds and Imperial College. Some groups which are amongst the strongest in UK astronomy have grown from nothing or essentially nothing in the past thirty years; these include the mainly observational group at Durham and the theoretical group at Queen Mary and Westfield College. Twenty years ago I would have expected to be replaced by a professor when I retired. At that time there were two established chairs of astronomy at Sussex but subsequently without a formal decision ever being taken, Sussex ceased to have established chairs in any subject. I can see how that happened and I appreciate that it would have been unreasonable to expect a chair now. However, the Sussex group is small. In the past it overcame this weakness by a concentration on senior posts and through its collaboration with the RGO. Some action may now be necessary to ensure that the Astronomy Centre continues to be recognised as a strong group.

Table 1

Programme of Seminars to celebrate the Thirtieth Anniversary

October 20	R F Carswell (1970) Element abundances at high redshift
October 27	S A E G Falle (1973) Detonation waves in Type I supernovae
November 3	J R Lucey (1981) New results from galaxy peculiar velocity studies
November 17	M J Ward (1979) First half century of quasar/active galactic nuclei research
November 24	P Coles (1988) Large-scale structure without N-body simulations
December 1	Y C Unruh (1995) Activity on solar-type stars
December 15	R J Tayler Astronomy at Sussex 1965-1995

In the case of the first six speakers, the date in brackets is the date of receipt of the DPhil.

## Table 2

### Permanent Faculty Members in Astronomy 1966-96

Professor W H McCrea	1966-72	(retired, Sir William January 1985)
Dr I W Roxburgh	1966-67	(professor of mathematics, QMW London)
Professor R J Tayler	1967-95	(retired)
Dr J Hazlehurst	(1967) 1970- 73	(professor of astronomy, Hamburg)
Professor M J Rees	1972-73	(Royal Society professor of astronomy, Cambridge, Sir Martin, Astronomer Royal)
Dr R C Smith	(1968) 1973-date	
Professor L Mestel	1973-92	(retired)
Dr J D Barrow	1981-date	(professor 1989)
Dr P A Thomas	1989-date	
Dr A C Cameron	(1987) 1990-94	(reader in astronomy, St Andrews)
Dr A R Liddle	(1989) 1994-date	
Dr C Haswell	from 1996 February	

Where dates are given in brackets, the faculty member was at Sussex as a research fellow before being appointed to the permanent faculty.

### Table 3

#### Temporary Teaching Faculty in Astronomy

Dr J C Jackson	1968-70	(reader in mathematics, Northumbria)
Dr R C Smith	1972-73	(at Sussex)
Dr N J Holloway	1974-80	(group leader UKAEA)
Dr J A Robertson	1980-81	
Dr R M Smith	1986-87	(Starlink Manager, Cardiff)
Dr F A Mellor	1992-93	(lecturer, science in context, West of England)
Dr P D Roche	1994-date	
Dr P F L Maxted	1995-date	

All except the first two were replacements for permanent faculty temporarily holding other posts or fellowships.

### Table 4

#### Astronomy Centre Secretaries

Miss Shirley Ansell	1966-67
Mrs Pearline Daniels	1967-70
Mrs Hazel R Freeman	1970-80
Mrs Julia Gilham	1980-83
Mrs Hazel Bisping	1983-84
Mrs Margaret Hall	1985
Mrs Pauline Hinton	1985-date

Miss Ansell was Professor McCrea's secretary from 1966-1970 and looked after the Astronomy Centre in its earliest stages.



## Table 5

### Visiting faculty members from the Royal Greenwich Observatory

#### Visiting Professors

E M Burbidge  
A Boksenberg  
F Graham Smith (later Sir Francis)  
D Lynden-Bell  
B E J Pagel  
Sir Richard Woolley

#### Visiting Readers

R J Dickens  
C A Murray  
M V Penston  
J V Wall

#### Visiting Lecturers

R G Bingham  
R A E Fosbury  
D H P Jones  
M Pettini  
K Taylor  
E Terlevich  
R J Terlevich

If the faculty member served in more than one grade, the final one is shown. Visiting faculty members successfully supervised 40 DPhil students and they and other RGO staff successfully supervised 73 MSc students.

## Table 6

### Honours and Awards of members of Astronomy Centre

1976	W H McCrea	Gold Medal RAS
1977	L Mestel	FRS
1985	W H McCrea	Knighthood
1990	R J Tayler	OBE
1993	L Mestel	Eddington Medal RAS
1995	R J Tayler	FRS

In addition many people closely associated with the development of astronomy at Sussex received honours and awards. Thus D Lynden-Bell, B E J Pagel and M J Rees all received the Gold Medal RAS and were elected FRS. Lynden-Bell also received the Eddington medal RAS and Rees was Knighted.

## Table 7

### Activities of Faculty Members outside Sussex

Research Councils Considerable representation on committees and panels of research councils

<u>RAS</u>	McCrea	Treasurer Foreign Correspondent
	Mestel	Council Member
	Smith	Council Member Managing Editor Quarterly Journal
	Tayler	Secretary Treasurer President Managing Editor Monthly Notices

### Observatory Magazine

Smith	Editor
Cameron	Editor

### International Astronomical Union

Mestel	President Commission 35 (Stellar Constitution)
Tayler	President Commission 35 (Stellar Constitution)

Invited Lectures Many invited lectures by members of faculty including Gifford Lectures on Religion and Science by Barrow and George Darwin Lecture RAS by Barrow and Tayler

Books Extremely successful books by Barrow – The Anthropic Cosmological Principle...The Artful Universe  
Textbooks by Smith, Tayler

The above is certainly not a comprehensive list of outside activities. It excludes for example many visits made overseas with Royal Society or other support particularly by McCrea.

## Table 8

### Higher Degrees in Astronomy awarded to date

DPhil	103
MPhil	1
MSc	247

This is a very large number of higher degrees for a group which has never had more than three or four full time teaching faculty members. It could not have been achieved without supervision of DPhil students by RGO staff (up to 1990) and supervision of MSc students by both RGO staff and research fellows. Nonetheless the small number of permanent faculty had the responsibility for organising the Astronomy Centre in which the work was carried out.

## Table 9

### In Memoriam

Three of our DPhils who already had distinguished careers in astronomy died tragically young. Their place of appointment at time of death is shown.

Dr C Cruz Gonzalez	(D) (Institute of Astronomy, Mexico City)
Dr M V Penston	(D) (RGO)
Dr J A J Whelan	(M, D) (IoA Cambridge)

Table 10

Former Postgraduates holding "Permanent" Posts in Astronomy or related subjects in the UK

In this and the following tables M denotes an MSc student and D a DPhil student. The information may not be 100 per cent up to date and accurate.

Dr M E Bailey	(M)	Director Armagh Observatory
Professor M J Barlow	(D)	UCL
Dr R F Carswell	(D)	IoA Cambridge
Dr M G Currie	(D)	DRAL Chilton
Dr P Coles	(D)	QMW
Dr J S B Dick	(D)	NERC Herstmonceux
Professor S A E G Falle	(M, D)	Leeds
Dr J R Lucey	(D)	Durham
Dr E M McCabe	(D)	Portsmouth
Dr C M N Moss	(D)	IoA Cambridge, Vatican Observatory
Dr D L Moss	(D)	Manchester
Mr L V Morrison	(M)	RGO
Professor J C B Papaloizou	(D)	QMW
Dr A J Penny	(M, D)	DRAL Chilton
Dr J M C Rawlings	(M)	UCL
Dr G T Rixon	(D)	RGO
Dr A Sansom	(D)	Central Lancashire
Dr J E F Skea	(D)	Aberdeen
Dr D J Stickland	(D)	DRAL Chilton
Dr C N Tadhunter	(D)	Sheffield
Dr K P Tritton	(D)	RGO
Mrs S B Tritton	(M)	ROE
Professor M J Ward	(M, D)	Leicester (from 1996 January)
Dr D Wands	(D)	Portsmouth (from 1996 January)

Table 11

Former Postgraduates with "Long-term" Astronomy Posts in the UK

Dr A J Allen	(M, D)	QMW
Dr D V Bowen	(D)	ROE
Dr P J F Brown	(M)	Belfast
Dr R J Dickens	(D)	Visiting Professor Bristol
Dr M D Gray	(D)	Bristol Royal Society Fellow
Dr R McD Johnstone	(D)	IoA Cambridge
Dr S N Kemp	(M)	Belfast
Dr N R Minchin	(M)	QMW
Dr J P D Mittaz	(M)	MSSL UCL
Dr S Phillipps	(M)	Bristol Royal Society Fellow
Dr W Saunders	(M)	Edinburgh Royal Society Fellow
Dr M G Watson	(M)	Leicester

## Table 12

### Former Postgraduates with “Permanent” or “Long-term” Posts Abroad

<u>Australia</u>	J A Bailey (D), J Bland-Hawthorn (D), I R Parry (M), R L Webster (M)
<u>Brazil</u>	A Schmidt (D), M R de G Maia (D)
<u>Canada</u>	H E Matthews (M)
<u>Germany</u>	A Mastichiadis (M), C M Sharp (M), A W Strong (M)
<u>Greece</u>	S Cotsakis (M, D), M Plionis (M, D)
<u>Iran</u>	N Riazi (M, D)
<u>Israel</u>	H Netzer (D) (Director or Former Director Wise Observatory)
<u>Mexico</u>	J M Echevarria Roman (D), A Gonzales (D), E Recillas-Cruz (M), A Serrano (D) (Director Institute of Astronomy), M M Tapia (M)
<u>Morocco</u>	K Chamcham (D)
<u>Netherlands</u>	R A E Fosbury (D) (ESTEC)
<u>Portugal</u>	M T V Lago (M, D), J P S Mimoso (D)
<u>South Africa</u>	A J Brickhill (D)
<u>Spain</u>	J Betancort-Rijo (D), V S Dhillon (D) (La Palma), A I Diaz (D), J A Femley (M) (ESA), K J Leech (D) (ESA), J Masegosa- Gallego (M), E Perez (D)
<u>Thailand</u>	K Muanwong (D), R Songsathaporn (M)
<u>Turkey</u>	Z Aslan (M, D), H Kirbiyik (M, D)
<u>USA</u>	C Aspin (M), C J Corbally (M), A C Danks (M), M Elvis (M), P A Hughes (M, D), C Kouveliotou (M), Li Jianke (D), L R Jones (M), D A Neufeld (M), A J Pickles (M), D H Smith (D), W B Sparks (M), J Tomkin (D)

### Table 13

#### "Media" or Public Understanding of Science Activities

A Evans	(M)	IOP Publishing
J V Field *	(M)	Science Museum
J R Gribbin	(M)	Freelance Science Writer
D Lindley	(D)	<i>Science Magazine</i>
T A Lyster	(M)	Deputy Editor <i>Sky and Telescope</i>
P Spence (Freeston)	(M)	Editor <i>Astronomy Now</i>
O M P Strimpel	(M)	Director Boston Science Museum

\* Now at Department of History of Art, Birkbeck College

### Table 14

#### Other employment of former postgraduates

First employers include UKAEA, CEGB, British Gas, Meteorological Office, British Antarctic Survey, Royal Aircraft Establishment, National Radiological Protection Board, GCHQ, Post Office, Royal Military College of Science and many posts in computing.

One former student, J M McNamara (M), is Professor of Statistics at Bristol.

Two others hold university posts in plasma physics, R Fitzpatrick (D) and K I Hopcraft (M).



Table 15

Research Fellows on Grants or Personal Fellowships

J A Adam	J Hazlehurst	A Schwarzenberg-Czerny
A J Allen	M A Hendry	R C Smith
D J Axon	H Hollingsworth	R M Smith
M E Bailey	P A Hughes	W B Sparks
M J Barlow	V Icke	J Stein-Schabes
N M Berman	M M Jardine	R J Stoneham
S P Bhavsar	C A Jones	K Subramanian
C P Blackman	A R Liddle	C-H Sung
J M Brett	J R Lucey	H Tadros
A C Cameron	J MacDonald	E Terlevich
C G Campbell	M S Madsen	S Tsuruta
R E S Clegg	F A Mellor	R Valdernini
P Coles	J A Morgan	D G Wands
V S Dhillon	L Moscardini	Y-M Wang
A C Edwards	P M Panagi	M J Ward
J A Eilek	J C B Papaloizou	C A Whyte
H J Falk	F R Pearce	A S Wilson
R P Fender	W D Pence	D B Wilson
J Frank	T P Ray	P R Wood
C S Frenk	I N Reid	J R Woods
D J Galloway	J A Robertson	M L Woolley
J Garcia-Bellido	B F Roukema	A E Wright
M A Garlick	M J Sarna	G A E Wright

There have also been a number of overseas fellows on fellowships from other sources. At least 50 of the 69 fellows listed still work in astronomy.