

EXTRACT FROM

A Personal History of the
Royal Greenwich Observatory
at Herstmonceux Castle
1948 – 1990

By George A. Wilkins

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6 END OF AN ERA – ALEC BOKSENBERG – 1981 TO 1990

6.1 A change in administrative style and policy

6.1.1 Changes in the senior administrative staff

Alexander Boksenberg formally became Director of the Observatory on Thursday, 1 October 1981, but his first day of duty at Herstmonceux was on Monday, 5 October. As a consequence my last act as Deputy Director was to welcome the Federation of Astronomical Societies on the Saturday morning at the start of its annual meeting over the weekend at the Castle. Boksenberg did come later that day, as did Patrick Moore. My recollection is that he told me on the Monday that he would not wish me (or anyone else) to hold the title of Deputy Director as he wished to appoint members of the senior staff to this position on an ad hoc basis whenever he expected to be away. I soon became glad that I no longer had this extra responsibility as I found myself in disagreement with the policies that he pursued. I continued, however, to make presentations to retiring staff from time to time!

Boksenberg, who was always referred to as Alec, rather than Alexander, was 44 years of age and had been Professor of Physics at University College London since 1978, the year in which he was elected a Fellow of the Royal Society. I knew little about him, except that he had developed a new instrument that was called an ‘image photon-counting system’ and known as an IPCS. He did not move to Herstmonceux with his family, but relied on the use of a small flat in the Castle when he was at the Observatory. He was, however, frequently abroad for observing and conferences and I understand that he returned home, rather than to the Castle, after meetings in the UK. (I understood that one of the reasons that he gave for not moving his family was that he considered that the rent for the apartment in the Castle was too high. He did, however, have teenage children and his wife may have been involved in many activities in London.) His wife attended the occasional function at the Castle, but I do not recall seeing his two children.

In 1984 Boksenberg obtained approval for the appointment of Dr Peter Davies as Secretary of the Observatory and Head of the Administration Division on transfer from the Swindon Office of SERC. He was an SPSO and so was senior to Bob Gordon who had previously held that title. Peter Davies resigned from SERC and left the RGO in January 1986. He was replaced by W E A (Tony) Davies from the Daresbury Laboratory, to which he returned after less than 2 years. In turn, he was replaced on 1 October 1987 by Bennet McInnes from the Royal Observatory Edinburgh.

Peter Davies wrote to Boksenberg on 28 June 1985 to explain his resignation and he sent copies of this letter to the Staff Side as well to Division Heads. In it he wrote:

“Over the last eighteen months I have become convinced that I no longer wish to have a career in SERC. I disagree with many attitudes and motivations that I meet. I feel strongly that the way SERC is organised, to be both a proxy customer for research and a major contractor to itself (in the Establishments), has lead [sic] to muddled thinking, unproductive conflicts and unwarranted interference.”

His criticisms of SERC appear to have been borne out by the way that it subsequently treated the RGO!

6.1.2 Other senior staff and the divisional structure

The divisional structure that had been introduced by Hunter was continued but with changes of title and constituent departments during the decade. I am not able to describe these changes as, unfortunately, there is a dearth of published reports during this decade. The Senior Staff Meeting became known as the Division Heads Committee and my recollection is that it met less frequently and that more decisions were taken without prior discussion by the Committee.

At the beginning of the decade Bill Goodsell was head of the La Palma Division and was in a higher grade than the other senior staff. Joe Paxton was head of Engineering, Richard Bingham was the acting head of Instrument Science, Jasper Wall was head of Astrophysics and Astrometry, I was head of Almanacs and Time, which then included the Computer Department, while Bob Gordon was the head of Administration. Other senior staff included John Pope, who was head of the Telescopes Department, and R P Milner, who was head of Civil Engineering. Bernard Pagel, Andrew Murray and Bob Dickens held Individual Merit grades. They did not, however, usually attend senior staff meetings. By this time the grade titles for scientific staff had been changed from SPSO and DCSO to grades 6 and 5, but the former are usually used here.

The 1985 report shows many changes in structure and in personnel. The Divisions were listed as follows.

Astronomy Support and Research, headed by Jasper Wall; this included the Computer Department as well as departments for various aspects of astronomy.

Facilities, headed by Mike Morris; this included instrument science, electronics and computing as well as La Palma Construction and Mechanical Engineering.

La Palma Operations, headed by Paul Murdin; this included a small Herstmonceux support team as well as about 40 staff members on the island. Murdin and Wall interchanged roles in April 1987.

Dynamical Astronomy and Space Geodesy, which was still usually known as Almanacs and Time (A&T) and of which I was the head. The Time Department, which was responsible for the satellite laser ranging system, is shown with only four members! This was smaller than the number of staff in Library and Archives. In the 1987 report the name has been changed to Almanacs, Space and Documentation (ASD).

Administration, headed by Peter Davies; this included 6 scientific staff in Scientific Administration.

6.1.3 Publicity and reports

Boksenberg placed a great deal of emphasis on publicity and what might now be called 'spin'. One of his early actions was to stop the production and publication of the annual report for 1980/1981. The style that Hunter had introduced in 1974, and which Bernard Yallop and I had followed in editing the report for 1979/1980, was not considered to be 'sexy' enough! (This was the first time that I had heard the word used

with such a connection.) Unfortunately, the next published report was not produced until the end of 1985 and was for the 5-year period 1980/1985. It is a high-quality production with a glossy illustrated cover; the editors were Paul Murdin and Jasper Wall. It contains interesting articles about selected aspects of the activities of the Observatory, but it ignores others. About one-third is devoted to the research in astrophysics and astrometry, rather more to telescopes and instrumentation, and the rest to the other activities and aspects of the RGO. It starts with a one-page diary of a representative selection of events at the RGO and on La Palma. It makes no attempt, however, to trace the overall development of the activities during the period; nor does it show the changes in the staff and structure. Unfortunately, the Royal Astronomical Society ceased to publish reports on the work of observatories in 1982.

The 1980/1985 report was preceded in 1983 by a 32-page ‘publicity brochure’ with the title *The Royal Greenwich Observatory to 1990*. This was primarily concerned with the RGO’s activities in providing telescope facilities for the new observatory on La Palma. The final short section on other programmes started with the statement that “The RGO will continue to devote a small fraction of its resources to the study of the dynamics of the solar system and to the application of astronomy to geodesy, navigation and civil life”. My copy indicates that my drafts for this section were drastically cut and changed. It was made clear that the costs of providing services to other Government departments and to the public would be recovered from charges.

Boksenberg attempted to replace the RGO Information Bulletin (which was circulated only within the RGO) after April 1982 by a magazine-style publication with a wider circulation. It was called *Gemini* in order to reflect its purpose of covering the activities at Herstmonceux and La Palma. Fortunately, it was soon realized that *Gemini* could not both meet the needs of the RGO staff and be of interest to astronomers and others outside the RGO and so a new un-numbered series of RGO Information Circulars was started immediately in May 1982.

Gemini was aimed at a wider readership and so gave greater detail about some of the activities and contained more and better illustrations than the bulletins. The first issue was for May 1982 and was edited by Margaret Penston. It contained articles on a wide variety of topics. One of them announced an “initiative, inspired by RGO’s new Director, Alec Boksenberg,” to start of a series of astronomical workshops as “part of a plan to exploit the potential offered by Herstmonceux Castle as a Visitor and Conference Centre for astronomy”. (See section 6.4.1.1) There was a special (un-numbered) issue of *Gemini* to record the Royal Inauguration of the international observatory on the Roque de los Muchachos on La Palma in June 1985.

The last issue of *Gemini* that I received before my retirement was issue no. 24 for June 1989. The last full opening includes photographs of some of the staff who had retired or resigned over the previous year. The last page illustrates the ‘farewell party’ that was held in the Castle in April, just before the hand-over to the developer who had bought the Castle and grounds. (See section 6.5.2)

There was also a series of *Not! Gemini* that contained humorous articles and drawings that often mocked the policies of the Director and SERC. There were 6 issues and the flavour can be judged from the articles on the first pages.

1. 1 April 1983. “Easter message from the Director”, Bosen G. Lacerberk.
2. Christmas 1983. “A Christmas message from your very own Director”, now Bob Greenslack.

3. Christmas 1984. "INT to return to Herstmonceux". (After which the telescope's building on La Palma was to be turned into a Conference Centre.)

4. January 1986. "Roque and Roll Extravaganza". (A take-off of the opening ceremony on La Palma with an appeal for "Looker's Aid" by Bob Gendenberg, astronomical impresario of the RGO.)

5. Summer '86 (12 pages). "Relocation of the RGO: Chairman's Statement", by the man who put the "er" in SERC.

6. 6 January 1989 (1 sheet only). "Secrets Case Continues". The back page announced "The RGO Share Offer" for selling off the RGO and the departure of the editor, Sue Dennim, who was generally assumed to be Chas Parker.

The RGO Information Circulars were replaced in November 1985 by a new series of RGO Information Bulletins that were in the same style apart from the use of large type for the section headings and the inclusion of more illustrations. Unfortunately, in an endeavour to make it more interesting, the new series no longer included the detailed lists of factual information, such as staff changes, visits and visitors, etc., although these were given (presumably) in the RGO Official Circulars. Bennet McInnes changed the policy in March 1988 when he introduced a new series known simply as *Reporter* to replace both the Circulars and the Bulletins. The Reporter was issued as single sheets, each containing a few numbered items about administrative matters only.

The next 'annual' report was for the 2-year period 1985 to 1987 and was similar in style to the previous 5-year report, but was much slimmer and contained reports on only a small selection of the activities. It made no attempt to give a general overview of the work, although it did give a list of the staff and lists of the departmental publications and of the scientific papers by individuals. Otherwise the only reference to the work of my division was a article about the 'satellite laser ranger'. My division was initially known as the 'Almanacs and Time Division', but Boksenberg did not consider that this was 'sexy' enough and so it became the 'Dynamical Astronomy and Space Geodesy Division' in the 1985 report and the more appropriate 'Almanacs, Space and Documentation Division' in the 1987 report. The name Astrodynamics Division and the abbreviation ASD Division were sometimes used. As far as I am aware no further reports of this type were published for the subsequent activities at Herstmonceux and Cambridge, but much information about the RGO's activities after 1987 is given in the house journal *Gemini* and its replacement in 1994 by *Spectrum*.

In the following sections of this chapter, I have frequently given references to articles in these two reports as it would inappropriate for me to attempt to include more than a brief indication of the activities in which I had no direct involvement.

Boksenberg continued Graham Smith's policy of encouraging greater public access to the Castle, the grounds and the Equatorial Group. A revised edition of the illustrated booklet about the RGO was issued in 1982. In addition, he improved the facilities in the Castle for conferences and, especially, for smaller workshops so that, apart from the intrinsic value of these meetings, astronomers generally would become more aware of the RGO and of its wide range of activities. (See section 6.4.1.1)

6.1.4 The 'brown-envelope exercise'

My recollection is that fairly soon after he arrived Boksenberg told the SSM that he had said at his interview board that he considered that the staff of the RGO could be cut by about 25%. If this was the case it was not surprising that SERC decided in 1983/1984 to use the "voluntary premature retirement" (VPR) scheme in order to achieve such a reduction in staff numbers without formally declaring staff to be redundant. Some staff were, however, transferred compulsorily to other SERC establishments. There was a similar (but probably less favourable) "job release scheme" for the industrial staff. The letters inviting the staff to take VPR were distributed in ordinary government brown envelopes and this gave rise to the name of the 'brown-envelope exercise'.

I forget the details, but I believe that it allowed staff over 50 to retire early and draw a pension based on an age of 60 right away. The terms certainly proved attractive to many staff.

The Division Heads were given the task of selecting those persons who should be offered VPR and we were told to choose more than the number by which the department or activity was to be cut. We were also told that if more than this number offered to take VPR we would be able to choose those who should stay and who should go. In practice this did not happen and I believe that everyone who volunteered was allowed to go. The NAO suffered badly since, for example, Brian Emerson unfortunately treated the receipt of a "brown envelope" as a sign that I did not appreciate his talents and the quality of his work and so he took VPR even though I had explained the circumstances and had told him that I did not wish him to leave.

The 1985 report shows that the total complement fell from 237 in 1981 to about 195 in 1985 and was predicted to fall to 128 in 1990, a fall of 46 %. In general, those who retired were not replaced by new staff. This led to a major change in the age profile for the staff, with the majority between 30 and 50, while there were very few young staff under 25.

6.2 A second round of reviews

During the 1970s the Observatory had been subjected to reviews that led eventually to the agreement that its main task should be the provision of technical support for UK astronomers, especially through the construction of the new northern-hemisphere observatory (NHO). It was also recognised that it needed to have staff who were engaged on astronomical research and that it should continue to provide services for both the government and the general public. The future of the Observatory seemed to be assured and Graham Smith was bidding for additional staff when he left to return to Jodrell Bank. We were therefore surprised and dismayed when Boksenberg took the opposite stance and SERC reduced the staff through the brown-envelope exercise. Unfortunately, this was not the end of the attacks on the RGO as the cost-cutting policies of the Conservative Government led to a series of reviews during the 1980s and eventually to the move to Cambridge in 1990 and closure in 1998.

So far I have found hardly any mention of these reviews in the documents that I have at home as I try to complete this section, but I hope that there are no major errors or omissions in it.

6.2.1 The Rayner Review 1983

The first of these reviews was that by the Rayner Committee on Stores and Estate Management in the SERC. It recommended in April 1983 that the SERC should make major changes in the infrastructure for astronomy. For example, it recommended that savings should be made by concentrating the activities on two sites instead of three — the Royal Observatories (RGO and ROE) and the Rutherford Appleton Laboratory (RAL). It recommended disposing of the Castle and surrounding land. Incredibly, it also recommended the sale of the Equatorial and Spencer Jones Groups of telescopes! It also recommended that the RGO archives and the rare books should be transferred to the Public Record Office even though the PRO does not accept books. Boksenberg argued against most of the recommendations, which were referred to an SERC panel.

6.2.2 The Willmore Panel 1983/4

Peter Willmore, a bearded space-research scientist at the University of Birmingham, was the chairman of the ‘Manpower and Site Review Panel’ appointed by the Astronomy and Space Research Board (ASRB) in September 1983. Apart from manpower requirements for the forward-look period it was asked to consider the implications of the recommendations of the Rayner Review. I was one of the persons interviewed by the panel when it visited RGO. The Panel gave as its ‘marginal preference’ that the RGO should stay at Herstmonceux, rather than be merged with the ROE in Edinburgh. This was accepted by the ASRB.

6.2.3 The SERC Secretary’s Panel 1985

It is clear that some members of the Council of SERC, who were from universities or industry, and possibly some of the administrative staff, were determined that the RGO should be split up or moved and cut still further. Consequently, the advice of ASRB was rejected and another panel was set up under the chairmanship of the Chairman of the Council (then Professor John Kingman) to “consider future arrangements for the Council’s support in the UK of the overseas facilities for ground-based astronomy, both regarding management and location”. This confirmed the statement by Kingman to RGO staff on 23 April 1985 that the panel would not take into account the other aspects of the work of the RGO. Kingman invited comments from astronomers and so I (and 20 others) wrote to him on 22 May pointing out my concerns for the NAO, SLR, Library and Archives, but I did not receive even an acknowledgment of my letter. Patrick Wayman, the Director of the Dunsink Observatory near Dublin, also drew attention to the other activities of the RGO when he wrote on 3 June. He commented that “it seems that influential scientists and administrators are dedicated to the task of removing the RGO from Herstmonceux Castle” and that “committees will go on being formed until the ‘right’ recommendations are made”. He ended by suggesting that other related services should be based at Herstmonceux.

The Panel reported in December 1985; it did not come to any firm conclusion but merely left as one of the options “a move of the RGO to a university site”. It stated that “when considering the options, the non-La Palma activities of the RGO have not been included” and that “financial projections for the various options have not been considered”. The links with the University of Sussex were discounted as “the two are not well matched”. In a statement attached to the report, Professor W.H. McCrea, who

was a member of the panel, states his view that the Council should decide “against any fundamental change in the status quo of RGO and ROE”.

Kingman was succeeded by Professor E. W. J. Mitchell, who made it clear to the Staff Side, which met him on 13 February 1986, that he was determined to move the RGO. The Universities of Cambridge, Edinburgh and Manchester, were invited to ‘tender’ for the ‘privilege’ of hosting the RGO. The former director, Graham Smith, persuaded the University of Manchester to put in a bid, which was based on the RGO using the unwanted Victorian Christie Building of the John Rylands Library for its offices. (It even produced an illustrated brochure.) Desmond King-Hele wrote on 6 March to Mitchell expressing the dismay of the Optical Tracking Subcommittee at the threatened closure and I wrote a long letter on 7 March to Dr. J. A. Catterall, the Secretary of SERC, giving arguments against a move. I am sure that others also wrote. The journal *Nature* took the view that “the real reasons for the change appear to be political” and considered that the net cost of the move would be £5 million and would be better spent on research. Nevertheless the Council decided that the RGO should move, but the press release of 20 March still left three options: a merger with ROE on Blackford Hill, to Cambridge or to Manchester.

My personal file for the period before the next press release on the 19 June shows an enormous volume of interest in the proposal, but little support for it. Patrick Moore arranged a special meeting of the Royal Astronomical Society on 6 June and there were only two dissenters to the motion that the SERC should reconsider its decision to move the RGO. Nevertheless, the Council decided on 18 June 1986 that the RGO should be moved to Cambridge. Four members of the RGO staff side had visited the three proposed sites and considered Cambridge to be the best of them, but I doubt whether this was taken into account by Council. The decision required ratification by the Department of Education and Science but, even before this, SERC set up a Relocation Steering Committee and a Relocation Project Group to oversee the projected move, which was then scheduled to start at the end of 1989. A new series of Relocation Bulletins, which were separate from the ordinary Information Circulars, was started to keep staff informed about the subsequent plans and changes.

6.2.4 The “Hands-off” and “Save RGO” Campaigns

The RGO Staff Side continued its campaign to stop the move in the hope that the minister would intervene. A petition with 17000 signatures was presented to the House of Commons and the campaign received the support of Patrick Moore and many astronomers.

Some members of the staff (Janet Dudley and Margaret Penston) were disciplined for their participation in this campaign. I was admonished for writing to our local Member of Parliament, Charles Wardle, who had passed on my letter to SERC.

The consequences of the decision to move the RGO to Cambridge are discussed in section 6.5.

6.3 Departmental activities 1981 to 1990

This section gives only brief details of the main activity of the Observatory — the construction, development and use of the observing facilities on La Palma and elsewhere — since I am not able to add to the detailed accounts in the RGO reports and other publications. The main emphasis is in sections 6.3.3 to 6.3.6 on those activities for

which I had administrative responsibility as Head of the Almanacs and Time Division or in which I had a special interest. I have included a variety of other topics in sections 6.3.7 and 6.4, while activities that were directly related to the move to Cambridge are described in section 6.5.

6.3.1 La Palma and related activities

By the time that Boksenberg had replaced Graham Smith the preparatory work for the new observatory on La Palma was well advanced. The building for the Isaac Newton Telescope appears to be almost complete in the photograph in IB 265, for 1 October 1981. Boksenberg visited La Palma for the first time at the beginning of November in the company of Bill Goodsell, head of the La Palma Division, and Paul Murdin, who had just been promoted to SPSO as the chief project scientist.

The Royal Inauguration by King Juan Carlos of Spain of the International Observatory on the Roque de los Muchachos on La Palma took place in June 1985. It is fully reported in a special issue of *Gemini*. The other countries that shared in the construction of the Observatory, namely Spain, Denmark, Ireland, the Netherlands, Sweden and the UK, were all represented at high levels. The RGO was responsible for the Isaac Newton Group (ING), whose main telescopes were the Isaac Newton Telescope from Herstmonceux and the new, larger William Herschel Telescope. In addition there was the Jacobus Kapteyn Telescope, which was partly funded by the Netherlands and Ireland, and the Carlsberg Automatic Transit Circle, to which Denmark made the major contribution. At this time the building for the WHT had been completed, but the telescope was in store pending shipment to La Palma.

6.3.1.1 Organisation and staffing for La Palma

A new La Palma Operations Division was formed in May 1982 and later in the year a new Facilities Division was formed by combining the separate divisions for La Palma construction, for engineering and for instrumental science. (Joe Paxton returned to the Rutherford Laboratory in January 1982 and Bill Goodsell retired in September 1982.) The Facilities Division was headed by M. C. (Mike) Morris, who transferred (on promotion) in August 1982 from the Daresbury Laboratory. In 1985 the Facilities Division included not only the La Palma construction team, but also groups for electronics and computing, instrument science, vacuum physics and mechanical engineering. The Operations Division was split into two groups; the group on La Palma was headed at first by J. W. (Joe) Gietzen and the Herstmonceux Group was headed by Paul Murdin, who was later made the head of the division. Gietzen was also promoted to SPSO, but took VPR in 1984 and Keith Tritton became the head of the 'Island Team', which numbered 32 in 1985. This number included some locally recruited Spanish staff, who did not count against the RGO complement.

Jasper Wall became head of the Operations Division in 1987 when he and Paul Murdin interchanged roles. Keith Tritton returned to head the Herstmonceux Support group. Another person who changed roles between the reports of 1985 and 1987 was Neil Parker. He had been made Head of the Electronics Department in November 1981, when Henry Gill took VPR, and was Head of Electronics and Computing within the Facilities Division in September 1985. By September 1987 he had transferred to the Operations Division and was Head of the Engineering Group on La Palma. He later became officer-in-charge on the island in the 1990s.

In the following notes I have referred to only a few of the many RGO staff who contributed to the success of the La Palma project and I have given only brief details of it since I have neither the background knowledge nor the time to study the reports on the work in detail. Unfortunately, there is no published general report on the activities after 1987. Reports on current activities are given in the issues of *Gemini*.

6.3.1.2 The telescopes and instruments on La Palma

The first telescope to be brought into operation in the Isaac Newton Group on La Palma was the Carlsberg Automatic Meridian Circle. The basic instrument was made by Grubb Parsons in 1952 to the same design as the Cooke Reversible Transit Circle at Herstmonceux and it was used at the Copenhagen University Observatory until 1976. The enhancements and the installation on La Palma was funded by Denmark (with support from the Carlsberg Brewery!) and the UK and it is operated jointly. The first observations were made in November 1983.

The second telescope was the 1-m Jacobus Kapteyn Telescope. This was, I believe, purchased 'off-the-shelf' and delivered to La Palma in October 1983. It came into use in May 1984. It had a wide-field photographic camera, but it also had a CCD camera, photometers and a spectrograph.

The first major British telescope to be brought into operation on La Palma was the 2.5-m Isaac Newton Telescope, which had required considerable structural modifications as well as a new larger mirror and instrumentation after its removal from Herstmonceux in 1979. John Pope, who had gained his experience of large telescopes while observing with Woolley and then with the construction of the Anglo-Australian Telescope, was the RGO's senior telescope engineer for this project. One of the members of his small team was Brian Mack, who had transferred from the Rutherford Laboratory in 1975 and who in 1987 was responsible for the telescope installation on La Palma. The building was handed over in January 1983, by which time the mechanical structure of the telescope was already in place. The first stars were seen at the prime focus in February 1984 and the first scheduled observing took place in May 1984. New cameras and spectrographs were installed and commissioned during the following years.

The 4.2-m William Herschel Telescope is the largest telescope on the site and when it was completed in July 1987 it was the third largest in the world. Again, John Pope and Brian Mack were strongly involved in its design. It was built by Grubb Parsons in Newcastle, where it was tested before it was dismantled, packed and put into store in December 1984 before the company closed. John Pope retired in April 1984 just after the telescope had been tested in the factory. The WHT is an alt-azimuth telescope with a wide variety of instruments. It was finally delivered to the site in May 1986 and 'first light' was in June 1987. Brian Mack was responsible for the installation on La Palma and was subsequently awarded an MBE.

The 1985 and 1987 reports contains several other interesting articles about the design, construction and use of the telescopes and instruments for La Palma and other observatories, and so reference may be made to them for further details of this work. In particular, I have made no attempt here to discuss the Carlsberg Automatic Meridian Circle, nor topics such as: the remote operation of telescopes; the conditions and users on La Palma; Dutch cooperation; and the data archive. (See appendix E.3.5 for a note about the CAMC.)

The success of the telescopes depended on a large variety of factors apart from the quality of the intrinsic mechanical and optical design and manufacture. Electronic and computing systems have revolutionised observational astronomy since I joined the RGO, but we must not overlook the fact that these highly complex facilities depend upon many people to design, construct, operate, maintain and use them. In turn these depend on administrative and support staff on the island and in the UK, but they too are omitted from this account.

6.3.1.3 Engineering and instrument development

Some of the work carried out by the engineering and instrument sciences departments on the design and construction of the telescopes and their instruments is described in articles in the 1985 and 1987 report, and in the issues of *Gemini*. It was found to be necessary to build a simulator for testing large and heavy instruments that were built in the workshops at Herstmonceux. Some of the work was in projects with and for other observatories. Some of these are mentioned in the 1987 report in an article on optics at the RGO.

6.3.2 Astrophysics and astrometry

During this period the former Astrophysics and Astrometry (A&A) Division was called the Astronomy Support and Research Division in the reports. It was headed by Jasper Wall and then from 1987 by Paul Murdin. It included Bernard Pagel, in the higher grade of DCSO, and Andrew Murray and Michael Penston as SPSOs, all of whom had had Individual Merit promotions so that they could concentrate on research and be free of administrative responsibilities. In 1981 the majority of the staff of the Division were in research teams, with the rest in the Meridian Department, headed by Tommy Tucker, and the Photographic Astrometry Department, headed by Bill Nicholson. Tucker retired in 1982 and his place was taken by Leslie Morrison, who had returned to the Meridian Department in 1981 after serving for over 18 years in the NAO.

The organisation chart for 1985 shows that the number of staff in these activities had declined, but the total for the Division had only fallen slightly since the Computer Department had been transferred from the Almanacs and Time Division in 1983. By then it was clear that the bulk of the work on the computers was for A&A, rather than for the A&T, and, moreover, I was no longer directly involved with any of the computer work. Ken Hartley continued to be the head of the department.

The Observatory kept up its links with the University of Sussex, and Bokseberg joined Pagel as a Visiting Professor there. Other RGO staff members acted as readers and lecturers; they both provided MSc lecture courses and supervised the theses for MSc and DPhil degrees. Apart from the monthly joint seminars, alternately at Falmer and Herstmonceux, staff and students attended other meetings at both centres and there was cooperation in research. Some members of the RGO staff took higher degrees there. Further details of the cooperation with Sussex and other universities are given in the 1985 report.

6.3.2.1 Astrophysical research

The astrophysical research programme of the RGO was extensive and productive. It was the subject of 15 double-page articles at the front of the 1985 report. The titles of the articles were: From here to quasars; Extragalactic HII regions; HII

regions and the chemical evolution of galaxies; The gaseous halo of our Galaxy; The stars of the Galactic halo; Weighing the black hole; Power for LINERs; Cen A - the nearest active galaxy; Are Elliptical galaxies really dead?; Ellipticals and doubles; Violent star formation; The jets of SS433; Star clusters; Probing the South Galactic Cap; Stellar cataclysms. The report concludes with an 11-page list of references to scientific papers, the majority of which are related to this astrophysical research programme. The 1987 report has an article on 'M dwarfs, brown dwarfs and the missing mass' and ends with nearly 7 more pages of references. The discovery of the supernova SN1987A in the Large Magellanic Cloud early in 1987 was of particular interest to those RGO astronomers who were working at the AAO at the time.

6.3.2.2 Astrometry

The primary aim of the astrometric programme was the improvement of the inertial reference frame with respect to which the motions of stars and galaxies may be determined from observations made on the Earth or in its neighbourhood. Various techniques are used to determine and link the reference frames for the Earth, for the Solar System and for the Galaxy to each other and to the extragalactic reference frame determined from VLBI observations of very distant extragalactic radio sources. The articles in the 1985 report on 'Inertial frames', on 'Astrometric and space geodesy' and on the 'Rotation of the Earth' discuss these matters and show clearly that much of the work in the Almanacs and Time Division was directly related to the astrometric work in the ASR Division. The work in ASR was in three main areas in optical wavelengths: (1) observations with the Carlsberg automatic meridian circle; (2) measurement of southern-hemisphere photographic plates using GALAXY; and (3) participation in the HIPPARCOS satellite mission of the European Space Agency (ESA).

The last observations with the Cooke reversible transit circle were made at Herstmonceux in April 1982, just before the retirement of Tucker, who had been in charge of the work since 1964. Attention was then given to completing the reduction and publication of all the observations up to that date. The Cooke RTC was later transferred to the Copenhagen University Observatory, where it was used to develop software for the Carlsberg Automatic Meridian Circle (CAMC), which had been built in 1952 by Grubb Parsons to the same design as the Cooke circle. The CAMC was delivered to La Palma from Denmark in August 1983 and regular observations began on 1 May 1984. As its name implies this circle is controlled by a computer and an impersonal photo-electric moving slit micrometer records the transits of stars and minor planets. The instrument was run jointly by the Copenhagen University Observatory and the RGO, whose small team of five was led by Leslie Morrison.

The use of the 26-inch Thompson refractor for the measurement of trigonometric parallaxes ceased at the end of 1981. The use of the 13-inch astrographic telescope probably also ceased, but the GALAXY measuring machine continued to be used for the measurement of plates for the Cape Photographic Catalogue. Such fundamental work was not consistent with the short-term policies of the SERC and funding was withdrawn for two years. (See the 1985 report.) It was reinstated when it was realized that it would be required to measure the wide-field plates to be taken with the new JKT on La Palma. The leader of the group of four was Nicholson, who retired in May 1986 (without comment in the IB, apart from an item about the farewell party in the Clubhouse). The 1987 report does not mention GALAXY, the JKT or any other aspect of photographic astrometry.

Until his retirement in 1986 Murray led a ‘galactic astronomy’ group of three that was primarily concerned with the preparation of the input catalogue and of programs for the reduction of the data to be obtained from the HIPPARCOS satellite. This international project had very long gestation period. I have a vague recollection of a very early presentation about the concept at an IAU meeting and it was then difficult to appreciate how it would operate and how parallaxes, positions and proper motions of high-precision of over 100 000 stars would be derived from the observations. The satellite was launched in August 1989 so that the bulk of the data processing and publication of results was carried out in the 1990s. The RGO team was led by Floor van Leeuwen (from Holland), who has written a review of the work on both the Carlsberg telescope and HIPPARCOS in the last issue of *spectrum*.

6.3.2.3 Developments in computing

This decade saw much further development of computing activities throughout the Observatory. The Computer Department, which was responsible for the major computers, was transferred from the A&T Division to the A&A Division in 1982 and I was replaced as chairman of the RGO Computer Committee in 1983. The VAX 11/780 computer, which had been obtained in March 1980 as the RGO node for the Starlink computer network, and which was used mainly for image processing, was supplemented in March 1982 by a VAX 11/750 for general purpose computing. This made it possible to close down the ICT 1903T computer in the following year on 25 March 1983. The VAX was not only more powerful but, like the 780, it was available all the time. Users, rather than a dedicated team of operators, were responsible for running their own programs. By this time, disc storage had obviated the need for frequent loading and unloading of magnetic tapes. The GEC 2050 link to the Rutherford Appleton Laboratory was closed on 1 July 1983 as it was superseded by Starlink.

The Computer Department, which was headed by Ken Hartley, continued to supervise the use of the computers and to provide support for the users. At first it made significant contributions to the development of software for the STARLINK network, but the loss of experienced staff left little time for further such work. The background to Starlink and the RGO contributions to its development are described by Ken Hartley in *Gemini 3* and in the 1985 report. There are illustrations showing the VAX 11/780 computer and the use of the image-processing software to improve the images from the new detectors by removing the fixed-pattern and other noise. The article in *Gemini 3* includes a brief history of the use of computers in the RGO.

The VAX 11/750 was used mainly for astrometry, such as processing the data from the Carlsberg telescope and from GALAXY, and for dynamical astronomy, including the production of the almanacs, studies of orbital motions in the Solar System, and satellite laser ranging. It was also used for the development of software for the HIPPARCOS project and later for processing the data from the satellite. The load on the system soon grew to the point where users could no longer use the system interactively, but had to organise their jobs so that they could be run in a batch queue.

Minicomputers were used for applications such as the control of telescopes, while microprocessors were used as integral parts of many instruments. The FORTH programming language was adopted for such purposes and its use in the RGO is described in the 1985 report.

The introduction in the 1970s of electronic desk and hand calculators has been mentioned in section 5.5.3.2, and of word processors in 5.5.3.3. The 1980s saw the

introduction of much more powerful general purpose desk computers that became known as 'Personal Computers'. At first there were many different incompatible systems and so the SERC Computer Coordination Panel, on which I represented the RGO from 1980 to 1983, was keen to select a system that would be the standard for its establishments and for universities seeking grants. A team went to the USA and came back with a recommendation that a computer known as PERQ should be adopted. We were given a demonstration and I was very impressed. One feature that I particularly liked was that the monitor screen was in portrait, rather than landscape, mode so that the whole of an A4 page could be seen in full-size type on the screen. Moreover, the image was in black on white, rather than in colour as was then the norm. Unfortunately, the introduction of the IBM PC made this a useless exercise and, as far as I am aware, no PERQs were purchased by SERC.

Our Data Logic word processors were replaced by 'Diamonds' and eventually by PCs. Diamonds were used elsewhere in SERC and were linked by a separate network. Throughout my time at the RGO the senior staff continued to have secretarial help and so our letters and papers were typed for us. A typing pool continued to provide a service, but many scientific staff began to type their own documents. (I purchased an Amstrad PCW word processor for use at home, but when I retired I found that the floppy discs were incompatible with the IBM discs used at the University and so I replaced it by a PC.)

A major development during the decade was that of international networks for correspondence by electronic mail for as well as for the distribution of large data files. My first introduction to this was in connection with the MERIT project when Peter Morgan, an Australian, persuaded us to use a GEC network for the transmission of MERIT data and for messages. An email link to La Palma was introduced in 1987.

6.3.3 H. M. Nautical Almanac Office

The description of the work of H.M. Nautical Almanac Office in the RGO 1985 report refers only to the work on the publications and data services. The work on dynamical astronomy is described earlier in an article on the motions of natural satellites without any indication that it was carried out in the NAO by staff who shared in the other work.

The team work in the NAO was probably a major factor that led to good attendances by former staff at reunions that were held in September 1982 and June 1987. The first of these was held to mark the sesquicentenary of the establishment of the NAO, although it may have been almost a year after the actual 150th anniversary. Some of those present had worked in the NAO over 50 years before and some of them also attended the later reunion. In particular, Donald Sadler was present at both and appeared to be in good health. The second one was held at his request, but he died in October 1987.

Professor George G Bennett, of the University of New South Wales, Australia, spent six months in the NAO while on study leave from June to December 1983. He worked mainly with Bernard Yallop. When he left he presented the Office with a plaque from the NSW Society for Surveyors. The Office also had two younger long-term visitors from China. The first was Mr Xia Jiongyu from the Institute of Geodesy and Geophysics at Wuhan and he stayed from May 1984 to July 1986; he was most interested in the work on the rotation of the Earth and he took part in the analysis of

SLR data . The second was Mr. Shen Kaixian from the Shaanxi Astronomical Observatory at Lintong, near Xian, and he stayed from June 1985 to July 1986; he worked with Sinclair and Taylor on the motions of natural satellites and he continued his collaboration with Taylor after the move to Cambridge. They lived in rooms in the Castle and they had the use of a small kitchen so that they could prepare Chinese food – Mr Xia had quite a shock when he was served with fish and chips for lunch in the canteen on his first day. I met Mr Xia and Mrs Shen during my visit to China in 1987, but Mr Shen was then in hospital.

The Office continued to collaborate with similar organisations throughout the world, and we maintained especially good relations with the Nautical Almanac Office of the US Naval Observatory in Washington. During a visit there in July 1985 I spoke at a colloquium about Project MERIT and then about Simon Newcomb, who had been a Director of the (US) NAO and one of the most well-known members of the Observatory! I also spoke about Simon Newcomb at RAS and IAU meetings.

6.3.3.1 NAO publications and data services

The Astronomical Almanac for 1981 onwards was printed in the USA, but for 1982 and 1984 the copies for sale by HMSO did not arrive until very late in the preceding year. Major changes in the basis of the ephemerides were introduced in the issue for 1984 in accordance with resolutions that were adopted by the International Astronomical Union in 1976. The fundamental ephemerides of the motions of the Sun, Moon and planets were computed by numerical integration at the Jet Propulsion Laboratory in California. The Office was still responsible for the computation from them of the ephemerides published in the first part of the Almanac. The type-styles in the printed volume showed clearly which pages were prepared and typeset in the UK and which in the USA. A Supplement that was printed in the 1984 edition gave details of the new system of constants and of the changes that had been made.

By 1985 the system used for automatic typesetting had been changed to reflect the developments in computer techniques since I had written the first system in 1968. Instead of producing a magnetic tape that was used directly by the phototypesetter the Office produced a file that specified exactly the format and content of each page. This file was then processed by HMSO to produce a new file that was appropriate to the particular model of typesetter to be used. The new system was known as TOPPS (Tables OutPut for Printing System). The programming system for the first stage was developed by Catherine Hohenkerk, while the interface program was written by Mr P Felgate of HMSO. A brief description of the system is given in the 1985 report and a user's manual, written by Catherine with the assistance of Ann Strong, was issued as *NAO Technical Note no. 66* in October 1987. The user's job was to write a program (in Fortran) that would combine 'commands', which specified the required layout (headings, type fonts and sizes, spacing), with the numerical data from a previously computed file. This program might modify the initial data when this was required for the particular table to be printed. The output from this program was printed on the line-printer for checking for formatting errors before the magnetic tape was sent to HMSO. This was a difficult task as the character set and spacing on the line-printer were so limited.

The availability of the new fundamental ephemerides meant that we could prepare the volume of *Planetary and Lunar Coordinates for the years 1984–2000*, and this was published in 1983. In addition the Office started a new series of booklets with

the title *Compact Data for Navigation and Astronomy* to provide low-precision data in a form that was suitable for programmable calculators and personal computers. The first volume was published by HMSO in 1985 for the years 1986-1990. (The data for 1981 to 1985 had been published in 1981 for trial purposes as *RGO Bulletin 185*.) This and the succeeding volume for 1991-1995 were prepared by Bernard Yallop and Catherine Hohenkerk.

As far as I can recall, there were no significant changes to *The Air Almanac* (except that it was published in one volume per year instead of two from 1987) or to *The Star Almanac for Land Surveyors*. A new section on sight reduction procedures was, however, included in *The Nautical Almanac* for 1989 so that separate volumes of sight reduction tables were no longer necessary. The final draft of this new section was prepared at USNO when Yallop attended a meeting of the ASCC WP 53 in Washington in March 1987. Nevertheless, we continued to update the *Sight Reduction Tables*. Further details of these and other activities are given in the 1985 and 1987 reports.

Although he had been retired since 1972, Donald Sadler participated in the design of *The Macmillan and Silk Cut Nautical Almanac*, which was issued annually from 1981, and he also compiled the set of sight reduction tables that were published in *The Macmillan and Silk Cut Yachtsman's Handbook*, which was first published in 1984.

The NAO issued its last worldwide predictions of occultations of stars by the Moon for the year 1982, but it did continue to prepare predictions of grazing occultations and it published the results of the observations made up to 1980 in *RGO Bull.* 192. Leslie Morrison, although no longer in the NAO, continued his collaboration with Richard Stephenson at Durham on the determination of the past variations in the rotation of the Earth. They produced a definitive paper in 1995 on the long-term fluctuations during the period 700 BC to AD 1995.

In addition to preparing data on astronomical phenomena for the almanacs, the Office continued to provide such data to publishers of calendars, etc, and to the general public, usually in the form of *RGO Astronomical Information Sheets*. The Public Information Unit was, however, transferred to the Administration Division and renamed the Public Relations Unit as its scope was widened; it took over the distribution of the data computed in the NAO.

A major disappointment during this period was our inability to prepare a new edition of the *Explanatory Supplement*. Changes that had taken place since 1960, and especially those for *The Astronomical Almanac for 1984*, had rendered it obsolete and so it was allowed to go out of print. I had originally intended to ask Leslie Morrison to act as editor for the revised edition and to spend a lot of time on it myself. Leslie was, however, transferred back to the Meridian Department and I found that my many other activities, including Project MERIT and the 'defence' of the RGO, used up almost all of the time that would otherwise have gone to the Supplement. Consequently, the editing was undertaken by Ken Seidelmann in USNO, and the completely new *Explanatory Supplement to the Astronomical Almanac* was published in 1992 by a commercial publisher, not the US Government Printing Office. My contribution was limited to writing (after my retirement) with Seidelmann the introductory chapter, but Catherine Hohenkerk, Bernard Yallop and Andrew Sinclair were responsible for other chapters. Seidelmann invoked the assistance of some astronomers from other organisations, such as the Jet Propulsion Laboratory, in addition to staff of USNO. The Supplement

includes a list of many of the *NAO Technical Notes* that had been published to give details of the techniques of computation that had been used.

6.3.3.2 Dynamical astronomy (except SLR)

The work on dynamical astronomy by Andrew Sinclair and Don Taylor was mainly concerned with the orbital motions of natural satellites. Taylor continued his studies of the three-body problem, and in addition Sinclair was heavily involved in the satellite laser ranging programme.

Good relationships were established with dynamicists in universities and during this period we organised three workshops in the Castle. (See section 6.4.1.1) We (ATS, DBT and GAW) also prepared and manned an exhibit at the annual Royal Society Exhibition in 1987 about satellite dynamics and SLR.

6.3.4 The Time Department and space geodesy

The decade saw a drastic change in the work of the Time Department and in 1987 it was named the Space Geodesy Department to reflect the character of the new work. The adoption in 1972 of coordinated universal time (UTC), which was derived directly from atomic time, as the basis of the international system of time scales led to a diminution in the value of the contribution that the RGO could make to the national and international time services. Moreover, such work was more appropriate to the National Physical Laboratory, rather than to an SERC establishment, and so the scale of the RGO effort was considerably reduced. Then, as the MERIT project clearly showed, the technique of optical astronomy for the determination of universal time was superseded by new techniques of space geodesy based on laser ranging and VLBI. Consequently the operation of the PZT was replaced by that of a satellite laser ranging system that made a significant contribution to the international services for monitoring the rotation of the Earth and for improving the geodetic reference frames. In addition, the transfer of the Hewitt satellite tracking camera from Malvern to Herstmonceux led to a major increase in its productivity.

In addition to international workshops for SLR and MERIT (see later) the RGO hosted a Summer School in Space Geodesy in September 1984.

The public interest in Greenwich time and the Greenwich meridian was boosted by the celebration of two anniversaries. Firstly, the 60th anniversary of BBC 6-pips time signal occurred on 5 February 1984. Separate interviews with John Pilkington were broadcast on nine BBC stations. (I drafted notes about the early history of the 6-pips, but I did not have time to polish them for publication. See appendix G.3.4) The 100th anniversary later that year of the recommendation by the International Meridian Conference in Washington that the Greenwich meridian should be used as the prime meridian of the world was much more significant. This eventually led to Greenwich Mean Time becoming the basis of standard time zones around the world and to the Greenwich meridian, defined by the Airy transit circle, being used for 'longitude zero' on maps. Members of the RGO staff contributed to the Longitude Zero Symposium that was held at the National Maritime Museum at Greenwich in July 1984. The participants also visited Herstmonceux. In October there was an evening reception at the Old Royal Observatory to mark the event and in November Sadler and I presented a paper about the International Meridian Conference at a special meeting of the Royal Institute of Navigation. (See appendix G.3.2) The anniversary is not mentioned in the 1985 report.

The occasional insertions of leap seconds in GMT (= UTC) usually involved radio interviews with Pilkington. The RGO's activities in time and geodesy led to my being invited to give, in January 1986, the Christmas lecture to the British Astronomical Association on the subject of 'Greenwich Time and the rotation of the Earth'. Later, in December 1988, members of the Eastbourne Astronomical Society came to the Castle for a talk on 'Space Geodesy'.

6.3.4.1 The Greenwich Time Service

RGO Information Bulletin 270 reported that on 29 January 1982 "The Director, Dr G A Wilkins and Dr J D H Pilkington visited the National Physical Laboratory, to discuss the responsibility for time matters. The meeting was held at the suggestion of Mr B W Oakley, Secretary of SERC, who was also present. It was agreed that the time-service activities at both establishments were fully justified and that the accuracy of the timing link between them ought to be improved".

Unfortunately, the level of funding and staffing failed to match this conclusion, and in late 1985 an article in *Nature* sparked a flurry of media interest in the 'demise of GMT'. Consequently, John Pilkington wrote an article headed "What's happening to the Time Service?" for the November issue of the RGO Information Circular for staff. In it he stated that "it has now been decided that the RGO will no longer aim to maintain an independent scale, and will rely instead upon timescales maintained elsewhere to provide the time-tags accurate to 1 millionth of a second that we need for our SLR observations". He also stated that we "intend to maintain our connection with the BBC to ensure that the '6-pips' Greenwich Time Signal will continue to provide GMT with an accuracy and reliability appropriate for normal civil use".

Pilkington later reviewed the activities of the Greenwich Time Service in an article in the 1985 report. The references to the *Time Service Circulars* and *Notices* that were issued by the Department were, however, omitted from the published report, although they are listed in the 1987 report.

The BBC took responsibility for the generation of the 6-pips time signal from 5 February 1990. I do not know when the Department ceased to monitor international time signals. I believe that two of the caesium standards were transferred to the SLR dome for use there.

The operation of the Photographic Zenith Telescope (PZT) ceased on 30 June 1984 even though we were participating in the MERIT Main Campaign (see section 6.3.4.4), which did not end until 31 October. Moreover the cuts in the staff were so severe that we were unable to reduce and publish all the observations that had been made. Consequently, a lot of observational effort was wasted. I suspect that even the data have now been lost and so it would be impossible to recover the results for the variations in local sidereal time and in the latitude of the PZT with respect to the pole of rotation of the Earth.

The PZT control building was subsequently let to a commercial company for office accommodation. I do not know what happened to the control desk — we were not consulted — but I do recall being horrified when I saw that the cables connecting the desk to the PZT itself had been roughly ripped out. I last saw the PZT itself in pieces in a Science-Museum store. The Greenwich Time Service control cabinets that featured in many published articles and in our postcards are also in store there.

6.3.4.2 Satellite laser ranging

The events that led up to the decision that the RGO should be responsible for the procurement and operation of the satellite laser ranging system are described in section 5.5.4.6 and the initial stages of the installation are described in section 5.5.6.4. The laser itself was installed in April 1982 by staff of the Physics Department at the University of Hull, who had designed and built it. The primary target, the satellite Lageos was first observed on the TV monitor shortly afterwards on 11 May. There was, however, a lot of commissioning work to be completed before the first laser returns from Lageos, and the smaller, lower satellite Starlette, were detected at night on 31 March 1983. Returns in daylight were obtained a few weeks later. The system was fully operational by October 1983, soon after the start of the MERIT Main Campaign.

The responsibility for the SLR system was assigned to the Time Department and we were fortunate in that John Pilkington had the necessary breadth and depth of knowledge to oversee the technical operation and maintenance of the system. In addition, the SLR team included Andrew Sinclair in the NAO, who not only had expertise in orbital mechanics, but who had also had practical experience of laser ranging during his year of secondment to the LLR team at Orroal in Australia. Graham Appleby was transferred from the NAO to the Time Department and became a valuable member of the team in developing the data analysis package and in collaborating with university groups in its use. Phil Cottrell, who was then the head of the Engineering Workshop took a particular interest in the project and after he had taken VPR we were able to keep his expertise as he was re-employed on a part-time basis. The initial team included also an electronics engineer, Bill Matthews, who kept the system in a highly reliable state, and Geoff Harvey, who developed the control software and then maintained and documented it. Graham, Bill and Geoff all acted as observers. Others who joined the team later included Peter Standen and Philip Gibbs.

An article about the system is given in the 1985 report and a longer article is given in *SERC Bulletin 3(1)*, January 1985. (An earlier article was published just after the installation of the telescope.) A technical description of the system is given in *SLR Technical Note 1*, May 1982. This was written by a newly recruited HSO, Paul Sharman, who left after a short while when he realized that the finance companies in the City of London offered salaries that were substantially greater than those in the Scientific Civil Service. The unusual nature of this hi-tech system aroused a lot of media interest and a photograph by David Calvert of the dome, telescope and green beam at night featured in July 1985 on the cover of a special issue of *Nature* on twenty-five years of lasers.

The laser system in the room below the floor of the dome generated a succession of pulses of light, each of which lasted a few tenths of a nanosecond (ns) and was a few centimetres long — roughly the size of a fist! (1 second contains 1000000000 ns) These pulses, each of which contained many trillions of photons, were eventually transmitted in a very narrow beam by a refracting telescope with aperture 10 cm to the target satellite. The principal target was Lageos, which was a sphere with a diameter of 60 cm (the size of a large beach ball!) that was covered in optical retroreflectors. Lageos was in orbit at a height of 6000 km so that the distance to the target was often as much as 12000 km. During a successful observation the satellite was illuminated by the beam and a small fraction of the photons were reflected back in a slightly diverging beam towards the telescope which had moved while the photons were going to satellite and back. Returning photons were detected individually by a special detector at the focus of a reflecting telescope, which has an aperture of 50 cm. The time-interval between the

emission of a pulse and the return of a photon was measured with a precision of about 0.1 ns by a special timing system. This interval was usually less than the interval of 0.1 s between the pulses themselves.

This complex system was controlled by a computer that had to continually calculate the direction to the satellite and record all the times of emission of the pulses and detection of photons. The telescope was continually receiving enormous numbers of photons, even at night, and so it was arranged that only those photons with the appropriate wavelength that arrived at close to the expected time were recorded. A graph on the computer monitor showed for each time of detection a point indicating the difference between the actual and expected time-interval. For real returns these points gradually built up a curve, while the other unwanted detections gave points that were scattered at random.

The system was operated by a single observer whose principal task was to initiate the observations, to monitor the progress of the recordings for each pass of a satellite and to take appropriate action if it became clear that returns were not being detected. In addition he had to look out for low-flying aircraft, including gliders, that might pass through the laser beam close to the Observatory. More distant aircraft were detected by a radar system that was slaved to follow the motion of the telescope and to switch off the laser system if an aircraft entered the radar-beam, which was very much wider than the laser beam. Consequently, during each pass the observer had to use a mini-console by the telescope rather than the main control desk in a warm room on the ground floor. A retroreflector on the empty INT dome was used for calibration purposes.

The system eventually worked extremely well technically and produced results of high precision. Moreover, the system was extremely productive in spite of the English weather. For several years we were at the top, or close to the top, of the annual table of passes observed by the SLR stations around the world. This was due largely to the excellent team-spirit shown by the observers, who tried to ensure that observations were made on all possible occasions when the weather permitted. The flexible conditions for observing duties outside ordinary office hours contributed, as did the fact that the system could be, and was, operated by only one person. At some (perhaps most) stations the systems were operated by shift teams that were not funded for full 24-hour 7-day working.

Pilkington and Sharman attended an international SLR Workshop at the University of Texas at Austin in October 1981 to learn from other groups with experience of operating such systems. The high level of interest in the RGO system was indicated by the attendance at the workshop to discuss the processing, analysis and exploitation of SLR data that was held in the Castle on 5-7 January 1983. There were 26 participants from UK universities and research establishments and 10 from the RGO.

A meeting of the European group for Range Observations to Satellites (EROS) was held in the Castle on 15/16 March 1984. The main topic was the planning of a special campaign [MEDLAS] to measure the motions of the tectonic plates around the eastern Mediterranean. RGO acted a reference point for the mobile stations. The fifth international laser ranging workshop was held in the RGO on 10-14 September 1984; there were 76 participants from 18 countries in addition to the RGO team. The opportunity was taken to hold meetings of the MERIT working group and of an ESA working group for international time transfer using lasers (LASSO). (See section

5.5.6.2) I was on the organising committee for the main workshop and this involved my attendance at a meeting in March in Prague, where the chairman, Professor Karel Hamal, was based. I recall that during dinner on one evening Carol Alley produced from his pocket a retroreflector of the type that was used in the arrays left on the Moon by the Apollo astronauts.

The results from satellite ranging were used not only in the monitoring of the rotation of the Earth, but also to establish the geodetic coordinates of the stations to high precision for use in defining an international geodetic reference frame. An Ordnance Survey trigonometric pillar was placed near the SLR building and was linked to the pillar near the INT dome so that the UK network could be linked accurately to the international network. The RGO results were used in NASA's Crustal Dynamics Project and the members of the team received Group Achievement Award certificates in 1986. Observations by receivers of the American Global Positioning System (GPS), which was then under development, were made in 1988 and 1989 from the pillar in order that the GPS coordinate system could be related to the international system.

A series of *SLR Technical Notes* was started in 1982, but the list of the early issues was omitted from the 1985 report, although some were listed in the 1987 report. These notes give details of the equipment and operational procedures and also results from the analysis of SLR observations from around the world — little can be derived from observations at only one station. A progress report by Andrew Sinclair on the observations of satellites by the SLR system and the Hewitt camera (see next section) was published in *SERC Bulletin* 4, Spring 1990. It describes how the SLR system was also used in photometric mode to study, for example, the rotation of the discarded rocket body of Cosmos 1844 and the occultation of a star by Titan, a satellite of Saturn.

6.3.4.3 Other satellite tracking activities

The NAO had provided the UK prediction service for artificial satellites during the first few months after the launch of Sputnik 1 in October 1957, but it had passed this job to the Royal Aircraft Establishment which had already recognised the need to determine regularly the orbital parameters of satellites for a variety of purposes. (See section 3.1.2.2) Desmond King-Hele at RAE was a leader in using the changes of the orbits for studies of the upper atmosphere and of the shape of the Earth. He was elected a Fellow of the Royal Society. He probably paid a major role in persuading Woolley to agree to the siting and operation of a kinetheodolite at Herstmonceux in 1963 and, later, at the Cape of Good Hope. (See section 3.3.3.3 and 4.3.4.6) I had first met King-Hele in 1958 (see section 3.3.1.3) and had continued to meet him from time to time as we both served on Royal Society and SRC Committees and Working Groups relating to orbit analysis and tracking. (He also came to Herstmonceux occasionally and we would then try to fit in a game of tennis as we were of a comparable standard!) It was therefore not surprising that we should collaborate in obtaining agreement for the installation of a Hewitt satellite-tracking camera at Herstmonceux.

The Hewitt camera is a large wide-field (angle of view) reflecting telescope that may be moved rapidly across the sky. It is not a conventional alt-azimuth telescope since it has three axes so that it has to be turned about only one axis when following a satellite during its pass. The mirror has a diameter of about 1 m, and there is thin corrector plate with a similar diameter at the aperture of the tube. The telescope was designed by Joseph Hewitt at the Royal Radar Establishment at Malvern for use in tracking the Blue Streak ballistic missile. Two such cameras were made; one was

operated at Malvern (or rather at Sheriffs Lench, near Evesham) until it was transferred to Herstmonceux. The second was operated by the Royal Observatory Edinburgh, but it was mothballed from 1975 until it was moved to Siding Spring in Australia in 1980. The Malvern camera was operated by the Ordnance Survey for geodetic triangulation from 1967 and then by the Earth Satellite Research Unit of the University of Aston from 1978 onwards. There is a photo of the camera in the 1985 report with some notes about it. Peter Knight, who now owns the site at Sherriffs Lench, has started to compile a history of the work there.

King-Hele and Clive Brooks from Aston visited Herstmonceux on 23 June 1982 to discuss the move of the Hewitt camera into the empty Dome C in the Equatorial Group. The camera was installed on 25 October 1982 and the first observations were made soon afterwards. The observing team, which continued to be employed by the University of Aston, moved with the camera and had the use of the adjacent B laboratory as their office. The move was extremely successful as there were productivity gains from the better weather conditions at Herstmonceux and from the fact that the observers lived close to the observing site and did not have to make long journeys to Malvern from their homes in Birmingham. The original members of the team were Vanda Bennett (leader), Roger Clarke, Robert McNaught and Max White. In February 1986 the Hewitt camera was used to provide support for the launch of a satellite by an Ariane 5 rocket.

One possible application of the Hewitt camera was to a project known as COGEOS. This was intended to obtain better information about the Earth's gravity field by studying the perturbations of satellites in geostationary orbits. An enthusiastic Italian couple came to Herstmonceux to talk to us about it and I attended a meeting in Pisa in 1988, but, as far as I am aware, the project did not go ahead.

Max White was an extremely active and knowledgeable member of the Kettering Group of amateur observers who been the first to (publicly) name the launching site for the Sputnik satellites. The Group was awarded the Prince of Wales Trophy for 1983 for its later work on various Soviet space missions. His description of the team's involvement in the media excitement about the re-entry of the Russian satellite Cosmos 1714 is given in IB April 1986 and there is a brief report in *Gemini 5*. He was also a reviewing editor and contributor in 1987 to an official US report on the space programme of the USSR.

These three observers also went to Australia to operate the second camera there. McNaught used the camera as an astronomical survey instrument and recorded the initial outburst of the famous supernova SN1987A in the Large Magellanic Cloud — unfortunately, he did not examine the plate until the following day, by which time the discovery had been announced. Max and Vanda married after their return from Australia and Vanda then worked in the exhibition prior to the birth of their son.

There were other activities related to satellite tracking. In December 1982 I gave an account of the NAO's satellite prediction service at meeting at the Royal Society to mark the 25th anniversary of the launch of Sputnik 1. A meeting for amateur observers of satellites was held in the Castle over the weekend of 9/10 March 1985; this was organised by a committee of the Royal Society. The participants were able to see the SLR and Hewitt systems in operation. In 1987 I received an unexpected invitation to attend a "Space Forum" in Moscow to mark the 30th anniversary of the launching of Sputnik 1. I obtained SERC approval to attend, but used annual leave since the event

was not directly to my work in the RGO. Most of my travel and accommodation expenses were met by the Soviet Government. It was a very interesting and enjoyable experience. I have written recently written a brief account in an article to be published in *The Antiquarian Astronomer*.

6.3.4.4 Rotation of the Earth — Project MERIT and the IERS

In 1978, as has been mentioned in section 5.5.6.3, I was appointed chairman of an IAU working group to make a comparative evaluation of the techniques for monitoring the rotation of the Earth and to make recommendations for a new international programme for observation and analysis. I did not realize then that I would be involved in this activity for the next ten years. The activity itself was very interesting, but it also gave me an opportunity to travel to many places around the world and to make friends with scientists from many countries. The group organised an international project that was known by the acronym MERIT (see below) and this provided the basis for the new International Earth Rotation Service that began operations in 1988. All of the activities — meetings and operations — were funded directly by the organisations taking part so that no time or effort was needed for fund-raising. My work and travel, as well as the SLR observations at Herstmonceux, were funded by the RGO. A general description of the project and a summary of the initial conclusions is given the 1985 report.

My role as chairman had several aspects. First of all, I convened and chaired the meetings of the group, whose members were usually nominated by the major organisations taking part. Secondly, I prepared the reports on the meetings and in doing so it was usually necessary to fill in detail, to sharpen up the conclusions of the discussions and to edit the technical contributions from the members. Thirdly, I prepared and distributed summaries of our objectives and of our proposals for the organisation of campaigns for observations and analysis. I issued newsletters and spoke about the project at conferences so as to make it known to a wider community.

When we started the principal method used regularly for monitoring the rotation of the Earth was that of optical astrometry using instruments such as photographic zenith telescopes to measure the variations in the rate of rotation (or in universal time) and in the orientation of the axis of rotation (or in the geodetic coordinates of the axis). The Bureau International de l'Heure in Paris was responsible for collecting and analysing the data for the former, while the International Polar Motion Service in Japan dealt with the latter. Additional data from Doppler observations of the orbits of navigational satellites was used for a 'rapid service' for UT. It had been shown that radio interferometry and laser ranging to satellites and the Moon could give accurate data on the rotation of the Earth, but appropriate observations were not made regularly.

The first meeting of the working group was held at Columbus, Ohio, in October 1978 at the invitation of Professor Ivan Mueller; he was not a member of the group but he played a major in the eventual success of the project. It was there that Martine Feissell, from BIH, proposed the acronym MERIT for 'Monitor Earth Rotation by International Techniques', but this was modified to '... and Intercompare Techniques' to match more closely the terms of reference of the group. The group also agreed to organise a short campaign in 1980 to develop interest and test ideas for the later organisation of a main campaign lasting at least a year in 1983/1984.

Our draft proposal was submitted to the IAU at Montreal in August 1979 and then to the International Association of Geodesy during the General Assembly of the International Union of Geodesy and Geophysics in Canberra in December 1979. From then on the group reported to both the IAU and the IAG; it also received the support of COSPAR (the international Committee on Space Research). The group met fairly regularly for short (half-day) meetings during conferences. In addition, it also organised several workshops lasting up to three days for the scientists who were involved in the operations. The initial rivalry between techniques and countries was soon replaced by a real spirit of cooperation and the level of participation increased as the project developed. It also became clear that the work for the determination of Earth rotation parameters (ERPs) must be integrated with complementary work for the determination of the geodetic coordinates of the stations and for monitoring the changes due to the motions of the tectonic plates. Consequently joint meetings were held with another IAG committee, known as COTES, for the establishment of a new terrestrial reference system. This was chaired by Ivan Mueller. Later we formally became a joint committee, with me as chairman and Mueller as vice-chairman. We made the final proposals for the new service, IERS, that would replace BIH and IPMS and would also be responsible for maintaining the celestial and terrestrial reference systems that are linked by the ERPs.

The first workshop was held at Grasse in southern France in May 1981, to review the lessons learnt from the Short Campaign and to make plans for the Main Campaign. The second workshop was at Herstmonceux in May 1983 to review the arrangements for the Main Campaign and to look ahead. The third workshop was held in July 1985 in Columbus, Ohio, in conjunction with a conference organised by Mueller on closely-related topics. After that workshop I was so busy preparing for the presentation of our proposals to the IAU at New Delhi in the following November that I had to put on one side the preparation of the full report on the workshop. I did not pick it up again until 15 years later, but it was then published in 2001. Our proposals were accepted by the international community and our working group became the Provisional Directing Board of the International Earth Rotation Service. The new service formally commenced operations on 1 January 1988, but the arrangements of the MERIT Main Campaign had remained in place during the meantime. I chaired the meeting of the IERS Board at the Paris Observatory in April and then at the IAU General Assembly in Baltimore in August 1988. As my retirement from the RGO was due the following year, I then handed over to Yaroslav Yatskiv, director of the observatory at Kiev in the Ukraine, then still part of the USSR. Incidentally, it was Yaroslav who sponsored my attendance at the Space Forum in Moscow in October 1987. He had stayed in our home after the workshop at the RGO in 1983, and we became good friends. By chance we were in adjacent rooms at the IAU GA in Manchester in 2000.

Apart from these workshops the members of the group met whenever possible at other conferences, either formally for general discussions or informally to discuss particular aspects of the work. Formal meetings and/or presentations took place at:

Dubrovnik, during an IAU European regional meeting, in October 1981;

Tokyo, during a general assembly of the IAG, in May 1982;

Patras, Greece, during the IAU GA, in August 1982;

London, at an RAS discussion meeting, in May 1983, just before the 2nd workshop at Herstmonceux; the group visited the Old Royal Observatory at Greenwich on the day after the RAS meeting;

Herstmonceux, during the international laser ranging meeting, in September 1984;

Paris, at the IAG Central Bureau in June 1985;

New Delhi, during the IAU General Assembly in November 1985;

Austin, Texas, during a meeting on positioning by satellites in April 1986; there was a demonstration of the way that VLBI techniques could be used to obtain very accurate positions from GPS satellites without using the secret military codes;

Prague, in September 1986, during an international symposium on the figures and dynamics of the Earth, Moon and planets;

Coolfont, Virginia, in October 1986, during IAU Symposium 128 on 'The Earth's rotation and reference systems for geodesy and geodynamics'; this was in essence a review of the achievements of Project MERIT and the proceedings were edited by Alice Babcock, of the US Naval Observatory, and myself;

Pasadena, California, in March 1987 at the Jet Propulsion Laboratory at the time of a NASA meeting of principal investigators for its crustal dynamics program(me);

China in April 1987; this was five-centre lecture tour at the invitation of the Chinese Academy of Sciences during which I spoke about MERIT/IERS and other topics [87/04]; the invitation was made at the suggestion of Madame Ye Shu-hua, who was the director of the Shanghai Observatory and a member of the MERIT group; she visited the RGO in August 1989;

Paris, at the Observatory, in April 1988;

Baltimore, during the IAU General Assembly, in August 1988;

and Potsdam, East Germany, later in August 1988, during a conference on the physics of the Earth, when I reviewed MERIT and IERS.

I also gave several talks about MERIT in other meetings in the UK. For example, I spoke about MERIT during my contribution about the fluctuations in the rotation of the Earth during a Royal Society meeting on 'Rotation in the Solar System' in 1984.

Shortly after my retirement, I attended two further conferences that were directly related to my involvement with MERIT. The first was IAG Symposium 105 on 'Earth Rotation and Coordinate Reference Systems' at Edinburgh in August 1989 and I subsequently edited the proceedings with the assistance of Claude Boucher (France). Then in October 1989 I gave a review of reference systems at IAU Symposium 141 on 'Inertial Coordinate System on the Sky' in Leningrad (now St. Petersburg again). Later in the decade, I gave an informal historical review of Project MERIT at an IERS workshop in Potsdam in September 1998 and a formal paper during IAU Colloquium 178 on 'Polar Motion' at Cagliari, Sardinia, in September 1999. The publication in 2001 of my report on the 3rd MERIT workshop marked the end of my participation in MERIT/IERS.

There were two scientific results that derived directly from the MERIT/COTES activities, which were aimed at not only improving the accuracy of the determinations but also at increasing the frequency of the determinations and at densifying the network

of stations. The first was that the short-period variations in UT were due largely to changes in the angular momentum of the atmosphere and the second was the demonstration that the current motions of the tectonic plates were largely in agreement with estimates made by geophysicists from geological studies. For the first of these we needed the support of meteorologists and Professor Raymond Hide of the Meteorological Office did much to encourage the necessary data collection and calculation. A permanent service for the computation of atmospheric angular momentum became part of the IERS. In recent years the name has been extended to 'International Earth Rotation and Reference Systems Service', but the acronym has been left unchanged.

6.3.4.5 Other national activities

Our involvement in satellite laser ranging and the rotation of the Earth led to our attending meetings concerned with geophysics and geodesy as well as meetings of the RAS. The Joint Association for Geophysics linked members of the RAS and of the Geological Society, which also had premises in Burlington House in Piccadilly. I believe that this organised the Geophysical Discussions that were held on the same day as the ordinary meeting of the RAS. In addition it sponsored UK Geophysical Assemblies that were organised annually, in turn, by universities with strong geophysical groups. These lasted 2 or 3 days with parallel sessions as they covered a large number of specialist topics. The timekeeping was, however, very strict so that it was possible to go from one session to another without missing the end of one talk or the start of the next.

I also attended some meetings of the Association of British Geodesists, but its role was taken over by JAG and it was wound up. I also spoke at a meeting of the Royal Institute of Chartered Surveyors. We also made a presentation at a 'Mason Conference' during the annual meeting of the British Association for the Advancement of Science in Glasgow in 1985. These meetings were intended to give the BAAS members the flavour of a meeting of a professional society, but we soon realized that we had to explain our work in considerable detail as only the other speakers were familiar with the background.

During such meeting I came to know geodesists in the Ordnance Survey and in the Department of Military Survey and, as a consequence, I was invited in 1979 to join the Geodesy Subcommittee of the Royal Society. I was unexpectedly nominated to be the chairman of the subcommittee in 1982. I accepted, but I was embarrassed when I realized that Alwyn Robbins, a Reader in Geodesy at the University of Oxford, had expected to continue as chairman. This position led to my becoming a member of the British National Committee for Geodesy and Geophysics (also within the Royal Society) and the chief UK delegate at the General Assembly of the International Association of Geodesy in Tokyo in May 1982.

6.3.5 The libraries and archives

The expansion of the activities on libraries and archives that followed the appointment of Janet Dudley in 1978 has been described in section 5.5.7. During the 1980s her enthusiasm and professionalism led to an even greater expansion of the work on the archives and it was sad day for the RGO when she resigned in 1987. She was joined by Jon Hutchins as a qualified assistant librarian in December 1981. Jon gave the first of a new series of lunch-time talks about the work in the RGO on 30 June 1982; his title was "Why librarians are not boring". He was promoted to Librarian grade in 1987,

but he left suddenly in 1989 before the move to Cambridge. Some students of librarianship gained useful experience in the RGO library; one was Nick Wyatt, who later joined the staff of the Science Museum Library.

The library was vital for the current work of the RGO, but its books and archives were a valuable resource for the history of astronomy and other fields of science, technology and even social history. Consequently, exhibitions of some of its holdings were prepared for display in the Castle and elsewhere. At the RAS *Conversazione* on 13 February 1987 there was an exhibition that linked William Herschel's original 40-foot telescope, which was first used in February 1787, to the new WHT on La Palma. A second display marked the centenary of the Astrographic Conference in Paris in 1887. An illustrated overview of the Library and Archives is given in the 1985 report.

6.3.5.1 Changes in the library services

The period saw further transfers of journals and books between the Castle and the various sub-libraries in the West Building, the Physics Building and on La Palma so as to make journals and books required for current use more readily available. Unfortunately, the sub-libraries were not supervised and stock checks revealed that many books were 'missing'. A listing of the holdings of periodicals was prepared and distributed widely. The library's book catalogue on index cards was transcribed so as to make an on-line catalogue that could be searched remotely and more quickly. This catalogue was mounted on a computer at the Rutherford Appleton Laboratory. Details about such changes, requests for missing books, etc., were given in the RGO Information Bulletins and Circulars and occasionally in *Gemini*; for example, an article by Jon on 'Libraries unlimited or Text retrieval in the machine age' was given in *Gemini 18*.

There were further sales of surplus rare books and the Airy Collection of rare books was transferred to new cabinets in the chapel in 1984.

The library became the custodian of artefacts of historical interest. Amongst them were copies of an ivory relief of a bust of the first Astronomer Royal, John Flamsteed. These were made by John Le Marchand, at the time of the RGO Tercentenary in 1975, from an original which was presented to the Observatory in 1777. Janet appealed for information about their whereabouts in February 1987. She must have been successful since she gave me one of the copies. There is an article by Adam Perkins on 'The treasures of the RGO' in *Gemini* 23, and a short article by Robin Catchpole on 'Historical artefacts at the RGO' in the last issue of *Spectrum*. These artefacts were to go to ROG when RGO closed. The NAO had an arithmometer and various items relating to computation, but I do not know where they are now.

One of the casualties of the great storm (or hurricane) of 16 October 1987 was G. B. Airy's very large commemorative vase that stood on a plinth in the east end of the chapel. Unfortunately the glass skylight (which had wires across it to mimic the wires in a transit circle) fell on it and smashed it into small pieces. Subsequently, Rosemary Yallop drew attention to a report by Flamsteed of a hurricane in 1703 and Adam Perkins appealed for photographs of damage for the archives. Some are shown, with the meteorological records and with a photograph of the vase before it was smashed, in *Gemini 18*.

6.3.5.2 The conservation laboratory

Tony Bish's work in the new conservation laboratory (see section 5.5.7.1) did not attract much attention, but its worth will be appreciated by the historians of the future. He resigned in March 1984 to take up a more highly paid post at the Wellcome Institute in London and he was replaced by Ian Maver, from the University of Glasgow, who joined in October 1984. In November 1986 he spoke at a conference on 'photographic conservation' about the work done on the RGO collection of solar plates; his interesting report on the conference is in IB 85/12.

The conservation laboratory was moved to the SW turret of the Castle, above the kitchen, so that the first site could be converted to make more accommodation for visitors. The laboratory was not moved to Cambridge, but I believe that Ian was able to buy much of the equipment so that he could set up an as an independent conservator after taking VPR.

6.3.5.3 The archives and the Laurie Project

The Laurie Cataloguing Project was started in 1983 by the award of a grant of £36000 by the Manpower Services Commission under the Community Programme Scheme for the cataloguing of the RGO archives. The grant met the cost of employing a professionally qualified supervisor, 6 archive assistants and two administrative staff for a period of one year. The name recognised the major contributions to the archives made by Phil Laurie, who had died in 1982. The work was so successful that the project was continued almost up the move of the RGO to Cambridge. The supervisor, Adam Perkins, started work in the Castle on 11 April and the rest of the team started by the end of the month. Most (all?) of them were graduates who were pleased to get an interesting job and so they worked with enthusiasm. For the fourth year of the project the number of staff in the team rose to 18 and for the fifth year the grant was £800000.

A brief account of the first two years of the project is included in the 1985 report. The names of the members of the team are listed there, but their appointments were not given in the IBs, presumably since they were not employed by the RGO. I trust that the team kept full reports and staff lists for the archives! I believe that the team was based in the Castle, but where?

The main collection of documents was stored in the Castle. The older ones were in the room off the library landing and through which Janet Dudley passed to her office in the NW turret. Others were in rooms under the library. The astrographic plates, most of which had been moved from Greenwich, were in the EQ group, while the solar plates, also mainly from Greenwich, were in the newly converted atomic-clock cellar in the West Building. (See section 5.5.7.1) The archives of the NAO and Time Department were also moved there.

In addition to sorting and listing the documents the team carried out a variety of other tasks, including listing the large stock of solar and astrographic plates and prints. It carried out conservation work on documents and plates under the direction of Ian Maver. It prepared a series of educational work packs for schools on such topics as 'Voyages of Discovery', as well as on topics more directly related to the Observatory and the Castle. (See appendix F.2) It also started a sound archive based on interviews with long-serving members of staff. Adam Perkins gave a lunch-time talk about the archives and the project on 23 June 1986. He also gave talks to other local organisations. I cannot, however, find any published article by him or Janet about the

archives and the project, but I feel sure that some must be available! There are some items about individual aspects in the information bulletins and circulars. The final issue of *spectrum* contains an article by Adam on ‘All Astronomers Royal: the legacy of Airy’, but only a small part of this is about the archives themselves.

When the Castle was sold prior to the move to Cambridge, the archives and the team had to be moved from the Castle to the West Building. The Laurie project came to an end on 31 August 1988, but it was replaced by another (CHART) with a small team to deal with the relocation of the archives to the Cambridge University Library. A short article about the Laurie project by one of the team members, Andy Shaw, is attached to the Reporter sheet for item 88/89.

6.3.5.4 The use of the archives

There was a steady stream of visitors to the RGO to use the archives, and some of them used to have lunch in the canteen so that I got to know them. A few examples:

Dr John A Chaldecott, who had retired from the Science Museum and lived in Eastbourne (or nearby), came many times in connection with his work on scientific instrument makers of the 17th and 18th centuries and on other topics.

David Harries came about chronometers. He remembered me in 2001 when I gave a lecture to the Wiltshire Astronomical Society and he also remembered that we had attended the same school in Croydon, although he was there before me. My memory was not so good!

Derek Howse, author of *Greenwich Time and the Longitude*, was a frequent visitor.

David Hughes, from the University of Sheffield, came to study Edmund Halley as he was particularly interested in comets.

Professor Ed Kennedy, from Saskatoon in Canada, came in 1984 in connection with an interest in sunspots and related phenomena, but I recall his interest in surveying. The obituary in *A&G* 41, 2.36, mentions his interest in Airy and the Maine-New Brunswick border surveys. (Airy’s assistants, Mason and Dixon, had surveyed the boundary between Canada and the USA.) My wife and I became friends with Ed and his wife Caroline, and they visited us in Devon after my retirement.

Lesley Murdin, wife of Paul Murdin, was occasionally employed as a short-term CO, but she also came to use the archives from time to time as she was particularly interested in the Flamsteed papers.

Others included Carole Stott from ROG, who later married David Hughes; Frank James, from the Royal Institution; and Patrick Wayman.

By far the largest and most-used class of the early archives is that for the Airy period. This reflects both his wide interests and his insistence on keeping copies of all his correspondence. One topic of particular interest is his involvement in the search for the planet (later named Neptune) predicted by J C Adams to explain the perturbations of the orbit of Uranus. The correspondence was found to be missing. Laurie had suspected that they had been taken by Eggen and so in 1981 Graham Smith wrote to him to enquire if he had any knowledge of the whereabouts of these and other papers that were missing. Eggen denied any such knowledge. The loss of the ‘Neptune papers’ was the subject of articles in astronomical journals in 1988 and later. (See appendix G.11)

Eventually the Neptune papers were found in Eggen's office at Cerro Tololo after his death in 1998 and were returned to the RGO archives with enough other archival material to fill three tea chests!

6.3.6 Other international activities

Throughout this period I was involved from time to time in international activities that followed from my participation in IAU Commission 5 on Documentation and Astronomical Data. I had been elected Vice-President of the Commission in 1979 and served the standard term of 6 years while Heintz Wolff was President. This did not require much action on my part, as far as I can recall, except that in 1985 I was asked to represent the IAU on the International Council for Scientific and Technical Information (ICSTI). This organisation had replaced the ICSU Abstracting Board in which the IAU had an interest because of *Astronomy and Astrophysics Abstracts* and *Physics Abstracts*, which contained much of interest to astronomers. I attended my first meeting in Baden-Baden in 1985.

I also attended other ICSTI meetings, including general meetings in York in 1986 and New York in 1987. I also arranged a meeting of the ICSTI Numerical Data Group at the RGO in December 1986. It seemed to me, however, that the activities of ICSTI had little relevance to the IAU and, on my recommendation, the IAU discontinued its affiliation after 1987. I renewed my link with CODATA and attended its conference in July 1986 in Ottawa, where I presented a poster paper about the data activities in Project MERIT.

I became President of Commission 5 at the IAU General Assembly in Delhi at the end of 1985. By this time the attendance by librarians had fallen away, but Brenda Corbin, from USNO, and Robyn Shobbrook, from AAO, were present and convinced me that the Commission should try harder to keep up its links with librarians and documentation. In 1979 the Commission had taken over the role of the Working Group on Numerical Data and its meetings had become increasingly dominated by this type of activity. Moreover, librarians had found it more difficult to obtain funds to attend the meetings since so little of the discussions were related to their interests. As a consequence I obtained the agreement of the IAU Executive Committee to the holding of IAU Colloquium 110 on *Library and Information Sources in Astronomy (LISA)* at the time of the next General Assembly, which was to be at Baltimore in 1988. In addition Brenda obtained the support of Gart Westerhout, the Scientific Director of USNO, to holding the meeting at USNO in Washington during the week before the GA. This meeting proved to be extremely successful and led to a series of such meetings. I edited the proceedings of LISA 1 with Sarah Stevens-Rayburn of the Space Telescope Science Institute at Baltimore, and after my retirement I attended LISA 2, which was held in 1995 at the headquarters of the European Southern Observatory, near Munich. (Incidentally, I stayed at the home of Bob and Tricia Fosbury, who had worked at RGO, even though they were away most of the time.) The later meetings were not, however, held close to the IAU GAs and so only a few astronomers attended them.

While I was President I used to prepare and distribute a newsletter about activities by, or relevant to, the Commission. I suppose, however, that my most significant contribution was the preparation of a completely revised version of the *IAU Style Manual*, which was published as Chapter 8 of the *Transactions of the IAU* for the 1988 GA and made available as a separate booklet. The manual was dedicated to the memory of Donald Sadler as he had been responsible for the original version when he

was the General Secretary of the Union and edited the Union's publications. It was hoped that the manual would also be used by other astronomical journals but, unfortunately, Helmut Abt, the editor of the *Astrophysical Journal*, objected to the standard international recommendations for the abbreviation of the names of journals in references. He used the very short forms that are understood by astronomers, but not by readers from other disciplines. A meeting of editors of astronomical journals was held in Paris in May 1988, before the new manual was ready; Abt pressed his view and most other editors followed his lead.

After my retirement I attended the IAU GA in Buenos Aires in 1991, while I was still President of Commission 5, and the IAU GA in La Hague in 1994. I was then chairman a small working group on the revision of UDC 52. I spent a lot of time on this project, and some short papers were published in 1994 and 1995, but the detailed proposals went into a black-hole at the British Standards Institution and I abandoned the project. I also attended the IAU GAs in Kyoto in 1997 and Manchester in 2001.

6.3.7 Administration

Bob Gordon continued as head of the Administration Division until his retirement on medical grounds at the end of October 1984. His role as the Secretary of the Observatory had, however, been taken by Peter Davies. My understanding is that Davies dealt with policy, while Gordon supervised the day-to-day running of the Division. The 1985 report shows that Davies formally became head of the Division and Gordon's role was taken by Jim Sadlier in a lower grade than Gordon. The 1985 report distinguishes between 'general administration', headed by Sadlier, and 'scientific administration', with many fewer staff but headed by Peter Andrews in a higher grade. These activities are described under 'public relations' in section 6.4.1. The structure chart in the report also shows 'Herstmonceux site services' within the Administration Division, but no staff are listed under this heading; the staff of the 'Works Unit' are, however, listed under general administration

In the 1987 report the responsibility for the grounds is included in scientific administration, but the works unit is no longer shown. This report also shows a 'Relocation Officer', P J Bradbury, with the same grade as Sadlier.

Canteen. The staff canteen was privatised in January 1985 and some of the staff transferred to the new organisation. Miss Margaret J Brett, who had been on the staff when I joined in 1951 and who had risen to become Supervisor in the report for 1979/80, is, however, shown as a messenger in the 1985 and 1987 reports. A cafeteria service for the public was started in what had been the garages by the West Entrance of the Castle. A trolley service was introduced in the West Building, but it was withdrawn in October 1988. The contract for the canteen terminated at the end of 1988. A six-course Christmas lunch (costing £5.50) was served on 21 December in the Ballroom, rather than the dining room. It was announced that a new service would start in the West Building, but there was change of mind and it continued in the Castle until this was vacated at the end of April 1989. The new service offered take-away fish and chips for 99 p on Fridays! The public cafeteria was used for staff lunches when the Castle was vacated at the end of April 1989. There was, however, an unexpected delay and some staff went hungry on 2 May.

Safety. I was chairman of the RGO Safety Committee from 1982 to 1988. We had an enthusiastic safety officer, Alfred Heath, who had come from RAL in 1978 and who

also served as training officer for a while. By 1985 A D White had replaced Heath, who did not retire until October 1986.

Training. The 1985 and 1987 reports do not, however, show anyone with specific responsibilities as a Training Officer, although two such part-time positions are shown in the 1979/1980 report. Talks on topics related to the work of the RGO were given from time to time in the lunch-hour.

An innovation was the series of “RGO Lectures” on non-astronomical topics. The first was given in October 1988 by Dr Hellen Rendell of the University of Sussex on “Dating human evolution: early man in Pakistan”. It was given at 3.30 pm in the conference room in the Castle; all staff were ‘welcome to attend, provided supervisors agree’, but clearly not all were expected! The second was given in January 1989 by Dr. Michael Rycroft of the British Antarctic Survey on “The springtime Antarctic depletion”. The third was given in the Clubhouse in July 1989 by Professor Margaret Boden of the University of Sussex on “Artificial intelligence”.

6.4 General activities in 1981 to 1990

6.4.1 Scientific administration and public relations

Public relations became a much more prominent activity under Boksenberg although it was disguised under the term ‘scientific administration’. Whereas the supply of information to the public used to be dealt with on a part-time basis by one person (see section 5.5.8.5), seven persons are listed for this activity in the 1985 report, which includes further information about it. One of them, in a non-complement position, was Nigel Henbest, who became Heather Couper’s partner in the production of many books and television programmes.

One innovation was the introduction of a programme for “Artist and composer in residence”, later called ‘vision and sound residencies’, whereby the South East Arts organisation funded posts for artists to produce works of art that would result from the stimulus of the scientific environment of the RGO. The initial period was for six months from 1 April 1987 for the composer Ron Geesin (of *Sunday, Bloody Sunday*) and the artists Susan Gamble and Michael Weynon. The scheme appears to have been extended for a further six months as the two artists returned in June 1988 to say goodbye to those who had helped them or shown an interest in their work. Their activities are described in two articles in *Gemini 17*.

The observatory on La Palma and new discoveries in astronomy attracted the attention of the media and so RGO staff were involved in radio and TV programmes about them. Many of them are noted in the IBs. Even the archives of the RGO attracted media attention as Adam Perkins spoke about them on Radio Devon in March 1989.

6.4.1.1 The Castle as a visitor and conference centre

The annual Herstmonceux Conferences were held in the Long Gallery (Ballroom) and they are listed in the last issue of the RGO house journal *spectrum*. Smaller short meetings, such as the joint seminar with the University of Sussex, talks by visitors and training lectures were given in the former chapel. The West Building Canteen was brought into use for such meetings after all the astronomers had moved

from the Castle. Boksenberg decided, however, that much more use should be made of the Castle as a conference centre. New antique-style tables and chairs were purchased for the Lady's Bower room, which had been converted for use as lecture theatre (see section 5.5.8.2). This room was accessible either from the Staircase Hall or the grand staircase in the centre of the east wing. The Lady's Bower window gave a view over the moat and towards the Equatorial Group. Many of the events were for small groups of UK participants, but some were for international workshops. It was also used for appropriate RGO meetings. The adjacent smaller room that had been used by the typing pool was used as an ante-room for poster displays. In addition, improvements were made to the accommodation for visitors.

My recollection is that the panelled room that had been used as lounge by Sir Harold Spencer Jones was used for occasional meetings by the SERC Council, Boards and committees. IC 83/04 mentions the completion of a lecture room on the ground floor; this may be previously used for the conservation laboratory or perhaps it was where Spencer Jones had his very large office.

Workshops. Most of the workshops were for astrophysics or instrumentation and are listed in the 1985 report, but the A&T Division organised several meetings to make use of this attractive facility. The international meetings were:

the second MERIT Workshop in May 1983;

a meeting of the European group for laser ranging to satellites (EROS) in March 1984;

the fifth International Laser Ranging Workshop in September 1984;

a meeting of the ICSTI Numerical Data Group in December 1986; and

a conference on celestial mechanics in September 1987 to mark the 300th anniversary of Newton's *Principia*;

while the UK meetings were:

a workshop on dynamical problems in the Solar System in September 1983;

a summer school in space geodesy in September 1984; and

two meetings on Project Longstop (for long-term integrations of the motions of the planets) in October 1984 and March 1985; and

meetings for artificial-satellite observers (mainly amateurs) in March 1985 and September 1987.

The closing dinner of the MERIT Workshop was held at the nearby White Friars Hotel, while that for the celestial mechanics conference was held at Drusilla's, near Wilmington.

Exhibition. The exhibition in the north wing of the Castle (see section 5.5.8.4) was improved and continued to provide some public access and views of the inner courtyard. Otherwise, public access to the Castle was normally limited to events in the Long Gallery, which was reached by the west entrance and the library staircase. Some outside organisations were allowed to arrange musical concerts and other such events in aid of charity. In September 1983 the Men of the Trees held their AGM and Jim Clark, the Head Gardener, and I spoke to them. (I was a member.) In September 1985 the Women's Institute was allowed to hold a major event that involved several rooms in the Castle and stalls in the gardens.

The exhibition, apart from the section on the history of the Castle, was transferred to the Equatorial Group and was formally opened in May 1986 by the Spanish Ambassador. Visitors were allowed to see some of the telescopes. A travelling exhibition to mark the 20th anniversary of the establishment of SERC was mounted in the Equatorial Group and 1200 invited schoolchildren came to see it and various parts of the RGO.

Other events. The Federation of Astronomical Societies held its annual meeting in the Castle from 1981 onwards. Lectures were given in the Long Gallery and Clubhouse, while the dining room was used for trade stands. I recall a Solar System display in the courtyard and a colourful comet banner over the door of the library. The participants were given the opportunity to see various aspects of the work of the Observatory.

The Nature Trail was also improved by the provision of more signs around the 2-km walk and by the inclusion of new waterfalls and rock pools. More material was provided for teachers and school parties were encouraged to visit the Castle and its grounds. A workshop for teachers was held in January 1984.

Radio and TV science-programme makers came from time to time. The Castle and its grounds were also sometimes used as settings for scenes in films that had no connection with astronomy.

“The John Dunn Programme “ of BBC Radio 2 was broadcast live from RGO on Monday, 1 April 1985. It included interviews with about ten members of staff. A photo by Norman King in IC 85/05 just shows me being interviewed beside the SLR telescope. Shortly afterwards BBC Radio 1 held a “Family day out” on Bank Holiday Monday, 27 May 1985, in the grounds and thousands of visitors were expected. There was a live broadcast of the Radio 1 Roadshow during the afternoon. .

A display of hot-air balloons was held at the Castle on 19-20 September 1987, but unfortunately the weather was unfavourable and some of the twenty balloons did not fly. Another show was held in the following year on 17-18 September 1988.

6.4.1.2 National Astronomy Week & Comet Halley

National Astronomy Week was held in November 1985 at a time when Comet Halley was in the northern sky and approaching its perihelion passage in the southern hemisphere. Special arrangements were made to allow members of the public to observe the comet through the Yapp telescope. A special exhibition with historical material from the RGO archives was prepared and this was also open during the day. Images of the comet were obtained on La Palma and were shown on TV programmes. Members of the staff gave talks and were interviewed for radio broadcasts. There were nearly one thousand visitors. The EQ Group also featured on a special postcard and a first-day cover to accompany the special Comet Halley stamps.

A display from the RGO’s archives and rare books was mounted at the Royal Institution in October 1985 to accompany a lecture by Carl Sagan about Comet Halley.

6.4.2 Various staff matters

During this period many members of the RGO received honours and awards of various kinds and I have attempted to compile a list of them in appendix C.8. The

highest civil honour was an OBE to Paul Murdin in the 1988 New Year Honours. A summary of his career was given by Chas Parker in IB 88/02. The former Director, Graham Smith, was made Astronomer Royal in November 1982 and an account of his career is given in *Gemini* 5. After his knighthood in 1986 he became known as Sir Francis.

Some members of the staff also served as officers of the Royal Astronomical Society or of other such societies. For example, Gordon Taylor, who took VPR from the NAO in 1984, was appointed Director of the Computing Section of the British Astronomical Association in 1987; he is still in that position in 2009. I served on the Council of the RAS for a second term of three years in 1983/1986 and then as a Vice-President for one year, 1986/1987. I also served on its Library Committee. In March 1987 Heather Couper, who was then the President of the BAA, and I arranged a joint meeting of the RAS and BAA on the interactions between amateur and professional astronomers; several members of the RGO took part.

The retirements of several staff who had served for long periods are included in a list in appendix C.7. For most of them brief details of their careers are given in the IBs or in *Gemini*. Sometimes, photographs taken at the retirement presentations and/or parties were reproduced, rather poorly, in the IBs. For example, Bill Nicholson, who had served for 10 years as the secretary of the RGO Club, retired on 11 May 1986 and was given a farewell party, with a kissogram girl and a descriptive poem, in the Clubhouse. The deaths of staff-in-post and of retired staff are also noted in the IBs and in appendix C.13.

The RGO Club continued to play an important role in providing sports and social activities for its members and helped to keep up the morale of the staff even when faced, first of all, with the cutting of staff numbers and, later, with the relocation to Cambridge. An account of the Club activities is given in appendix D.

6.4.3 Other events and activities

There was some severe weather in January 1987 as the February IB starts with “Phew! What a freezer!”. It appears that roads were blocked by snow for a while. Later that year the ‘hurricane’ of 16 October caused much damage in the grounds, as well breaking Airy’s Vase. There is an article with charts and photographs in *Gemini* 18.

The Chronometer Department, which was no longer part of the RGO, was closed in 1986 and the work was transferred to a contractor. A note by Bert West is reproduced in appendix B.4. Its workshop on the top floor of the West Building, with its north-facing windows, was taken over by the drawing office. See also the notes by Bill Roseman that are listed in appendix G.1.3.

6.5 The relocation to Cambridge

The Information Bulletin for October 1986 started with the heading RELOCATION REPORT, and it reviewed the actions that had already been taken by SERC in advance of receiving the formal approval from the Department of Education and Science and the Treasury. The outline timetable for the construction of the new building at Cambridge envisaged that the move would start at the end of 1989. From then on information about relocation matters was promulgated in a series of 11

Relocation Bulletins between 17 October 1986 and 5 December 1988, and then in individual paragraphs in the *Reporter*.

For convenience I kept a 'personal set of papers' that supplemented (and partly duplicated) the official papers in the A&T Division files relating to the relocation. The following sections have been written from memory with only occasional attempts to verify the statements that are included.

6.5.1 Administration

A major change in the structure of the Administration Division was made on 1 September 1988. Jim Sadlier remained head of general administration and a new SEO, Peter Bradbury, was put in charge of 'relocation and site disposal'. The latter included the staff for the Castle, grounds and exhibition who would not be needed in Cambridge. A new structure chart was issued in March 1989.

6.5.2 Castle

The SERC needed to recover the costs of the move to Cambridge as soon as possible and so it was envisaged right from the start that the buyer might wish to occupy the Castle and much of the estate before the move was completed. Ray Foord, who had taken VPR in 1984, was temporarily re-employed to look into the implications of this possibility. The Castle was put on the market in May 1988 and the sale to James Developments was announced on 21 October 1988. The guide price was between 6 and 10 million pounds, but the agreed price was not stated. The developer intended to build a championship golf course and other leisure facilities, while the Castle would be used as a hotel. The purchase of the Castle and most of the grounds, including the EQ Group but not the West Building, was to be completed in May 1989. Most of the activities in the Castle had ceased by the end of 1988; for example, accommodation was no longer provided for short-term visitors. All use ceased at the end of April as the developer formally took possession on 2 April 1989.

In addition to the West Building and SLR dome, the hand-over arrangements allowed for the continued use of the cafeteria by the Castle, of the EQ Group, of the outdoor sports facilities and of the Clubhouse. Staff could also continue to walk around the gardens in working hours. The west gate was closed at night, but staff could enter by the east entrance by opening the barrier with their APT cards.

The requirement to vacate the Castle in advance of the main move meant that much effort was wasted in moving facilities and staff to the West Building. Other materials became surplus to requirements and so were sold at knock-down prices, as is shown by the price list for bedlinen. The editors of *The Observatory* were forced to dispose of their stock of back issues of the magazine, including some long runs, and offered them to staff, but most were scrapped.

The Royal Commission on Historical Monuments took the opportunity to make a photographic record of the Castle.

The last public opening of the Castle and grounds took place over 10 days in April 1989 with a total attendance of 9000 visitors. A craft fair was held in the Castle over the weekend and there were 4000 visitors.

A "Farewell to the Castle" party was held during the evening of Saturday, 22 April 1989. Current and former members of the staff were invited to bring one guest.

Food and some drink was provided, and pay-bars were available. Some photographs taken at the party are to be seen in *Gemini 24*. I have been surprised to see that it includes a photograph of me with Marcia King (wife of Norman, with whom I had won the SERC men's doubles tennis tournament), Jean Nicholson (wife of Bill, with whom I had shared a room in the NAO for many years) and my own wife, Betty. The photographs were probably taken by Norman King as he was a keen photographer. Over 500 past and present staff attended with their guests.

I do not know the fate of the many paintings and other objects of historical interest in the Castle. I trust that those relating to the RGO were taken to Cambridge or transferred to ROG, but I suppose that those relating to the Castle may have been sold to the developer.

6.5.3 Library and archives

The decision to move the RGO to Cambridge had major consequences for the library and the archives. Initially it was stated that that "it remains the intention of the RGO to maintain the archive in its building at Cambridge", but in the event the archives were transferred to the care of the Cambridge University Library. Nothing was then said about the future of the library, which was then probably the finest astronomical library in the world, and in the event it was split into several parts.

The decision to move to Cambridge, coupled with the disciplinary proceedings, probably prompted Janet Dudley to apply for the post of Head Librarian at the Royal Signals Research Establishment at Malvern. She was successful and the RGO was the loser. A special lunch was held in the Ballroom on 13 May 1987 to mark her move and Ron Geesin, the composer in residence played "Janet's passion" in her honour on a xylophone. I believe that Jasper Wall made a presentation from the staff and Joy Hamblyn presented her with a bouquet from IPCS. Jon Hutchins became librarian (and was promoted) and Adam Perkins, as head of the Laurie Project team, became fully responsible for the archives. Peter Andrews was given responsibility for the oversight of the library and archives from April 1989, when my responsibility for the ASD Division ceased. Shortly after this Hutchins resigned suddenly and two temporary assistants (wives) were appointed. Another qualified librarian, Ingrid Howard, was eventually appointed.

The Laurie Project office was moved to the West Building in August 1988 but the project stopped at the end of the month. A small nucleus of the team, led by Andy Shaw, formed a new group, known as the Cambridge Herstmonceux Archives Relocation Team (CHART), to deal with the move of the hundreds of boxes of documents and of the solar plates. Not surprisingly, Shaw left the RGO in March 1989 when he had the opportunity to work at the County Records Office in Lewes. The archives in the Castle were transferred directly to the Cambridge University Library by April 1989, but those held in the West Building were not moved until later

In May 1989 all staff were "advised to make an immediate start on the task of weeding through their office contents, disposing of as many items as possible to archives, stores, the library or the dustbin". This led to a later instruction that "Adam Perkins should be consulted on what should be archives". I suspect that historians of the future will find more gaps than usual in the records of the work for this period.

The accommodation provided for the library in the new building was quite inadequate and so the librarian had the difficult task of deciding which books and

journals should be taken to the new building, which should be passed to the Cambridge University Library and which should be disposed of in some other way. In the meantime, some of the stock was moved from the Castle to the West Building and made available in the old ICL computer area of the NAO spur, but the rest was put into boxes to await the removal to Cambridge. Surplus back numbers of astronomical journals were offered to staff and the stocks of RGO publications were drastically weeded. Some material must have been 'lost' in the move as I found copies of a computer journal from the NAO library for sale in a bookshop in Eastbourne.

6.5.4 EQ Group

My understanding is that the SERC failed to make any explicit provision for future of EQ Group and merely relied upon the intentions of the developers, as stated in their press release in October 1988, "to establish the continued and probable increased use of the scientific buildings and their equipment, in order to attract and expand worldwide public awareness and participation in science and industry". (The draft press release is on the back of IC 88/129.) The press release referred to discussions with Professor Richard Gregory of the University of Bristol, who was responsible for the science exhibition centre (The Exploratory) in Bristol. He and Patrick Moore had visited Herstmonceux on a beautiful day in May 1988 and were shown around by Paul Murdin, Chris Benn and myself. Public access to the Group and to the exhibition in it continued more or less as before, with ex-members of the RGO acting as stewards.

I do not know what conditions were attached to the empty INT dome, which lay to the south of the EQ Group. I have a recollection that there was a proposal in the 1980s that it should be demolished, but this was rejected as it was said to be a navigational aid for shipping in the English Channel. The dome and was fitted with a retroreflector so that it could be used in calibrating the SLR system.

6.5.5 Astrodynamics

6.5.5.1 H. M. Nautical Almanac Office

The proposal for the NAO after my retirement envisaged a considerable reduction in staff. I feared that such a small group would not be viable and that it would be better if the production of the almanacs were to become part of the responsibility of a larger group within the RGO. This would imply, however, that it would be inappropriate to retain the name of the Office. Accordingly I drafted a proposal along these lines and passed it for comment to Bernard Yallop, who was expected to take full responsibility for the almanacs when I retired. He was, however, very much in favour of keeping the name, and so I changed the thrust of my draft. I passed the revised version to Andrew Sinclair, who was the other PSO in the NAO, as well as to Yallop. Sinclair, who had not seen the original draft, argued that the name should be dropped "while we all have respectful memories of the achievements of the Office". I decided, however, to stay with Yallop's view as Sinclair was expected to move out of the NAO to take charge of the SLR team. My memorandum prompted the following comment from Boksenberg: "I consider that there is a good long-term prospect for the work of the NAO and its development. My decision is to retain the name of the Office in full and I wish to encourage the exploitation of its potential".

6.5.5.2 Satellite tracking

King-Hele and I (with the backing of others outside the RGO) continued to argue for the retention of the SLR system at Herstmonceux even after the SERC had decided that the RGO should move to Cambridge. The original suggestion was that the system should be moved to Cambridge and I was disappointed to find that Andrew Sinclair, who would be in charge of it, was resigned to such an action. We were, however, able to convince SERC that it should stay in place. The main arguments for this were as follows. Firstly, the value of maintaining the continuity of the observations from the same site so as to improve the accuracy of the measurements of the coordinates and motions of the site with respect to other SLR stations; such results were used in the improvement of the International terrestrial reference frame and in studies of the movements of the tectonic plates. Secondly, the fact that we had shown that good results could be achieved at Herstmonceux, whereas the weather conditions at Cambridge were much poorer. Thirdly, that the move would involve a loss of observations for some considerable period, especially if the experienced staff did not move to Cambridge, and that the costs of a new building, and possibly of new equipment, would be considerable and unnecessary. I was also concerned that the project would be abandoned once the Herstmonceux system had been dismantled. There was also a suggestion that responsibility for the system should be transferred to the Rutherford Appleton Laboratory, but this was rejected by the SERC Director for Laboratories. The developers agreed to the operation of the SLR being continued for up to 15 years.

The RGO took over from the University of Aston on 1 April 1988 the responsibility for the operation of the Hewitt cameras at Herstmonceux and at Siding Spring Observatory in Australia, but the project was expected to stop in March 1990. The Australian camera was used by another group for a few more years.

6.5.6 Other instruments and equipment

The PZT and RTC in the Spencer Jones (Meridian) Group had already been taken out of action and had been mothballed. The PZT and its control panel are now held by Science Museum in a store. The control panel for the Greenwich Time Service is also there, perhaps with other Time-Service equipment, such as the phonic motors that transmitted the 6-pips signal to the BBC, and the display cabinet containing early valves and other such items of historical interest. Some of the caesium frequency standards went to the SLR.

The occultation machine that had been used by the NAO for the prediction of occultations by the Moon was transferred to ROG, although the earlier version of the machine is held by the Science Museum.

Surplus machines from the Engineering Workshop were sold and I suppose that the VAX computers and similar items were sold for scrap.

I do not know what happened to other substantial items of equipment but I hope that information will be on file in the archives. It would be interesting to know, for example, what happened to the GALAXY measuring machine; as far as I am aware, it did not go to Cambridge for use there and I have not found any mention of it in the information circulars or in the last issue of *spectrum*.

Many minor items of equipment were offered for sale. For example, I bought for a small sum a Brunsviga mechanical calculating machine. The short period allowed for the move did not allow for proper consideration of the historical and commercial value of such items. I do not know what happened to items that were not bought by the staff.

6.5.7 University of Sussex

One of the arguments for moving the RGO to a new site was so that it would benefit from interactions within a university. This ignored both the value of the existing strong links with the astronomy centre of the University of Sussex and the deleterious effects of a move on the astronomers of the centre. The last joint seminar was held in what had been the West Building canteen on 23 February 1990, when Professor McCrea spoke on “Mind and the Universe”.

6.5.8 Effects on the staff

The work of the staff of the Observatory throughout most of the 1980s was affected for the worse by the uncertainties about whether or not their jobs were secure and about whether or not they would have to move, either to La Palma or to a university city or to a new job elsewhere. Time was taken up in reading and discussing the proposals and in trying to understand the various regulations concerning redundancy and transfers, as well as in the grass-roots campaign “to save the RGO”. In addition, much of the effort of senior staff was spent, not in planning the scientific and technical work nor in thinking about theory or observational results, but in reading, discussing and writing reports and memoranda related to the future of the work of their groups or of the RGO as a whole. Consequently, during these years the scientific output of the Observatory must have been considerably less than would otherwise have been the case.

Staff who saw their jobs at risk, in either the short or long term, were faced with the options of resignation if they could find another job, or of VPR if they were eligible, or of transfer to another establishment in SERC or the Civil Service generally, or of being given redundancy terms. The issues of the *Reporter* show that many good staff chose to resign. Some staff made early moves to Cambridge, while others found jobs with the developers at the Castle. A small number of staff stayed with the SLR at Herstmonceux, and they included some who had not previously worked in the team. Some of the staff whose jobs moved to Cambridge decided to keep their homes in Sussex, especially if they were expecting to retire within a few years. But others wished to avoid the upheaval of a change of house and garden and the loss of contacts with relatives and friends or they did not wish the members their families to have to change schools or jobs where they were well established. The results in June 1989 of a survey of ‘mobile staff’ who would be expected to move to Cambridge showed that only 38 out of 70 intended to transfer, although a further 9 would go if the transfer terms were sufficiently favourable and others were expected to go if their other options failed. Even so, it was “clear that there will be some shortfall of staff transferring to Cambridge”. As a consequence, it is likely that the productivity at Cambridge was low for some time after the move was nominally completed.

The chairman of SERC visited the RGO on 18 May 1989 and he had the courage to talk to the staff after lunch! The meeting was in the Clubhouse as none of the meeting rooms in the West Building were large enough.

6.5.9 New building at Cambridge

The new building at Cambridge was not in a prominent position on the Madingley Road as Boksenberg had hoped, but instead was relegated to the back garden of the Institute of Astronomy. The foundation stone was laid on 27 October 1988 and staff were later offered free copies of photographs of the ceremony!

The Tercentenary Sundial was also moved from its place in the garden at Herstmonceux to Cambridge and a member of the staff gave me a copy of a photograph of it on the back of a lorry being driven up the lane to the village! I next saw the sundial in the yard at Cambridge and it was sometime before it was re-erected in a suitable position. It has since been returned to the formal garden at Herstmonceux Castle.

6.5.10 Changes and events on my retirement

Although I was not due to retire until 4 July 1989, it was decided that I should give up my responsibilities as Superintendent of the NAO and Head of the ASD Division at the end of March. (Incidentally, I had previously refused an earlier oral invitation to take voluntary premature retirement!) Bernard Yallop became Superintendent and Andrew Sinclair became Head of the Space Geodesy Group. John Pilkington continued to be in charge of SLR operations and the remaining activities of the Greenwich Time Service, but he moved to new duties at Cambridge. Paul Murdin took the NAO and Space Geodesy into the ASR Division, while the Library and Archives were transferred to Scientific Administration. I was grateful to Bernard for the continued use of my room, with its views over the Pevensey Levels, until the final move took place in April 1990.

Just before my retirement I gave a talk entitled “The RGO at work and play: 1951-1981” giving a personal view of the events and changes during that period. It was given at 3.45 pm in the Clubhouse and all staff were invited to attend. I also wrote an article on “Nearly 40 years at the Royal Greenwich Observatory”, which was published in *Gemini* 23. The Club organised a lunch in the Clubhouse on 3 July and I was presented with various mementos of the RGO and Castle as well as a substantial cheque. Betty received a bouquet. We have a booklet of photographs and signatures, many with goodwill messages. I was surprised to be given a large photograph by Norman King of the Castle in sunshine with a black cloud behind it; this is now on the wall in our lounge. The cheque was used to buy an unusual globe of the Earth. When set and illuminated it shows correctly the boundary between day and night and the various levels of twilight. Another event to mark my retirement was attendance with my wife at a Garden Party at Buckingham Palace.

I continued to go to the Observatory regularly, but I gradually transferred surplus copies of information bulletins and memoranda, as well as my personal copies of books and journals, to my garage at home. The former have since proved to be invaluable in the writing of this account. I paid £10 for some racking, which I re-erected in the garage and which I later moved to the garage at our new home, Windward, in Sidford, Sidmouth, in Devon. My last visit to the West Building was in the late afternoon of 4 April 1990 when I left some correspondence and notes for posting and distribution internally before clearing my files on the VAX computer. In the evening I played my last table-tennis match for the RGO Club versus Saffrons T T Club; I was pleased to record that we drew 5-5 and that I won two sets!