

*EXTRACT FROM*

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

By George A. Wilkins

Sidford, Devon: 2009

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## APPENDIX A. UNPUBLISHED REVIEW ARTICLES AND NOTES

**A.1 A review of the history of the RGO, 1948–1990**

*This unpublished article on the history of RGO at Herstmonceux Castle is based on a lecture that I gave to the Bristol Astronomical Society at the University of Bristol on 1 February 2002. George A. Wilkins.*

**A.1.1 Introductory remarks**

The first 300 years of the history of the Royal Greenwich Observatory (RGO) were fully documented in a 3-volume set at the time of the celebration of the Tercentenary in 1975. There have been many other books and articles about the Observatory and about the Astronomers Royal who dominated its activities while it was based at Greenwich. In this article I have concentrated on the period from 1948 to 1990 when the Observatory was based at Herstmonceux Castle in Sussex. I had the good fortune to be based there for almost the whole of this period.

I should make it clear that this is not intended to be a dispassionate objective statement of the astronomical work of the Observatory. There are three main reasons for this. Firstly, I want to try to give an impression of what it was like to work, and play, at Herstmonceux, and this must be largely based on my own experiences. Secondly, I was involved in what was usually referred to as the service work of the Observatory, rather than with the more glamorous astrophysical research, much of which was done at overseas observatories, rather than at Herstmonceux. Thirdly, the work of the Observatory covered such a wide range of activities that it would be impossible in an article such as this to discuss in detail the nature of the results or of the facilities that were used or developed at Herstmonceux.

Strictly, the name Royal Greenwich Observatory dates from 1948 at the start of the move from Greenwich to Herstmonceux Castle, but I shall use it also for the Royal Observatory (RO) at Greenwich. The talk to the Bristol Astronomical Society was based largely on the use of slides, many of which I had taken of facilities and activities at Herstmonceux, but I have relied on words only for this article. In expanding the notes on my slides, I have added some additional detail that was not given in the talk at Bristol, and I have omitted some remarks. I start with a very brief sketch of the history of the RGO up to the move from Greenwich to Herstmonceux Castle in Sussex.

**A.1.2 Early history**

The Royal Observatory at Greenwich was founded by Charles 2 in 1675 to provide the astronomical foundation for the determination of longitude at sea. The first Astronomer Royal, **John Flamsteed (1675-1719)** concentrated on star positions. Then **Edmund Halley (1720-1742)** made observations of the position of the Moon over a 19-year cycle. **James Bradley (1742-1762)** improved the accuracy of observations. **Nathaniel Bliss (1762-1764)** left no mark on the RO.

The fifth Astronomer Royal, **Nevil Maskelyne (1765-1811)**, achieved the main objective by producing the *Nautical Almanac and Astronomical Ephemeris* (NA) for 1767 and the *British Mariner's Guide*, which contained the instructions on how to use the method of lunar distances to determine longitude. John Pond (1811-1835) neglected the NA, and Thomas Young became Superintendent of NA. The next Superintendent set up the Nautical Almanac Office, which was separate from the RO

for the next 100 years. In 1833 a time ball was installed on Flamsteed House to provide the first public time signal for ships in the port of London. “Greenwich time and the longitude” by Derek Howse is the best account of this early period and of the later developments in the spread of Greenwich time.

**George Biddell Airy (1835-1881)** believed that the RO was funded as a public service and he was content to leave astronomical research to the universities and wealthy amateurs. He became the unofficial chief scientific advisor to HMG. In 1838 magnetic and meteorological observations were started and in 1849 the electric telegraph was used for the distribution of GMT. He is, perhaps, best known for the Airy transit circle (1851), which in 1884 was adopted to define the zero meridian and hence GMT for international use. 1873 saw the start of the RGO series of daily observations of sunspots and other solar phenomena – these are related to both geomagnetism and climate.

**William Christie (1881-1910)** took a greater interest in astrophysics and in 1894 installed the 28-inch refractor. His successor, **Frank Dyson (1910-1933)** organised the 1919 Eclipse expedition to test Einstein’s theory of general relativity. The 10th Astronomer Royal, **Harold Spencer Jones (1933-1955)** was interested in astrometry and geophysics, rather than astrophysics. Spencer Jones became formally responsible for the Nautical Almanac when the suspension of Leslie John Comrie (Supt. NAO 1930-1936) led to the NAO becoming part of the RO for administrative purposes. Comrie’s successor was Donald H Sadler (Supt. NA, 1936-1972), who was then a young man. During the war the NAO was evacuated to Bath; Sadler was awarded the OBE for his work for the Admiralty Computing Service.

Spencer Jones pressed for the move of the RO from Greenwich, but no action was taken until after the war. It was decided to move the whole of the Observatory, rather than to set up a remote observing station. The estate of Herstmonceux Castle was chosen as it was in the best part of the country for observing and there was ample space for new buildings. Moreover, the Castle and some temporary wartime buildings could be used right away for offices, workshops, etc, while the new buildings were being constructed.

### **A.1.3 End of Spencer Jones era – 1949-1955**

Herstmonceux Castle is situated about two miles south of the village of Herstmonceux in Sussex in an estate of 375 acres, much of which was rented out for farming. The castle was built of brick in about 1440; much of it was demolished in the 18th century, but it was rebuilt between about 1911 and 1935. An aerial view of the Castle, probably taken in about 1948 after it had been purchased by the Admiralty, shows also temporary huts that were built during the war for the Hearts of Oak Friendly Society.

One of my earliest colour slides (1956) shows the east wing of the Castle and the ornamental lake, which was referred to as the “moat”. The more imposing view is that of the south wing, with its imposing gatehouse and twin towers. The Great Hall of the Castle was converted for use as the library. Other rooms were used for offices and one was used for the staff canteen. The north-east wing was converted to make a residence of Spencer Jones and his successor. The panelled drawing room was later used as a committee room (1981); I first saw it when Lady Spencer Jones entertained the very young children of the staff during a Christmas/New Year children’s party. The imposing Staircase Hall was normally used for important committee meetings and for

presentations to staff, etc. A slide shows George Harding as Father Christmas at a party, but Sir Harold used to play this role.

Above the offices for the Meridian Department in the north wing of the Castle was the Long Gallery; this was panelled and had a Jacobean overmantel above a fireplace. Although it had a decorated plaster ceiling and a sprung floor for dancing, it was broken up by partitions to make offices for the astrometry and astrophysics department, which remained at Greenwich until 1957. The small chapel in the east wing of the Castle was used for seminars, teaching and other staff meetings. There was a horizontal circular 'window' in the roof above where the altar would have been and two wires had been fixed across it to simulate the wires of a transit instrument.

I joined H M Nautical Almanac Office in 1951 after it had moved in 1949 from Bath to Herstmonceux. At that time most of us used hand-cranked Brunsviga calculating machines, although we did have some electric machines that were useful for certain types of work. The bulk of the computing was carried out by the use of punched-card machines. There was also an analogue computer in the form of an occultation machine that was used for the prediction of the times of occultations of stars by the Moon. A slide shows Miss Marion Rodgers, who joined the NAO in the 1930s; she is now in her 90s and she still keeps in touch with many past members of the staff. Amateurs used to observe the occultations and the differences between the observed and computed times were mainly used to determine the variations in the rotation of the Earth.

Apart from the production of almanacs for international use in astronomy, marine and air navigation, and geodetic surveying, the NAO used to compute sunrise, sunset and lighting-up time for places in the UK for diaries and other publications. The slide shows Angela James in front of a map showing the places concerned; she was one of two young lady graduates who were appointed just before the move from Bath.

I lived in the men's hostel in one of the huts for almost two years. The ladies' rooms were in the north attic of the Castle; we ate in the canteen. Most of the staff were members of the Social and Sports Club. There were clubrooms in the huts for billiards and snooker, table tennis, and social events, including an annual pantomime for the children. There was a sports field for hockey, cricket and stoolball. This was a Sussex game with rules similar to those of cricket, but was usually played by ladies or mixed teams. There was also a single tennis court and we used to enter a team in the tournament for small clubs organised by the local paper, the Sussex and County Herald. A slide shows that the RGO tennis team in 1953 was made up of 3 men and 3 ladies from the NAO. Donald Sadler was a fine sportsman and had played both tennis and hockey at a high club standard before the war. Gordon Taylor, who came from Bristol, is now the Director of the Computing Section of the British Astronomical Association. Mavis Gibson married Patrick Wayman, who joined the RGO just after me and who left to become the Director of the Dunsink Observatory, near Dublin.

The staff had access to the formal gardens and to the grounds; these were open to the public on a few afternoons each week during the summer. A slide of the gardens shows two of the NAO Assistants (my tennis partner, Aileen Grogan, and Ruth Timbrell) by the west border, while a slide showing white rhododendrons by a woodland path was my first colour photograph and was taken on 1956-05-30.

The solar dome, shown in a slide when the hillside was covered in snow, was at first the only observing facility. Complaints about its appearance led to the appointment of a naval architect to design the rest of the new buildings and domes.

Although Spencer Jones was the AR, and lived in the Castle, we saw little of him. He spent a lot of time at national and international meetings. He followed up a proposal by Professor Plaskett in 1946 for a large telescope for the UK by obtaining an American donation of a 98-inch mirror blank. There were discussions and it was decided to site the Isaac Newton Telescope at Herstmonceux, but there was no further action on it before his retirement at the end of 1955. The construction of the new buildings for the RGO (West Building, Equatorial Group and Meridian Group) had been very much delayed by the stop-go policies of the government and they were not then finished.

#### **A.1.4 Woolley period – 1956-1971**

The 11th Astronomer Royal was **Richard van der Riet Woolley (1956-1971)**. He had been a Chief Assistant at Greenwich before his appointment as the Commonwealth Astronomer for Australia. When he landed at Heathrow he made what he thought was an off-the-record comment to the effect that space travel was “utter bilge”. This led to a newspaper cartoon showing the solar dome and men carrying placards proclaiming “unfair to spacemen”.

Almost his first job was to make a presentation to Donald Sadler at the Club party after the pantomime, as Sadler had won the Spencer Jones Indoor Sports Trophy during the autumn. Woolley was also a keen sportsman and had played hockey for the RO, but at Herstmonceux he contented himself with tennis and cricket. A slide shows him (and me) in the RGO cricket team in 1956.

At this time the telescopes were being installed in the Equatorial Group and the construction of the West Building for the NAO and Time Departments and for the Chronometer and Engineering Workshops was well advanced.

I went on duty to USA for one year from Feb 1957 to Feb 1958, and so I missed the finish of the construction and the move of the NAO from huts to WB. I spent 6 months at the U. S. Naval Observatory in Washington, D.C., and 6 months at the Yale University Observatory. I learnt how to program an IBM 650 computer and attended lectures on celestial mechanics. The experience proved to be very valuable. I received a foreign-service allowance as single man, but my wife and two-year old son went with me.

When I returned in 1958 the rest of the staff had moved from Greenwich and the Equatorial Group on the hill to the east of the Castle was in use. It had an imposing entrance through gates in a massive wall decorated with flint knapping. I still regret that I did not photograph the craftsman who knapped an enormous pile of flints for this building. There are 3 domes (A, B & C) on the north side for reflecting telescopes, and three on the south side for refractors, but Dome C remained empty as there were no funds for the planned new Schmidt telescope. The domes were clad in copper so that would turn green and blend with the countryside; they had to be heavily insulated and were a constant source of trouble. There was an ornamental pool and steps between the various levels of the domes and walkways. These architectural features proved to be very hazardous to astronomers (and students) working in the Group on dark nights!

There was no formal opening, but the Duke of Edinburgh did visit the Observatory in November 1958. The telescopes were transferred from Greenwich and included:

the 30-inch Thompson reflector (1897); the 36-inch Yapp reflector (1934);  
the 26-inch refractor (1892) in a dome with a rising floor to save time when

changing to another star between short exposures for the measurement of parallaxes; a 13-inch astrographic refractor (1890); and the 28-inch refractor (1894).

The EQ Group contained an optics laboratory and an aluminising plant; this was designed for the 36-inch mirror, but its first use, with difficulty, was for a 1-metre mirror from the Vatican observatory (?).

My slide of the main entrance to the West Building, which I took on my return in 1958, shows that the work on the approach road and car park had not yet been completed. The staff of the NAO had moved from the huts by the Castle at the beginning of October, just after the launch of Sputnik 1, the first artificial satellite of the Earth. Some of the staff were then desperately struggling with the problem of providing predictions for this unexpected satellite. The punched-card machines were also moved and were supplemented in 1959 by an ICT 1201 computer. This was operated by NAO staff, but was used generally for RGO purposes.

[When I went to the USA I took a programming manual for an English Electric DEUCE computer, which was the commercial version of the ACE Pilot Model at the National Physical Laboratory, as this appeared to be the most suitable computer for our work. Unfortunately, the Admiralty rejected our proposal and chose a less expensive computer that proved to be very expensive in effort — I had to write the basic software and no scientific software was available from other sources — and very low on speed and capacity.]

The Time Department moved from Abinger and was split to provide a separate Electronics Department. The Greenwich Time Service used quartz-crystal clocks at this time, but it had a link to the first atomic clock at the National Physical Laboratory. An enormous double-storey atomic-clock cellar was included in the West Building, but it was not needed as small commercial caesium time standards became available after a few years. The third wing of the West Building included the Chronometer Workshop and the main stores and was linked to the Engineering Workshop.

The Spencer Jones Group (originally known as the Meridian Group) contained the Cooke reversible transit circle (RTC), and the photographic zenith tube/telescope (PZT). The former was used to determine precise positions and proper motions of stars and continued the work of the Airy transit circle. The PZT was used to measure universal time and the variation of latitude as the UK contribution to the international programme for monitoring the rotation of the Earth. The telescope was controlled from a separate building, which also served as a rest room for the observers. It had small a snooker table for cloudy periods! There was also an astrolabe, which was intended to supplement the PZT, but this was soon transferred to the Royal Observatory at the Cape of Good Hope.

When the position of the new Ordnance Survey pillar was determined with respect to Greenwich a discrepancy was found and it was eventually realized that that the OS did not change to the Airy meridian after 1884, but continued to use the earlier meridian, which was some 19 feet away. The RTC and the PZT both began operations in 1957.

Work started in the spring of 1959 on the building of a Clubhouse to replace the accommodation that had been lost when the wartime hutments were demolished after the completion of the West Building. It was built by the voluntary efforts of the members of the Club which had been given a major boost by the coming of staff from Abinger. The Clubhouse was opened in October 1960 and provided a bar and kitchen as

well as two snooker tables and a general area that was used regularly for table-tennis, badminton and ballroom dancing.

Woolley was very keen on country dancing, but this was organised independently of the Club. The partitions in the Long Gallery were removed at the end of 1957 and the staff were transferred to other rooms in the Castle or to the top floor of the Time Block in the West Building. This meant that the Long Gallery could be used for other purposes, including country dancing and social functions. For a while Woolley kept his grand piano in the Long Gallery and he sometimes dined there in the evening.

Woolley made various changes in the organisation of the Observatory and introduced some new activities: For example, the first of the annual Herstmonceux Conferences was held in 1957 to encourage links between RGO and universities. Leading astronomers from overseas were usually invited and the Long Gallery was used for this and other such meetings. Woolley also started the vacation course for undergraduates, many of whom became astronomers. For a while there were two courses of about six weeks each during the summer.

Woolley set up astrophysics research teams and reduced the emphasis on the long-term observational programmes. He developed an extensive programme for the use of telescopes overseas, especially in South Africa, but also in Egypt, Spain, and the USA. Some of the engineering department staff went out too to build up their experience.

Unfortunately, Woolley also decided that RGO should publish its research papers as well as the data resulting from the observations made by the staff. The papers came out as individual *RGO Bulletins* and at first were printed from typescripts. Consequently, the research was undervalued by the rest of the world.

Woolley carried the day in his opposition to the UK joining the European Southern Observatory and he obtained approval for the Anglo-Australian Telescope project. The telescope was good, but the site at Siding Springs was inferior to the ESO site in Chile.

In April 1965 responsibility for the funding of the RGO passed from the Admiralty to the Science Research Council. This led to an enormous increase in bureaucracy and eventually proved disastrous for the Observatory. The University of Sussex at Falmer on the outskirts of Brighton, was established at about this time with an institute for astronomy led by Professor W. H. McCrea. Woolley and others were given honorary positions there and joint seminars were held at the two sites alternately.

Luckily the replacement for the ICT 1201 computer was ordered before the changeover to SRC and an ICT 1909 computer was installed in 1966. It was not the computer I wanted, but it proved to be better than I expected. It was used by the University of Sussex for a short while.

Soon after his arrival Woolley had forced a change of design of the Isaac Newton Telescope (INT), but the project was subject to many delays. It was, however, continued by the SRC. The INT was intended for general use by UK astronomers, and was not to be regarded as an RGO telescope. Nevertheless, the RGO was expected to provide operational support, although it was not given any extra resources for this job.

The construction of the dome was started in 1965 and I took a series of slides of the building and of the arrival of the parts of the telescope. In February 1966 I slipped into the dome when the massive dome arches were lowered in to place – there was no Health and Safety Executive in those days! I also went in during some lunch times to

watch the progress in the construction of the telescope, but I did not have suitable equipment to get good photographs. The telescope was formally inaugurated on 5 December 1967 by Queen Elizabeth. My slide of her signature in the RGO visitors book also shows the original INT and a replica that was made in our workshops for the Queen. It was a foggy day and so the Queen was unable to look through the telescope, nor did she get a good view of the Castle, which was floodlit for the occasion.

1967 was also the year in which we celebrated the bicentenary of the Nautical Almanac. The National Maritime Museum mounted a special exhibition in the Old Royal Observatory at Greenwich and Sadler wrote the booklet *Man is not lost* to accompany it. Unfortunately, NMM failed to print and publish the booklet before the exhibition closed!

By the summer of 1969 construction had started on a building just to the north of the Engineering Workshop for the new Physics Department, which was headed by Dennis McMullan from Cambridge. Its first task was to design and build electronographic cameras, but then it turned to the development of detectors based on the use of CCDs (or charge-coupled devices). Woolley was very much against the use of computers for telescope control; it was said that in orders they had to be disguised as process controllers

In 1971 the 28-inch telescope was moved back to Greenwich – it had been used mainly for double-star observations, but no resources were left for such work.

At the beginning of 1970 Sadler was given leave of absence in order to organise the IAU General Assembly that was held at the University of Sussex in August. I became Acting Superintendent and later, in 1971, Superintendent as Sadler did not return to the post. [Woolley tried to block the confirmation of my acting promotion to SPSO as he wished to use the complement position for astrophysical research, but my appeal to SRC was successful.]

Woolley was knighted in 1963 and he retired at end of 1971. He then became the director of the new South African Astronomical Observatory, which was formed from the Royal Observatory at the Cape of Good Hope. After his departure a portrait in oils of Sir Richard hung in the Long Gallery – it was his leaving present, which he gave back.

### **A.1.5 Period of change – 1972-1981**

**Margaret Burbidge (1972-1973)** was appointed director, but not as Astronomer Royal — this title went to Martin Ryle at Cambridge. She resigned in the autumn of 1973 and returned to California. She had spent a lot of time away from Herstmonceux as she continued to observe on telescopes overseas and to attend many international conferences. At this time Alan Hunter was deputy director and a slide shows him at the final retirement of Donald Sadler in 1972.

**Alan Hunter (1973-1975)**, who had joined the RGO in 1937, became director and it was appropriate that he should oversee the RGO Tercentenary celebrations in 1975. The highlight was the Tercentenary Royal Garden Party when Princess Anne unveiled a bust of Flamsteed that had been carved by George Elliot, one of the stonemasons who worked on the restoration of the Castle. In addition there was a large sundial, which had been suggested and designed by Gordon Taylor. [I had the task of verifying that his design was sound. I was also made chairman of the local organising committee for a special tercentenary symposium that was held in the Castle.] A booklet

about the history of the RGO was written by Professor McCrea at the instigation of the RGO. A much more extended and expensive history in three volumes was published commercially and many articles about the RGO were published in newspapers and magazines.

Hunter had a quite different management style from Woolley and in 1974 the departments of the RGO were grouped into divisions [I became responsible for the oversight of the work of the Time Department as well as of the NAO and the Computer Department, which was split from the NAO. Later the Library and the Archives were added to this Almanacs and Time Division (A&T).] This was also a period of review by SRC about the role of the RGO in the context of proposals for a Northern Hemisphere Observatory (NHO). Eventually it was agreed that RGO should be responsible for building of the NHO, and Graham Smith was appointed as the next Director to carry it through.

When Hunter retired he gave to the RGO Club a cheque for double the amount of his leaving present to pay for pumps and water-treatment equipment, etc, so that the small ornamental pool in the formal gardens could be used by the staff as a swimming pool.

**Graham Smith (1976-1981)** had meanwhile been pressing forward the planning of the NHO. He decided that the publications and records store in the basement of the chronometer wing of the West Building should be converted to office space for the NHO design team. Although most of it was then above ground, it was designed to withstand attack in the event of war, and so the cutting of windows through the thick reinforced concrete walls was a difficult and expensive operation that is shown in my 1976 slide.

Graham Smith also decided in 1976 that the Meridian Department should be evicted from its rooms in the north wing of the Castle in order to provide space for a permanent public exhibition to follow up the Tercentenary celebrations. Part of the rationale for the move of the staff to the West Building was to break their isolation from the other staff concerned with photographic astrometry and astrophysics.

In 1977 the RGO series of daily observations of sunspots and other solar phenomena was stopped after more than 100 years. It was claimed that the results were no longer useful as more sophisticated observations were being made elsewhere. This was true, but the basic reason was that Woolley had deliberately allowed the Solar Department to run down by not replacing its senior staff when they retired; consequently there had been no upgrading of its objectives and equipment.

Consideration was given to the transfer of the early records of the RGO to the National Maritime Museum at Greenwich, but thanks to the enthusiasm of Janet Dudley, whom we had just recruited to act as librarian, it was decided to keep them at Herstmonceux. The extensive collection of papers that were kept by Airy formed a major part of these archives. Janet obtained the support of the Manpower Services Commission for a major project to sort and list the archives and so make them much more accessible than they would otherwise have been. Some time later she obtained approval to set up a conservation laboratory and she even poached the conservation officer from the East Sussex County Council. She also brought together the early books that were scattered throughout the library; most of them had been collected by Airy.

1979 saw both the construction of a new wing of the West Building for the astrophysics teams and the removal of the Isaac Newton Telescope. The former was a

result of the Labour Government's programme to support the building construction industry. The latter had been agreed by Graham Smith as part of the price for the NHO. The INT was to be transferred to La Palma as one of the three telescopes. This was not to save construction costs, but to ensure that the RGO did not devote resources to the maintenance and use of the telescope in the UK. Consequently a lot of effort and costs were wasted on the redesign and on rebuilding, which included a new mirror. Moreover, the UK did not have a convenient test bed for new instruments, nor a large telescope that could be used by students and others for training before travelling to the Canary Islands. The empty dome remains at Herstmonceux as a landmark for mariners in the English Channel.

Two years later, however, on 1981-07-03 a telescope for the new satellite laser ranging system (SLR) was installed in what had been the solar dome. This was the result of a proposal by a combination of university groups and the A&T Division as it was realized that the PZT would be superseded by new techniques for monitoring the rotation of the Earth. [I drafted the proposal and argued for it in SRC committees.] The choice of telescope was made by our senior telescope engineer, John Pope, who was on hold owing to the delay in the international agreement for La Palma. This was lucky for the project as he realized that the telescope proposed by the laser group at the University of Hull would have been inadequate for the task.

Graham Smith resigned after his appointment as successor to Sir Bernard Lovell as director of the radio observatory at Jodrell Bank. I acted as his deputy for his last year of office and made the staff presentation to him. A slide shows him handing to me a cheque for double his leaving present; he asked that it be used to provide staff facilities on La Palma.

#### **A.1.6 Period of decline – 1981-1990**

**Alec Boksenberg 1981- 1995**, from University College London, succeeded Graham Smith. A slide shows him and Patrick Moore on the South Bridge of the Castle, on the occasion of the first annual meeting of the Federation of Astronomical Societies on 1981-10-03 at Herstmonceux. This was shortly after I had carried out my last duty as deputy director by opening the meeting before Boksenberg arrived to take up his post on the following Monday.

Boksenberg's first action was to initiate a reduction of about 25 % in the staff levels of the RGO, whereas under Graham Smith our complement had been rising to cope with the demands of La Palma. A more than proportionate cut was made in the services, such as those of the A&T Division. Nevertheless, the SLR was successfully brought into operation and proved to be extremely effective. For several years we were the most productive station in the world. A photograph of the SLR at night, with its green beam piercing the sky, was used as the cover illustration for an issue of *Nature* in 1985. In addition, a Hewitt satellite-tracking camera was moved from Malvern and installed in the empty Dome C in the Equatorial Group. The operators were transferred from the University of Aston and they achieved a significant improvement in productivity

Boksenberg attempted to make the Castle a positive asset as a conference centre. It was ideal for this purpose as it already had bedrooms, kitchen and dining room, the Long Gallery (now usually called the Ballroom) and other meeting rooms, the library, the gardens and grounds. One of the large offices, which had views over the moat, was converted for use as a conference room and furnished with antique-style chairs. It is

shown in a slide of a dynamical astronomy workshop — A&T played its part by organising several national and international workshops in the Castle.

The year 1984 was celebrated as the centenary of the decision of an international conference that the Greenwich meridian should be the prime, or zero, meridian for the measurement of longitude. [Correspondingly, the universal day was defined by Greenwich Mean Time starting at midnight on the Greenwich meridian. The Nautical Almanac continued, however, to use the astronomical day starting at noon until 1925.] The booklet produced by the Ordnance Survey to mark the event describes the founding of the Royal Observatory and its role in the determination and distribution of time. Members of the Brighton Astronomical Society walked along the zero meridian from Peacehaven on the coast to Greenwich and I was asked to start them off early on 1984-08-17.

The main purpose of the RGO had been changed from astrometry under Spencer Jones to astrophysics under Woolley and then, under Smith and Boksenberg to the provision of support for UK astronomers at overseas observatories on La Palma and elsewhere.

The observatory on **La Palma** is an international one and involves several European countries other than Spain and the UK. The observatory is built on the rim of an extinct volcano and is usually above the clouds, as is seen in a slide giving a general view, with the building for the INT. The opening ceremony took place in fine weather in June 1985. There are three telescopes in the Isaac Newton Group. They are usually known by their initials.

INT – needed considerable modification to cope with the new latitude and a new generation of instruments. The new, slightly larger mirror has an aperture of 2.5 m.

JKT – Jacobus Kapteyn Telescope – a 1 m astrographic telescope that was jointly funded with the Netherlands – hence the name – and Ireland.

WHT – William Herschel Telescope was completed in July 1987. It is an altazimuth with 4.2 m mirror. The cover of the RGO Report for 1985-1987 shows the WHT Dome at night – half open!

CAMC – Carlsberg Automatic Meridian Circle came from Denmark – hence the name – and is the same basic design as the RTC at Herstmonceux, which ceased operation in 1982. CAMC started operation in 1984 and is jointly operated by Denmark and the UK.

By about 1985 the RGO at Herstmonceux was under threat once more, but complete closure was averted. A slide dated 1986-05-31 shows Professor Richard Gregory & Patrick Moore at Herstmonceux to consider whether instruments could be kept in use as a part of a science centre. The decision to sell the Castle and its estate and to move RGO to Cambridge with a further reduction in complement was announced in 1986. My arguments that the SLR should stay at Herstmonceux were accepted and it continued to operate successfully with funding from the Natural Environment Research Council.

I retired in July 1989 but continued to make occasional visits until the RGO moved to a new building at Cambridge in the spring of 1990. My successor, Bernard Yallop, allowed me to continue to use the same room.

The new RGO building was built on university land behind the Cambridge University Observatory. At first all seemed to be going well, but then the funding organisation changed as the Science and Engineering Research Council (formerly SRC)

was split into the Particle Physics and Astronomy Research Council and the Engineering and Physical Sciences Research Council. PPARC appointed a new Chief Executive soon the daggers were out again. This time, In spite of the efforts of the new director **Jasper Wall (1996-1998)**, the assassins were successful and the RGO was closed at the end of 1998 after 323 years. The RGO staff held a reunion prior to the closure on a fine day in the summer of 1998.

Some of the staff went to La Palma and others to the Astronomy Technology Centre at Edinburgh. A few others found posts in the Institute of Astronomy at Cambridge or elsewhere in astronomy. The NAO staff went to the Rutherford Appleton Laboratory.

### **A.1.7 Concluding remarks**

During its long history the RGO made many valuable contributions to society through its services to navigation and time as well as through its observation and publication of astronomical, geomagnetic and meteorological data. It has also contributed through its work on the development of instruments and techniques and through its research on all aspects of astronomy.

I am pleased to be able to conclude by noting that three of the activities for which I was responsible at Herstmonceux have survived:

The NAO is now based at the Rutherford Appleton Laboratory in Oxfordshire.

The SLR is still in operation at Herstmonceux

The RGO archives are now in the care of the Cambridge University Library.

Herstmonceux Castle is no longer the home of the RGO, but it is, fittingly, being used as an International Study Centre. The developer who bought Herstmonceux Castle failed to get planning permission for the additional buildings that he wished to erect and he eventually sold the Castle and estate to the Queen's University of Ontario, Canada. The West Building has been converted from offices and laboratories to bedrooms and lounges. The Equatorial Group is open as a Science Centre and a Lottery grant has just been received to bring the telescopes and domes into use again.

### **A.2 Review of almanacs and time activities**

*The following review of the post-war activities of H.M. Nautical Almanac Office and of the Time Department was written hurriedly on 1998-12-09 in response to a request from Professor Sir Francis Graham Smith for material about the NAO for inclusion in a talk about the RGO to be given at the meeting of the Royal Astronomical Society in January 1999. He mentioned 'MERIT & the laser ranger' and so notes on the work of the Time Department, which was based at Abinger until late 1957, are also included. It has since been edited in order to make it suitable for a wider readership.*

*George A. Wilkins*

The Nautical Almanac Office (NAO) moved from Bath to Herstmonceux Castle in 1949 to join other departments of the Royal Greenwich Observatory (RGO). Donald Sadler, the Superintendent, then carried through the unification of the almanacs of the UK and the USA. He and Gerald Clemence (Director of the NAO in the US Naval Observatory) had to persuade the navies and the air forces to change their practices in order to arrive at a common content and format, and this was not easy. There was already a lot in common between the astronomical almanacs, but there had to be some

give and take to get the final agreement on content and on the sharing of the work of computation and printing. Unfortunately, he could not persuade the Americans to change their title from *American Ephemeris* to *Astronomical Ephemeris (AE)*. The preparation of the *Explanatory Supplement* was also shared, although it was only published in the UK.

Sadler had been aiming even higher — for an *International Astronomical Ephemeris*, but he did not achieve this, although Germany gave up its *Astronomisches Jahrbuch* and took over from us the work of publishing *Apparent Places of Fundamental Stars*. The unification of the *Nautical* and *Air Almanacs* was accompanied by a unification of the auxiliary navigation tables (mainly for RA/Dec to Alt/Az conversions) and Sadler played a major role in this. He also designed the *Star Almanac for Land Surveyors*, which is still in use in its original form nearly 50 years later!

Sadler was strongly involved in both technical and administrative activities in the International Astronomical Union (IAU). He made major improvements when he was General Secretary, and his final task was to organise the IAU General Assembly in Brighton in 1970. When he retired he not only passed on the job of Superintendent of the NAO to me, but he nominated me for two IAU jobs, so that I became the chairman of the IAU Working Group on Numerical Data and the IAU's representative on the Federation of Astronomical and Geophysical Services. I eventually became the secretary of FAGS, and I suspect that this led to my being nominated as the chairman of the IAU Working Group on the Rotation of the Earth in 1978. This WG organised Project MERIT which evolved in 1988 into the successful International Earth Rotation Service.

The NAO was also responsible for an international service for the prediction and reduction of occultations of stars by the Moon, which was led by Mrs Flora Sadler until her retirement in 1973. This was primarily aimed at providing a uniform time-scale against which the variations in the rate of the rotation of the Earth could be determined. This aspect was superseded by atomic time, but the expertise in the NAO was used by Leslie Morrison in particular to collect and re-reduce earlier observations so as to considerably improve our knowledge of the variations in the 'length-of-day' since the 17th century. Leslie also provided the technical back-up for Richard Stephenson's work on the use of the records of ancient eclipses for the same purpose — now described in detail in a book.

An unexpected offshoot of the NAO's occultation programme was the discovery of the first quasar. The NAO provided predictions for the occultations of radio sources, which were used to help to map their structures. Then Cyril Hazard observed one that behaved like a point source; Bill Nicholson was responsible for the reduction to determine the coordinates of the source, which led to the optical identification of 3C 273B as a quasar. Predictions were also provided for X-ray sources. Gordon Taylor predicted the occultations of stars by the major planets and by minor planets (asteroids). These led to the discovery of the rings of Uranus and more accurate estimates of the sizes and shapes of some asteroids.

The NAO did not have enough resources to carry out a major program of research or development in celestial mechanics — the US Navy was more sympathetic to this than the SRC! I produced an improved 'improved lunar ephemeris' for the AE, and learnt to write Fortran in the process, but such work was taken for granted and I doubt whether it got more than a sentence in the annual report. Andrew Sinclair and later Don Taylor did, however, produce a series of papers on the motions of minor planets and

satellites whilst also contributing to other aspects of the work of the office.

The NAO was responsible for the provision of a computer service for use throughout the RGO. Unfortunately the Admiralty turned down our bid for a DEUCE computer and allocated us an ICT 1201, which was really only fit for commercial accounting. Our later bid for an IBM 360 was also turned down, but the ICT 1909 proved to be a very powerful tool that was used for astrophysical research as well as for astrometry and the almanacs. In the NAO we developed one of the first systems for the automatic composition of numerical tables for phototypesetting from magnetic tapes. During the 1970s we also pioneered the introduction of ephemerides in compact forms for use in portable electronic calculators etc and Bernard Yallop developed this in the volumes of *Compact Data for Navigation and Astronomy*.

The divisional structure of the RGO was introduced in 1974 and I became Head of the Almanacs and Time Division (A&T), which included the NAO and the Time Department, and later the Library and Archives. Under Humphry Smith the Time Department had played a major role in the introduction of atomic time for the national (Greenwich) time service — until we got our own commercial caesium standards we regulated our quartz clocks by reference to the NPL primary standard. We and USNO introduced ‘coordinated universal time’ by agreeing when to make the step adjustments in the epoch and rate of the time signals that were then trying to follow the time given by the Earth as monitored by instruments such as the photographic zenith telescope and the astrolabe. Smith was the chairman of the international working party that eventually agreed on the TAI/UTC system that has been in use since 1972.

In the early 1970s the NAO was a party to a bid for a lunar laser ranging system to be built in the UK for deployment in South Africa, but that was not approved by SRC, possibly because we could not get appropriate support from any South African group. We did, however, get approval for Andrew Sinclair to spend a year in Australia to work on the LLR project at Orroral, near Canberra. This proved to be one of the keys to the later success of the satellite laser ranging project, which replaced the PZT as the RGO’s contribution to the determination of UT and polar motion. By this time the occultation program was obsolete and so NAO staff moved to the Time Dept to develop and operate the SLR system. Another key to its success was the allocation of John Pope to the project while we were waiting for the go-ahead for La Palma — it was he that ensured that the telescope was capable of the doing the job that was required. The SLR made its first observations in 1983 during the MERIT Main Campaign and went on to become the most productive station in the world for several years — I am pleased to say that is still up high up on the list for the number of satellites observed.

The NAO provided the first UK prediction service for artificial satellites, but Woolley would not support the work and it went to the Royal Aircraft Establishment (RAE) and later to the Radio and Space Research Station (RSRS) at Slough. In the 1960s a kinetheodolite from the RAE was operated by a group within the NAO for the observation of the positions of satellites; the prediction programme was passed on to RSRS. After a few years the kinetheodolite was transferred to the Royal Observatory at the Cape. In the 1980s a much more powerful satellite-tracking camera was moved from its original site near Malvern into one of the domes of the Equatorial Group and the observers joined the A&T Division. This Hewitt camera was later moved to Australia.

My involvement with international activities and with administrative matters in RGO and SRC meant that I did not give as much time to the NAO as I would have liked. I did, however, put forward proposals for the revision of the *Astronomical*

*Ephemeris* and I finally persuaded the Superintendent of USNO to seek the approval of Congress for the change of name of the *American Ephemeris* to the *Astronomical Almanac*. These changes were incorporated in the *Astronomical Almanac for 1981*. I did not, however, find enough time to carry through the corresponding revision of the *Explanatory Supplement* before my retirement in 1989.

One point that may be of particular interest in connection with the closure of the RGO is the effort that was put into the RGO archives. This was almost entirely due to Janet Dudley, who first of all persuaded us that we should retain the archives at Herstmonceux and not pass them to the National Maritime Museum. Then she obtained an enormous amount of high-quality labour, including Adam Perkins, from the Manpower Services Commission to list the records. In addition she argued for, and obtained, the setting up of a conservation laboratory. Unfortunately, the laboratory was lost when the archives were moved to the Cambridge University Library, but the listings are available there for use for research. I also suspect that more recent papers were saved than would otherwise have been the case.

The NAO was reduced to 4 or 5 persons when the move to Cambridge took place, and the Time Department was abolished. The NAO has continued to fulfill its share of the cooperative work with USNO and to provide a public data service. In addition, one of its new members, Steve Bell, wrote a bestseller — *The RGO Guide to the 1999 Total Eclipse of the Sun*. It is such a pity that the RGO is now in permanent eclipse!

### **A.3 Recollections of the Royal Greenwich Observatory, 1951-1990**

*This is a revised and extended version of the article that I wrote for the RGO house journal Gemini under the title “Almost 40 years in the RGO at Herstmonceux Castle” just before I retired from the RGO in 1989. George A. Wilkins.*

#### **A.3.1 1951–1965**

Although I had chosen a book on astronomy as a school prize I had no intention of becoming an astronomer and my studies at Imperial College took me from physics to mathematics and into geomagnetism. At one time it seemed that my first job would be concerned with the design of electrical-power lines, but my Ph.D. supervisor, Prof. A. T. Price, drew my attention to a vacancy in H. M. Nautical Almanac Office (NAO), which was already at Herstmonceux Castle in East Sussex. He saw this as a possible route into the Magnetic & Meteorological Department of the Royal Greenwich Observatory (RGO), but for me the initial attraction was a job in computing that applied astronomy to the public service. The post also carried deferment from compulsory military service, but it was the location at the Castle in proximity to the sea and the South Downs that finally made the offer of a post irresistible.

I joined the RGO on 1 October 1951, and during my first two years at the Castle I lived in the men’s hostel in one of the ‘huts’ that used to stand on the area by the south courtyard that is now used a car park for the public visitors. The ladies’ hostel was in the north attic of the Castle and we had our meals together in the dining room of the Castle. The RGO Club then had the use of two large rooms in the huts; one contained three table-tennis tables and a stage, while the other had a billiard table, a dartboard, and some rather dilapidated armchairs that were arranged to form a lounge area. The clubrooms were very heavily used at lunchtime but, as very few members of the staff had cars in those days, the evenings were usually quiet.

Observatory vehicles were used to bring staff to work from Herstmonceux village or from Pevensey Bay Halt in the morning and to return them in the evening; these vehicles were also used for some recreational purposes, and the Club arranged outings to various places of interest. There was an infrequent bus service between the nearby Herstmonceux Church and Hailsham, but after a table-tennis match in Eastbourne I would have to dash for the last bus to the village and then walk down the lane back to the Castle. I can even recall walking back across the marsh from Pevensey after an evening in Brighton; the sky was clear and I saw more stars and nebulae than on any other occasion.

At that time the NAO occupied huts on each side of the south courtyard, and I looked out from my office across Halley Road to another wooden hut. The Chronometer Workshop, which was then extremely busy, was also in a hut, and its staff were also very pleased to move to the West Building, now called the Bader Building, some years later. The Astronomer Royal, Sir Harold Spencer Jones, lived in the Castle, which was also used for offices for the Solar, Mag. & Met., and Chronometer Departments; the General Office was then so small that it fitted comfortably into two rooms in the south-east corner. The rest of the RGO was still dispersed, with some staff at Greenwich and others at Abinger; we saw some of them on the day of the Annual General Meeting of the Association of Astronomers, as our branch of the Institution of Professional Civil Servants (IPCS) was then known. It was a time of economic stop-and-go, and there was little money for new buildings; one site engineer was delighted at completing one task — the laying of grass verges along the road to the East Gate! Another site engineer had the swimming pool cleaned out and I was able to have a swim before the water turned green again for another twenty years.

The Superintendent of the NAO was Donald Sadler (then known to the staff as DHS), and during my first few years in the NAO he gave me a series of jobs that gave me experience in the use of a variety of calculating machines and in the organisation of the work; I also had to learn about the techniques of editing and printing. The aims were to get results that could be trusted and to get them in an economical way; moreover, the printed numbers had to be right and the layout and style had to be such that the numbers could be used with the minimum of effort and risk of error. The production of the Almanacs was very much a team effort and Sadler made clear his displeasure with anyone whose work was not up to the expected standard. In all written memos the members of the staff were referred to by their initials; titles and given names were not used to show rank or status. Even the Astronomer Royal was known as 'the A.R.'

The NAO had a variety of desk calculating machines, the most popular of which was known as a Brunsviga; it was operated by turning a handle, but for complex tasks it was faster than electric machines. The bulk of the calculations were carried out on punched-card machines, each of which could perform a very limited set of operations. Their main virtue was that intermediate results could be passed from one stage to the next without anyone having to write them down and then reset them, as was the case with the desk machines. By the standards of the day they were very reliable, but a great deal of time had to be spent in applying checks to the results so as to pick up the errors made by the machines, their operators, and by those who designed the procedures and the 'plugboards' that controlled the machines. At first all the results had to be keyboarded by the printer and so every member of the staff had to spend two hours each day 'reading' proofs to find all the errors made by the printer or by our own staff in preparing the 'copy'. Each page was normally checked in some way by at least six

different persons, but still the occasional error would slip through to the published volume. Eventually the NAO obtained an IBM card-controlled typewriter that produced copy that was good enough to be photographed to make the printing plate, but this could only be used economically if there were a large number of pages with the same layout.

Richard Woolley became the A.R. at the beginning of 1956, and he arrived from Australia just in time to attend the Club's pantomime and party. One of his first actions was to start a country-dancing group, which met in the huts. Some years later, there was a clash with another Club function, and he had the office partitions that were in the Long Gallery of the Castle taken down so that once again the Castle had a ballroom. He was also keen on cricket and tennis, which was then played mainly as mixed doubles since the RGO recruited many attractive players from the local girls grammar schools. Most games were played within the lunch-hour, but when the A.R. played the games went on into the middle of the afternoon.

Woolley had more profound effects on other aspects of the RGO since he built up research teams at the expense of the traditional long-term observing programmes, especially those of the 'geophysical' activities, including the solar work. I sometimes wonder how my life would have changed if I had accepted Woolley's invitation to move from the NAO into astrophysical research, but at no time have I felt that I should have done so, even though in recent years the NAO-type activities have been cut to the point where their continued viability is in doubt.

In 1957 my life was changed dramatically as Sadler had managed to arrange with Gerald Clemence, the Director of the Nautical Almanac Office of the U.S. Naval Observatory (USNO), that I should spend a year in the USA to learn about the use of electronic computers, which were just becoming available commercially, and about celestial mechanics. Since I was to be away for only one year the Admiralty was only prepared to pay my foreign service allowance at the single-man's rate, but nevertheless my wife Betty, whom I had married in 1953, and our young son, Michael, went with me on the Queen Elizabeth. We lived for 6 months in Washington DC, where I worked in the Nautical Almanac Office of the Observatory and learnt to use IBM 650 computers. Then we spent another 6 months in a small seaside village outside New Haven, in New England, where I attended lectures in the Astronomy Department of Yale University and used the computer there to continue the work I had started at the USNO. But that would make another article by itself...

Just before I went to the USA, we had put in a bid for a DEUCE computer that was then being built by the English Electric Co. as an engineered version of the pilot model of the ACE (Automatic Computing Engine), which had been developed at the National Physical Laboratory. We were unsuccessful, and rumour had it that it was in direct competition with a bid for a new crane for the dockyard at Chatham! We were eventually allocated an Hollerith 1201 computer, which was originally known as the HEC4 (Hollerith Electronic Computer), and which was considerably less powerful than the DEUCE and much more difficult to use than the IBM 650 computers that I had been using in the USA. It came without any software, and so I had to develop a set of routines that were equivalent to what is now known as an assembler. I even had to invent ways of representing and describing numbers based on 4 bits, and so in the early NAO Computer Circulars there are tables for 'bi-octal' numbers (now known as hexadecimal bytes). We also had to develop all the basic routines for evaluating trigonometric functions etc. We did the initial development work on a computer in

London, and I gave training lectures for other RGO programmers in the Chapel of the Castle.

While I was in the USA the first artificial satellites were launched and the West Building was completed. When I arrived back I was pleased to find the NAO in its new offices, but I was very disappointed to find that Woolley had insisted that the NAO should abandon the satellite prediction service that it had established; the responsibility was transferred to the Royal Aircraft Establishment. I was also just in time to see the final stages of the clearance of the huts. The Club then had no meeting room, although some use was made of the canteen in the West Building. The Club had had, however, an influx of new members, including Joe Bates, from Abinger, where there had also been a thriving Club. In the spring of 1959, thanks largely to the determination of Joe, we started to build our own Clubhouse by working in the evenings and at weekends; it was a dry summer and we had the roof on by the autumn. Then some members of the local planning committee claimed that we did not have planning permission and the building must be demolished. We knew that we had approval from the Admiralty, but it took months to resolve the situation. Four of us (Joe Bates, Henry Gill, Harold Rodemark and myself) continued regularly with the fitting out until the threat had gone, and work could resume in earnest. The Clubhouse was formally opened on 1960 October 1. All those who had contributed more than 200 hours received a polished wooden gavel, and their names were listed in the booklet about the RGO Club that was published at the time.

The Clubhouse provided a wide range of facilities for the staff — two full-sized snooker tables, table-tennis, badminton (but the ceiling was too low for matches), darts, a lounge and a bar. The office was soon converted into a 'shop' for bulk purchases, before the days of cash-and-carry stores. The Clubhouse was used mainly in the lunch-times, and was used only occasionally for major events as the ballroom in the Castle was available for social events, at which the local Blue Stars band was very popular. A ballroom-dancing section was started, but as with the folk-dancing it soon became dominated by associate members who did not work at the RGO. I gave up cricket and stoolball, but I continued to play tennis regularly. Although we had only one tennis court, we were able to play in a tournament for small clubs that was organised by *The Sussex Express and County Herald*.

In 1961 I attended the General Assembly of the International Astronomical Union in Berkeley, California, and in retrospect it is clear that this was the start of another thread in my career. Sometime afterwards, Professor Fricke, the Director of the Astronomisches Rechen Institut in Heidelberg, invited me to visit his Institute in 1962 to lecture on the subject of a paper that I had given at Berkeley. In 1963 I became the secretary of the IAU Working Group on Astronomical Constants, of which he was the chairman. I was then elected Vice-President and later President of IAU Commission 4 (Ephemerides), which was primarily concerned with developing further cooperation between the almanac offices of the world. Since then I have held a variety of offices within the IAU and have represented it on other international organisations. Between 1975 and 1979, I was secretary of the Federation of Astronomical and Geophysical Services. As a consequence I travelled to many interesting places and made many friends in other countries.

It soon became clear that the 1201 computer (which had only 1024 words of store for both programs and data) was not capable of doing many of the NAO data-processing jobs, and it was even less suited to research projects. I acquired a copy of a program

from the Jet Propulsion Laboratory for the evaluation of the coordinates of the Moon and used it to teach myself Fortran so that I could run the program on an IBM 7090 computer in London. We soon began to run other jobs in this way and to press for a replacement for the 1201. I spent a large part of one year in a computer specification and evaluation exercise involving the Post Office Technical Support Unit and Admiralty O & M. At the end of it we went out to tender to four companies. I put great weight on software and on compatibility with the USNO and other astronomers, and so I favoured an IBM 360, but the computer selected by the team was an ICT 1909, which undoubtedly had more hardware power for its price. We insisted on an acceptance trial that lasted a week and during which the computer had to demonstrate its reliability and its ability to run four programs together. We subsequently expanded the system by replacing the central processor and adding disc drives discarded by the Atlas Computer Laboratory, but although the system worked well we were never able to share software easily with other groups.

### A.3.2 1965–1981

The year 1965 saw the transfer of the responsibility for the RGO from the Admiralty to the newly-formed Science Research Council (SRC, later SERC and now PPARC). The consequential increase in funding for astronomy led to a welcome increase in the complement of the RGO, but to an even greater increase in the amount of time and paper that was involved in non-scientific activities such as the annual cycle of estimates and reports. The more significant change was that the RGO was no longer regarded as an Observatory whose main functions were to carry out astronomical programmes of observation and to provide national and international services for navigation and time. Instead the RGO's first priority became the support of research in universities; the conduct of its own projects came second, and services soon became a poor third. Woolley managed, however, to continue to develop the research programme in association with the Institute of Astronomy at the new University of Sussex. His successors were less successful and the RGO's own programme was gradually reduced and was subjected to frequent external review.

The change from the Admiralty to SRC saw the end of a practice that was known as Staff-Side Scrutiny. This meant that each annual report on a member of staff was seen by one member of a panel of scrutineers who were elected by the staff. The aim of the scrutineers was to ensure that no member of staff was penalised by an unjust adverse report on himself (or herself) nor by the overmarking of another person. Now Woolley was keen to know about all his staff, and he carried the procedure one stage further. We had an annual meeting of all reporting officers at which they read out their draft markings and commented on the work that had been done during the year. The countersigning officers and the scrutineers were also present, and anyone could question any mark that was felt to be unjustifiably high or low in comparison with others in the same grade. I am sure that this led to a much more uniform standard of marking and it also meant that more attention was paid to the career development of staff; for example, staff were moved from one department to another in order to widen their experience, or to make better use of their talents, or even to remove a personality clash that was thought to be having an adverse effect.

I spent some time on the continuation of my Ph.D. research in geomagnetism since my external examiner, Professor Sydney Chapman, had pressed me to write it up for publication in the *Philosophical Transactions of the Royal Society*. As a

consequence, in 1965 I attended a conference in Brazil and then flew to the USA to give a lecture at the Goddard Space Flight Center, but I declined an invitation to work on geomagnetism at the Center. I also tried to continue the work on the orbits of the satellites of Mars that I had started at USNO; this led to invitations to lecture at a summer school in the Tyrol and to speak at a conference in Rome, but I made little real progress as my main duties in the NAO took up most of my time and attention. Sadler had become General Secretary of the IAU, and so he delegated to me more responsibility than would otherwise have been the case. I became Acting Superintendent at the beginning of 1970 when Sadler was assigned to special duties for one year to organise the IAU General Assembly at the University of Sussex; he did not take back his responsibilities for the NAO before he retired in 1972. During 1970 the Astronomy Committee of SRC decided to stop the publication of our principal publication, then known as *The Astronomical Ephemeris*, but I was allowed to speak at the next meeting and I was able to get the decision rescinded.

During the mid-1960s we watched with curiosity the building of the dome for the Isaac Newton Telescope and then the lifting-in of the parts of the telescope. It had, however, been made clear to us that this was not to be 'an RGO telescope', but was for the use of university astronomers. Some of us were invited to the Long Gallery when the Queen came on one foggy day at the end of 1967 to inaugurate the telescope, but I suspect that few of us realized that the future of the RGO would be so closely linked with its success or failure. Unfortunately it came ten years too late, and the RGO did not, at first, give sufficient priority to its development and operation. As a consequence, the task of building and operating the new Northern Hemisphere Observatory (NHO) was almost denied to the RGO.

The SRC tried to encourage a corporate spirit by sponsoring annual sports days, which were at first held at the Civil Service Sports Ground at Chiswick. The RGO participated strongly against the larger laboratories in cricket, netball, 5-a-side football, bowls and tennis, in which I occasionally shared in winning the mens-doubles or the mixed- doubles trophy. After some years an indoor sports day was also held. On the first occasion I went to Runcorn as a member of the volleyball team; several of us had not played the game before, and so we were comprehensively beaten. Our table-tennis team fared much better.

The decade of the 70s saw major changes in the role and administration of the RGO. Woolley retired at the end of 1971 and the title of Astronomer Royal was conferred on Martin Ryle, a radio astronomer at the University of Cambridge, rather than on Margaret Burbidge, who was belatedly appointed as the next Director of RGO. Our IPCS Branch Secretary, Joy Penny, claimed that this was yet another indication of SRC's intention to take away the national status of the Observatory and, unfortunately for the RGO, she has been proved right. The Deputy Director, Alan Hunter, had to take on most of the work of running the RGO during Mrs Burbidge's short term of office, and he was then made Director until the end of the RGO's Tercentenary Year (1975). He instituted the grouping of departments into divisions, and I found myself also having responsibility for the Time Department and for the Library, including what became known as the Archives. I then had no inkling of the extent, character or value of the 'records' that had been brought from Greenwich but, thanks to the appointment of Janet Dudley as Librarian in 1978, they have received in recent years the recognition and care that they so richly deserve.

The Tercentenary celebrations can now be seen to have occurred at the time of a

crucial change in the role of the RGO. The Director-Designate, Graham Smith, was in post and the NHO Division had been formed. The decision to move the Isaac Newton Telescope (INT) to La Palma was made for ‘political’ reasons, rather than on technical or financial grounds, but I did not realize at the time that it would eventually lead to the complete abandonment of Herstmonceux as the site of the RGO. It was ironic that the dismantling of the INT took place in the same year (1979) as a new wing of the West Building was brought into use for the staff that were engaged in astrophysical research.

In the early 1970s the NAO was party to a university proposal for a UK lunar laser ranging system to be sited at Sutherland in South Africa, but the proposal was rejected when it was found that all the costs would have to be met by the UK. Some years later the RGO supported a revised proposal for a satellite laser ranging system (SLR), and we eventually found ourselves taking the lead role. The delay that occurred before the international agreement for the new observatory on La Palma was signed did have one beneficial effect as far as the SLR project was concerned. It allowed John Pope to be the SLR project engineer for a while, and it was he who drew up the specification for the telescope, which has been a critical contributor to the eventual success of the project.

In 1978 I was asked to be chairman of an international working group to develop the use of new techniques for monitoring the rotation of the Earth. This involved a stint of 10 years, but ‘Project MERIT’ gave me a great deal of professional satisfaction, as well as a lot of extra work. The new International Earth Rotation Service (IERS) came into being on 1988 January 1; the new techniques had effectively taken over several years earlier — we stopped operating our Photographic Zenith Telescope in 1983 in order to put more effort on the SLR — but we had to get international agreement to a new organisational structure.

The RGO’s 100-year old programme for observing the Sun was stopped in about 1978 since it was considered that the results no longer justified the effort required; we had hoped that the work would be continued by an observatory in Hungary, but this did not happen. The building was then used for the SLR project. In 1982 advantage was also taken of the move of a small telescope to Spain by installing a Hewitt satellite-tracking camera in its place in Dome C of the Equatorial Group. The camera had previously been operated at a site near Malvern by a group based in the University of Aston. The transfer of the camera and observers to Herstmonceux resulted in an enormous gain in productivity, because of the better weather and the fact that the observers were able to live nearby.

The involvement of the RGO in space geodesy through the operation of the SLR and the Hewitt camera led to my becoming a member of the Geodesy Subcommittee of the Royal Society, but I did not expect to become its chairman for a term and to have to justify the development of geodetic activities in the UK. The involvement of the RGO in geodesy was not, however, a new development. The Royal Observatory was founded to develop an astronomical technique for the determination of longitude at sea, and the 7th Astronomer Royal, Sir George Airy, started several geodetic and geophysical programmes. In fact, the 10th Astronomer Royal, Sir Harold Spencer Jones, was the President of the International Union of Geodesy and Geophysics at the time that I joined the RGO. Unfortunately, the following Directors of the RGO were not as broad in their interests, and during the 1980s I had to spend a lot of time trying to maintain the staff and funding for the activities of the Almanacs and Time Division of the Observatory.

### A.3.3 1981–1990

Soon after Alec Boksenberg became Director in 1981, the RGO suffered a major redundancy exercise that reduced the complement by about 25%. I am thankful that on his first day in office he relieved me of the additional duties as Deputy Director that I had been given by Graham Smith during his last year as Director. (Instead he appointed a full-time scientific administrator and so was able to spend much of his time away from Herstmonceux.) It was a wretched task to identify the staff who should receive a ‘brown envelope’ containing an offer of ‘voluntary premature retirement’, especially as my Division did not have the priority work associated with the new observatory and telescopes on La Palma. The Greenwich Time Service suffered particularly badly and we lost experienced staff with specialist knowledge from the NAO.

Surprisingly, there was an enormous increase in the amount of effort devoted to the RGO archives, even though just a few years earlier it had been suggested that they should be transferred to the National Maritime Museum, which had the responsibility for the Old Royal Observatory at Greenwich. Thankfully, Janet Dudley had persuaded me and then Graham Smith and SERC that the RGO should not only retain them, but should also take steps to ensure their conservation. A conservation officer was recruited and a conservation laboratory was set up in the north-east wing of the Castle. Janet later persuaded the Manpower Services Commission to support a project to sort and catalogue the enormous quantity of records that had accumulated over the three hundred years of the existence of the Observatory. The project was called the ‘Laurie Project’ in memory of Phillip Laurie, who had died shortly after his retirement and who, almost alone amongst the scientific staff, had appreciated the value of the records. He had not only started to catalogue them, but he had also done much to save them from destruction some years before.

The staff of the Laurie Project were recruited from the unemployment register on a temporary basis; their pay was low even though some of them were graduates, but most were enthusiastic about the work. Janet appointed Adam Perkins to lead the team and he proved to be so suited to the job that he is now the RGO Archivist in the Cambridge University Library. At first the information was written on index cards, but then the team was provided with some personal computers. I have benefited greatly from their work during my post-retirement visits to the library to seek information about the history of the NAO and RGO.

The brown-envelope exercise was followed by a series of reviews, culminating in the decision by SERC to move the RGO from Herstmonceux to another site. Almost all the staff (apart from a few senior staff) were strongly opposed to this decision and some of us wrote to our local MPs to try to gain their support. They appeared sympathetic, but it appears that they forwarded our letters to the SRC, with the result that we were admonished for our actions. Two ladies, who had written on behalf of the trade unions that formed the Staff Side, were even subjected to formal disciplinary proceedings. The proposal was widely criticised in the press and the Council was unable to obtain the approval of the astronomical community to the move, but it went ahead and decided to move the RGO from its fitting home at Herstmonceux Castle to the garden of a small Victorian observatory in Cambridge!

Throughout this troublesome period in the 1980s I was fortunate in that I was involved in several international activities that gave me new interests and experiences. During the 1970s I had been chairman of the IAU Working Group on Astronomical Data and had successfully proposed that it be incorporated into the IAU Commission 5

on Documentation, which was also concerned with the storage and retrieval of information. I later became Vice-President and then President of the Commission, in which capacity I was able to initiate the first LISA meeting on Library and Information Services in Astronomy; this was held in Washington in 1988 just before the IAU General Assembly in Baltimore. The opening reception was held in the library of the U.S. Naval Observatory, where I had worked during my period at USNO in 1957.

The organisation of Project MERIT involved geodesists as well as astronomers from all around the world, and so I visited Australia again in 1979 and had a fascinating visit to Japan for a Geodetic Conference in Tokyo in 1982. It also led to my being invited to give a lecture tour in China in 1987, when during the course of three weeks I spoke at three observatories and two geodetic institutes. Our hosts ensured that my wife and I were shown the principal tourist attractions in each area. The triennial IAU General Assemblies took me to Patras and Delhi, as well as Baltimore, and so my collection of colour slides increased considerably during this decade. I also arranged for some of our meetings to be held in the Castle as Boksenberg had endeavored to make use of its potential as an attractive conference centre.

I was fortunate in that I was due to retire before the move would actually take place, but many of the staff faced a major disruption to their lives, and some decided to resign rather than uproot their families. There were many regrets when we had our last Xmas Lunch in the Castle and when, a few months later, we held a 'Farewell to the Castle' party just before it was handed over to the developer who had bought the estate. I was relieved of my duties as a Division Head and as Superintendent of the Nautical Almanac at the end of March 1989, and so I was able to devote my last three months of service to trying to round off some of the many jobs that I had started but had been unable to complete.

The RGO Club arranged a memorable retirement party for me and my wife by way of a buffet lunch in the Clubhouse. Amongst the presents was a photograph of the Castle that had been taken by Norman King, with whom I had played many games of tennis and table tennis since he joined the RGO in 1979. I subsequently used a cheque from the staff to buy a globe of the Earth that had several features linking it closely to the work of the NAO and Time Department. A few days later the end of my career in the civil service was marked by attendance at a Garden Party at Buckingham Palace, but this time my wife and I did not travel to London in a chauffeur-driven RGO car as in 1969, when Andrew and Mary Murray also had invitations.

I was able to retain the use of my office in the West Building until the move to Cambridge took place in April 1990. I cleared my desk on April 4 and in the evening played in the RGO table-tennis team in a drawn league match, which was held in the Clubhouse. My diary records that "I won two sets!!" — not bad for a veteran!

Although my memory of many events has faded and although I have left out much that might have been included, I hope that I have been able to convey in this article some of the satisfaction and enjoyment that I have gained from my work for the RGO and especially from the many members of the staff who became my friends during my 38 years at Herstmonceux Castle.