A personal review of the history of the Royal Greenwich Observatory at Herstmonceux Castle, 1948-1990

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The Royal Greenwich Observatory took its new name in 1948 at the start of the move to Herstmonceux Castle, when Sir Harold Spencer Jones was the Astronomer Royal. The move of the departments from their wartime bases to new buildings around the Castle was not completed until 1958, by which time the Astronomer Royal was Richard Woolley. He changed the primary emphasis of the astronomical work from long-term data-gathering programmes to astrophysical research. The transfer of responsibility for the Observatory from the Admiralty to the Science Research Council, in 1965, led eventually to a further major change in the 1970s, when Alan Hunter and Graham Smith were the Directors, as the primary task became the building of a new observatory on La Palma. During the 1980s, when Alec Boksenberg was Director, there were major cuts in staffing levels, especially for the public-service activities, and the R.G.O. was moved to a new building in Cambridge in 1990.

The first 300 years of the history of the Royal Greenwich Observatory (R.G.O.)[1] were fully documented at the time of the celebration of the Tercentenary in 1975.[2,3,4] 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 paper I have concentrated on the period from 1948 to 1990, when the Observatory was based at Herstmonceux Castle in Sussex, England.[5] I had the good fortune to be work there for almost the whole of this period.

This paper 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 largely depend 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. I have, however, given brief details of some of these less-well publicised service activities. Thirdly, the work of the Observatory covered such a wide range of activities that it would be impossible in a paper such as this to discuss in detail the nature of the astronomical results or of the facilities that were used or developed at Herstmonceux, mainly for use overseas. I start with a brief sketch of the history of the R.G.O. up to the move from Greenwich to Herstmonceux Castle in order to set the background for subsequent developments.

Early history

The Royal Observatory at Greenwich was founded by Charles II in 1675 to provide the astronomical foundation for the determination of longitude at sea. The first Astronomer Royal (A.R.), John Flamsteed (in office for the period 1675–1719) concentrated on star positions. Then Edmund Halley (2nd A.R. 1720–1742) made observations of the position of the Moon over a 19-year cycle. James Bradley (3rd A.R. 1742–1762) improved the accuracy of observations. Nathaniel Bliss (4th A.R. 1762–1764) left no mark on the Observatory.

Nevil Maskelyne (5th A.R. 1765–1811), achieved the main objective by producing the *Nautical Almanac and Astronomical Ephemeris* (N.A.) 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 (6th A.R. 1811–1835) neglected the N.A., and in 1818 Thomas Young became the first 'Superintendent of the Nautical Almanac'. The next Superintendent, W. S. Stratford, set up the Nautical Almanac Office (N.A.O.), which was separate from the Observatory 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.

George Biddell Airy (7th A.R. 1835–1881) believed that the Observatory 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 the government. In 1838 magnetic and meteorological observations were started, and in 1849

the electric telegraph was used for the distribution of Greenwich Mean Time (G.M.T.). He is, perhaps, best known for designing and installing in 1851 the Airy transit circle (A.T.C.), which in 1884 was adopted to define the zero meridian and hence G.M.T. for international use.[6] 1873 saw the start of the R.G.O. series of daily observations of sunspots and other solar phenomena – these are related to both geomagnetism and climate.

William Christie (8th A.R. 1881–1910) took a greater interest in astrophysics and in 1894 installed the 28-inch refractor.[7] His successor, Frank Dyson (9th A.R. 1910–1933) organised the 1919 eclipse expeditions to test Einstein's theory of general relativity. Harold Spencer Jones (10th A.R. 1933–1955) was more interested in astrometry and geophysics, rather than astrophysics. Spencer Jones became formally responsible for the N.A.O. when the suspension of the Superintendent, L.J. Comrie, in 1936 led to the N.A.O. becoming part of the R.G.O. for administrative purposes. Comrie's successor was Donald H. Sadler. During World War II, the N.A.O. was evacuated to Bath, and later carried out work for the Admiralty Computing Service. Sadler was awarded the O.B.E. for this work.

Spencer Jones pressed for the move of the Observatory from Greenwich, but no action was taken until after the war, when 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 immediately for offices, workshops, etc, while the new buildings were being constructed.

End of the Spencer Jones period, 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.[8] An aerial view of the Castle (Figure 1), probably taken in about 1948 after it had been purchased by the Admiralty, shows also temporary huts that were built during World War II for the Hearts of Oak Friendly Society.

The Castle has an imposing gatehouse and twin towers in its south wing, and is set in an ornamental lake, which was referred to as the "moat". The Great Hall of the Castle in the west wing was converted for use as the R.G.O. 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 for Spencer Jones and his successor. The panelled drawing room was later used as a committee room; I first saw it when Lady Spencer Jones entertained the very young children of the staff during a Christmas/New Year children's party. At these events, Sir Harold used to play the rôle of Father Christmas and would descend to the children in the Staircase Hall, which was normally used for important committee meetings and for presentations to staff, etc.

Figure 1

Aerial view of Herstmonceux Castle *circa* 1948

In this view, the camera is pointing north-east. The formal gardens are to the north of the Castle. Nearest the camera, to the south of the Castle, the temporary, war-time huts are visible. These housed some sections of the R.G.O. when it first moved from Greenwich at about the time this photograph was taken.

Author's unpublished photograph taken from R.G.O. Archives, *circa* 1989.

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. The offices for the administrative staff and for the Solar Department were also in the east wing.

The attic rooms in the north wing were used for a ladies' hostel, while one of the temporary huts to the south of the Castle was used as a men's hostel. The hostels were used by new staff and visitors. Many of the staff who moved to the new site were provided with accommodation on Council housing estates in Herstmonceux village, while others bought or rented houses or flats in the neighbourhood or in Hailsham, Bexhill or East-

bourne. Some staff, especially junior staff, were recruited locally. Observatory vehicles were used to meet buses in the village and trains at Pevensey Bay Halt. There was a kitchen and dining room in the south wing of the Castle; this provided lunches for all staff, as well as breakfast and evening meals for the hostel residents. The staff had access to the formal gardens and to the extensive grounds of the Castle; these were open to the public on a few afternoons each week during the summer.

Most of the staff were members of the Social and Sports Club (later referred to simply as 'the 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 – a Sussex game having 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 newspaper, the *Sussex Express and County Herald*. The R.G.O. tennis team in 1953 was made up of 3 men and 3 ladies from the N.A.O., including the Superintendent, Sadler (a fine sportsman who had played tennis and hockey at a high club standard before World War II). I lived in the men's hostel for about two years and made much use of these facilities.

I joined the N.A.O. in 1951 after it had moved in 1949 from Bath to Herstmonceux Castle, where it had offices in the huts on the south side of the moat. 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. There were two National Accounting machines that were used in production of the almanacs; these were in effect modern versions of the 'Difference Engine' that Charles Babbage had designed in the first half of the 19th century. The bulk of the computing was, however, carried out by the use of punched-card machines (Figure 2), including a powerful IBM 602A calculating punch and an IBM card-controlled typewriter. 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. Amateur astronomers used to observe these events; the differences between the computed times and the observed times they reported were used mainly 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 N.A.O. used to compute sunrise, sunset and lighting-up times for places in the U.K. – for diaries and other publications.[9]

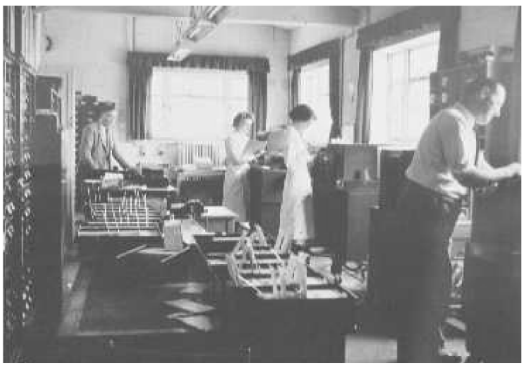

Figure 2

Machine room of the Nautical Almanac Office

This is the scene *circa* 1951, showing the Hollerith punched card machines. The N.A.O. staff in this photograph are, left to right, Albert Carter, Audrey Nevell, Audrey Crisford and George Harding.

Author's unpublished photograph taken from R.G.O. Archives, *circa* 1989.

The Solar Dome was built on the hillside to the south-west of the Castle and was the only observing facility for several years. Complaints about its appearance led to the appointment of a naval architect to design the rest of the new buildings and domes. The Chronometer Department had moved from Bradford-on-Avon, Wiltshire; it had offices and rating rooms in the west wing of the Castle. Its workshop was in a hut to the south of the Castle.

Although Spencer Jones was the Astronomer Royal, 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 U.K. by obtaining an American donation of a 98-inch mirror blank. After discussions it was eventually decided to site the Isaac Newton Telescope (as the new telescope became known) (I.N.T.) 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 R.G.O. (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. The new Photographic Zenith Telescope (P.Z.T.) (for the determination of Universal Time) was, however, brought into use in 1955, and the Reversible Transit Circle (R.T.C.) (for the determination of the positions of stars) was moved from Greenwich in 1955, although regular observations did not start until 1957.

Thomas Gold joined the staff as a Chief Assistant in 1952. He was full of ideas and started a cosmic-ray monitoring unit, but he resigned in 1956 to take a position at Cornell University at Ithaca, New York state in the eastern U.S.A.,

where he became director of a new centre for radiophysics and space research. He had tried, unsuccessfully, to interest Spencer Jones (and Woolley) in the use of radio techniques for astrometry.

The 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 the publication in a national newspaper of a cartoon showing the solar dome and small boys carrying placards proclaiming "unfair to spacemen".

Figure 3

R. van der Riet Woolley making a presentation to D.H. Sadler

Woolley (the newly appointed Astronomer Royal) is on the right; Sadler on the left. The presentation was of the Spencer Jones Indoor Sports Trophy. It took place during the New Year party of the R.G.O. Social and Sports Club, January 1956. Also shown are George Rickett (seated) and Gilbert Satterthwaite.

Author's unpublished photograph taken from R.G.O. Archives, *circa* 1989.

Almost his first task was to make a presentation to Sadler at the Club party after the pantomime as Sadler had won the Spencer Jones Indoor Sports Trophy during the autumn (Figure 3). Woolley was also a keen sportsman and had played hockey for the Observatory at Greenwich, but at Herstmonceux he contented himself with tennis and cricket.

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

I went on duty to the U.S.A. for one year from February 1957 to February 1958, and so I missed the finish of the construction. I spent 6 months at the U. S. Naval Observatory in Washington, D.C., and 6 months at the Yale University Observatory at New Haven, Connecticut. (I received a foreign-service allowance as a single man, although my wife and two-year old son went with me.) During my time in the U.S.A. I learnt how to program an IBM 650 computer, determined improved orbits for the satellites of Mars and attended lectures on celestial mechanics. The experience proved to be very valuable.

When I returned at the end of February 1958 the rest of the staff had moved from Greenwich, and the Time Department, had moved from Abinger, Surrey, while the Chronometer Workshop and the N.A.O. had moved from the huts to the West Building. The north wing of the building included the Chronometer Workshop and the main stores and was linked to the Engineering Workshop. The work on the approach road and car park for the new buildings had not yet been completed.

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 regret that I did not photograph the craftsman who knapped an enormous pile of flints for this building. There are three domes (A, B and 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 they would turn green and blend with the countryside. They did not reflect sunlight, and so had to be heavily insulated; they were a constant source of trouble (Figure 4).

Figure 4

The dome of the 26-inch equatorial refractor under construction in 1956

Notice the new installed copper cladding, which was later to be the source of much difficulty with temperature equilibration.

Photograph by the author.

There was an ornamental pool and steps between the various levels of the domes and walkways (Figure 5). These fine architectural features, although attractive, proved to be very hazardous to astronomers (and to students) working in the buildings of the Equatorial Group on dark nights!

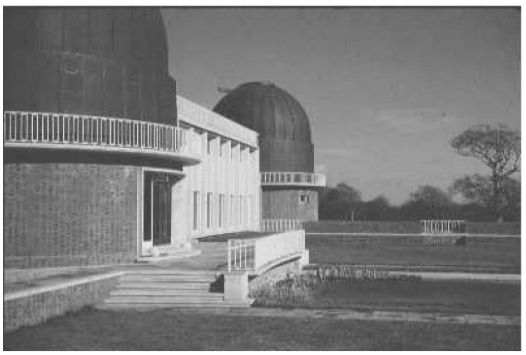

Figure 5

Domes B and C of the Equatorial Group of telescopes at Herstmonceux

This photograph, looking east, was taken in 1958. Already the copper of the domes is covered with verdigris. Notice the ornamental pool and access steps.

Photograph by the author.

There was no formal opening of the Observatory, but the Duke of Edinburgh did make an visit in November 1958. The telescopes were transferred from Greenwich, including: the 30-inch Thompson reflector (first commissioned in 1897); the 36-inch Yapp reflector (1934); the 26-inch refractor (given by Thompson in 1892) in a dome fitted 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 Equatorial 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.

The staff of the N.A.O. had moved from the huts by the Castle at the beginning of October 1957, 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. When I went to the U.S.A. in 1957, I had taken a programming manual for an English Electric DEUCE computer, which was the commercial version of the ACE Pilot Model at the National Physical Laboratory (Teddington, Middlesex), 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 basic software, and no scientific software was available from other sources – and to be very low on speed and capacity. The computer was managed and operated by N.A.O. staff, but was used generally for R.G.O. purposes.

The Time Department 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 Spencer Jones Group (originally known as the Meridian Group) contained the Cooke reversible transit circle, and the photographic zenith tube/telescope (Figure 6). The former was used to determine precise positions and proper motions of stars and continued the work of the Airy transit circle. The P.Z.T. was used to measure Universal Time and the variation of latitude for the Greenwich Time Service and as the U.K. 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 in the Group. It had a small snooker table for use during cloudy periods! There was also a Danjon prismatic astrolabe, which was intended to supplement the P.Z.T., but this was soon transferred to the Royal Observatory at the Cape of Good Hope.

When the position of the new Ordnance Survey (O.S.) pillar on the Herstmonceux site was determined with respect to Greenwich, a discrepancy was found. It was eventually realized that that the O.S. had not changed to the Airy meridian after

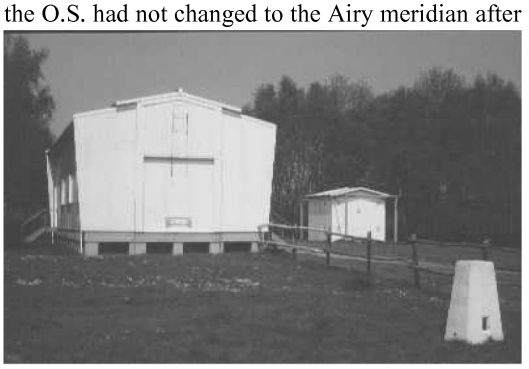

Figure 6

The Spencer Jones (Meridian) Group

This photograph, taken from the south, in 1985, shows the Reversible Transit Circle (R.T.C.) (large building) and the Photographic Zenith Tube (P.Z.T.) (building in the distance).

Photograph by the author.

its adoption as the Prime Meridian in 1884, but had continued to use the earlier, Bradley meridian, which was some 19 feet away.

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 West Building was completed. It was built by the voluntary efforts of the members of the Club, which had been given a major boost by the arrival of staff from Abinger. The Clubhouse was opened in October 1960, and provided a bar, kitchen and lounge, as well as two snooker tables and a general area, used regularly for table-tennis, badminton and ballroom dancing.

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 wing in the West Building. This meant that the Long Gallery could be used for social functions, including country dancing, as well as for official purposes. Woolley was very keen on country dancing, but this was organised independently of the Club. 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 the R.G.O. and universities. Leading astronomers from overseas were usually invited and the facilities of the Castle were used for this and other such meetings. Reports on the Herstmonceux Conferences appeared in *The Observatory*. Woolley also started the vacation course for undergraduates, many of whom became astronomers. For a while there were two courses each of about six weeks during the summer. Series of lectures on basic astronomy, mathematics and physics were also given to junior staff, some of whom continued their studies to a higher level.

Woolley set up astrophysics research teams and reduced the emphasis on the long-term observational programmes. He recruited, and quickly promoted, Bernard Pagel to lead one team and Olin Eggen came from Australia as a Chief Assistant. Woolley developed an extensive programme for the use of telescopes overseas, especially in South Africa and Australia, but also in Egypt, Spain, and the Mount Wilson Observatory in California, U.S.A. He put a professional engineer, John Pope, in charge of an expanded Engineering Department and some of its staff went to overseas observatories in order to build up their experience.

Unfortunately, Woolley also decided that the R.G.O. should itself publish its research papers, as well as the data resulting from the observations made by the staff. The papers came out as individual *R.G.O. Bulletins* and at first were printed from typescripts. Consequently, the research was undervalued by the rest of the world as it was not independently peer-reviewed and was not seen in the main journals used by professional astronomers.

Woolley carried the day in his opposition to the U.K. joining the European Southern Observatory (E.S.O.) and he obtained approval for the Anglo-Australian Telescope project. The telescope was good, but the site at Siding Springs was inferior to the E.S.O. site in Chile.

In April 1965 responsibility for the funding of the R.G.O. passed from the Admiralty to the Science Research Council (S.R.C.). This led to an enormous increase in bureaucracy and eventually proved disastrous for the Observatory. The annual meeting of the Board of Visitors was no longer held and the detailed annual report was stopped. Instead, each of the activities of the Observatory was subjected to detailed scrutiny by S.R.C. committees. The public service functions of the Observatory were given the lowest priority of all R.G.O. scientific activities and were barely mentioned in the brief annual reports that were published by the Royal Astronomical Society.

The transfer of the R.G.O. to the S.R.C. led to an increase in the activities of the trade unions in the Observatory, as the Council wished to change the conditions of service of the staff since they varied between the establishments now controlled by the Council. The Observatory section of the Institution of Professional Civil Servants, which had originally been known as the Association of Astronomers, had already changed considerably, as it now included a much higher proportion of engineering and other technical support staff for instrument development and computing.

The University of Sussex at Falmer, on the outskirts of Brighton, was established at about this time, with an astronomy centre led by Professor W. H. McCrea. Woolley and others were given honorary positions there and contributed to the teaching. Joint seminars were held at the two sites alternately. Many of the R.G.O. staff were able to take part in post-graduate M.Sc. and Ph.D. courses at Falmer. Correspondingly, the University staff and students made use of the Herstmonceux facilities.

Luckily the replacement for the ICT 1201 computer was ordered before the changeover to S.R.C. management, and an ICT 1909 computer was installed in 1966 (Figure 7). It was not the computer that I had wanted, but it proved to be better than I expected and it was used extensively by almost all of the departments of the R.G.O. It was

Figure 7

The ICT 1909 computer at the R.G.O. Herstmonceux *circa* 1965

Author's unpublished photograph taken from R.G.O. Archives, *circa* 1989.

also used by the University of Sussex for a short while. It was upgraded to an ICL 1903T in 1974.

Soon after his arrival, Woolley had forced a change of design of the Isaac Newton Telescope (I.N.T.), but the project was subject to many delays. It was, however, continued by the S.R.C. The I.N.T. was intended for general use by U.K. astronomers, and was not to be regarded as an R.G.O. telescope. Nevertheless, the R.G.O. was expected to provide operational support, although it was not given any extra resources for this task.

The construction of the dome of the I.N.T. was started in 1965 and I took a series of slides of the construction of the building and of the arrival of the parts of the telescope. From time to time I slipped into the dome to watch the progress in the construction of the telescope – there was no Health and Safety Executive in those days! The telescope was formally inaugurated in December 1967 by Queen Elizabeth. She signed the R.G.O. visitors' book and was presented with a replica of Isaac Newton's original telescope. The replica was made in our workshop. 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.[10] The National Maritime Museum mounted a special exhibition in the Old Royal Observatory at Greenwich and Sadler wrote a booklet about astronomical navigation to accompany it.[11] Unfortunately, the Museum 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 a drawing office and for the new Physics Department, which was headed by Dennis McMullan from Cambridge University. Its first task was to design and build electronographic cameras, but then it turned to the development of detectors based on the use of C.C.D.s (charge-coupled devices). Woolley was very much against the use of computers for telescope control; it was said that in orders for the provision of equipment they had to be disguised as 'process controllers'.

In 1969 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. The dome was later used for another telescope, but little use was made of that.

At the beginning of 1970 Sadler was given leave of absence in order to organise the General Assembly of the I.A.U. that was held at the University of Sussex in August. I became Acting Superintendent of the N.A.O. and later, in 1971, Superintendent, as Sadler did not return to the post. Woolley tried to block the confirmation of my acting promotion to the Civil Service grade of Senior Principal Scientific Officer, as he wished to use the complement position for astrophysical research, but my appeal to S.R.C. was successful. Much of my work in the R.G.O. depended on co-operation between organisations and individual astronomers and I was involved in several international activities, especially in the International Astronomical Union (I.A.U.) as Sadler had been.[12]

Woolley was knighted in 1963. 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.

Period of change, 1972–1981

Margaret Burbidge (1972–1973) was appointed as Director of the R.G.O., but not as Astronomer Royal (this title went to Martin Ryle at Cambridge University). 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 he arranged the first regular meetings of senior staff.

Alan Hunter (1973–1975), who had joined the R.G.O. in 1937, became the next Director and it was appropriate that he should oversee the R.G.O. 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 Danny Elliot, one of the stonemasons who worked on the restoration of the Castle. The bust stood in front of the

large, equiangular sundial (Figure 8) that had been made to a design by Gordon Taylor, then in the N.A.O., to commemorate the Tercentenary and the link with Greenwich. (Taylor was a dedicated amateur observer and later he became the long-serving Director of the Computing Section of the British Astronomical Association). I had the task of verifying that his design was sound.

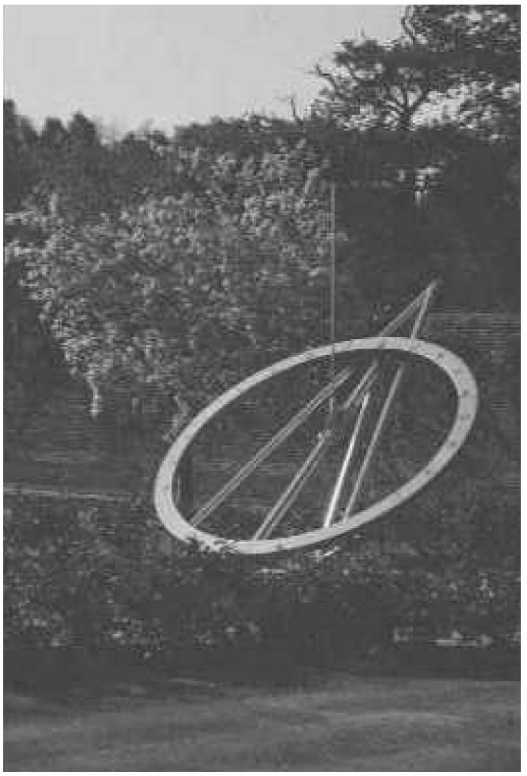

Figure 8

The tercentenary (equiangular) sundial at Herstmonceux Castle

The sundial was designed by Gordon Taylor when a member of the staff of the Nautical Almanac Office. This photograph was taken in 1980, five years after the sundial had been installed to commemorate the tercentenary of the R.G.O.

Photograph by the author.

An historical symposium was held at the National Maritime Museum at Greenwich.[4] A booklet about the history of the R.G.O. was written by Professor McCrea[2] at the instigation of the R.G.O. A much more extended and expensive history in three volumes was published commercially[3] and many articles about the R.G.O. were published in newspapers and magazines. A special tercentenary research symposium was held at the Castle and was attended by many distinguished astronomers from overseas. During August, members of the public were given the opportunity to see the telescopes for the first time. This proved to be very popular.

Hunter had a quite different management style from Woolley, and in 1974 the 'Departments' of the R.G.O. were grouped into 'Divisions'. I became responsible for the oversight of the work of the Time Department as well as of the N.A.O. and the Computer Department, which was split from the N.A.O. Later the Library and the Archives were added to this newly-formed Almanacs and Time Division (A&T). He also re-introduced the detailed annual report as a separate publication, which was issued for the years 1974 to 1980.

This was also a period of review by the S.R.C. about the rôle of the R.G.O. in the context of proposals for a Northern Hemisphere Observatory (N.H.O.). Eventually it was agreed that the R.G.O. should be responsible for the building of a new N.H.O. on a good site. Francis Graham Smith (1976–1981) was appointed as the next Director to carry it through. Site testing led to the choice of the rim of an extinct volcano on the Spanish island of La Palma in the Canaries. Other European countries also set up new facilities there.

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

Graham Smith had, meanwhile, been pressing forward the planning of the N.H.O. 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 N.H.O. design team. Although most of it was then above ground, it had been 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.

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 end their perceived isolation from the other R.G.O. staff concerned with photographic astrometry and astrophysics.

In 1977 the R.G.O. 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. Woolley had stopped the meteorological observations completely, but these were later re-instated by the Meteorological Office.

Consideration was given to the transfer of the early records of the R.G.O. 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 to make the Airy Collection, as 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 from the site of the I.N.T. 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 to be paid for the N.H.O. The I.N.T. 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 R.G.O. did not devote resources to the maintenance and use of the telescope in the U.K. Consequently, a lot of effort and costs were wasted on the redesign and on rebuilding. A new ceramic mirror was provided to enhance the performance of the telescope. The UK, however, no longer had 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.

The rapid developments in computer technology and the need for powerful computing facilities for processing the digital images from the new C.C.D. detectors led to the acquisition in 1981 of a VAX 11/780 computer as part of the UK-wide Starlink system. Consequently the ICT 1903T system was shut down in 1983.

In July 1981 a telescope for the new satellite laser ranging (S.L.R.) system was installed in what had been the solar dome. This system was the result of a proposal by a combination of university groups and the R.G.O. as it was realized that the P.Z.T. would be superseded by new international techniques for monitoring the rotation of the Earth. (I drafted the proposal and argued for it in S.R.C. 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 director of the radio-astronomy observatory at Jodrell Bank in succession to Sir Bernard Lovell. I acted as his deputy for his last year of office and made the staff presentation to him (Figure 9); he responded by handing to me a cheque for double his leaving present, and he asked that it be used to provide staff facilities on La Palma.

Figure 9

Francis Graham Smith, Director of the R.G.O., on the occasion of his retirement in 1981

Francis Graham Smith (on left) is seen exchanging cheques with the author at the retirement ceremony on 25 September 1981.

Author's unpublished photograph taken from R.G.O. Archives, *circa* 1989.

Period of decline, 1981–1990

Alec Boksenberg 1981–1996, from University College London, succeeded Graham Smith. He came to the Castle to take up his post on 3 October 1981, on the occasion of the annual meeting of the Federation of Astronomical Societies. This was the first to be held at Herstmonceux. Boksenberg arrived shortly after I had carried out my last duty as deputy director by opening the meeting.

One of Boksenberg's first actions was to initiate a reduction of about 25 % in the staff levels of the R.G.O., whereas under Graham Smith our complement had been rising to cope with the demands of the new facilities on La Palma. A more than proportionate cut was made in the services, such as those of the A&T Division. Nevertheless, the S.L.R. system was successfully brought into operation in 1963 and, despite the English weather,

soon became the most productive station in the world for several years. It made a significant contribution to the international Project MERIT to monitor the rotation of the Earth.[13] The Project led to the establishment of the International Earth Rotation Service in 1988. (I had been appointed the chairman of the I.A.U. Working Group for this project in 1978 and was chairman of the Directing Board of the new service at its first meeting, in the year before my retirement from the R.G.O.) A photograph of the S.L.R. system at night, 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 observers 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 – 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. The A&T Division played its part by organising several national and international workshops in the Castle, including the second Project MERIT workshop in May 1983.

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.[6,14] Correspondingly, the universal day was defined by Greenwich Mean Time starting at midnight on the Greenwich meridian instead of at noon as was then the practice in astronomy . The *Nautical Almanac* continued, however, to use the astronomical day starting at noon until 1925. The booklet produced by the Ordnance Survey[15] to mark the event describes the founding of the Royal Observatory and its rôle 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 August 17.

The main purpose of the R.G.O. had been changed from astrometry under Spencer Jones to astrophysics under Woolley and then, under Smith and Boksenberg, to the provision of support for U.K. astronomers at overseas observatories on La Palma and elsewhere. The Roque de los Muchachos Observatory on La Palma is an international one and involves several European countries other than Spain and the U.K. There are four telescopes in the Isaac Newton Group. They are usually known by their initials.

I.N.T. – Isaac Newton Telescope – 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.

J.K.T. – Jacobus Kapteyn Telescope – a 1-m astrographic telescope that was jointly funded with the Netherlands (hence the name) and Ireland.

W.H.T. – William Herschel Telescope – was completed in July 1987. It is an altazimuth with a 4.2-m mirror. The cover of the R.G.O. Report for 1985-1987 shows the W.H.T. Dome at night – as if half of it was open to the sky!

C.A.M.C. – Carlsberg Automatic Meridian Circle came from Denmark (hence the name) and is the same basic design as the R.T.C. at Herstmonceux, which ceased operation in 1982. C.A.M.C. started operation in 1984 and was then jointly operated by Denmark and the U.K.

The R.G.O. established an administrative base in Santa Cruz at the foot of the mountain, but additional technical support and observers were provided from Herstmonceux. The Isaac Newton Group provided a powerful facility that was used successfully by astronomers from the U.K. and other countries. The international observatories on La Palma and Tenerife were formally inaugurated in June 1985. Detailed descriptions of the facilities on La Palma and of other aspects of the work of the R.G.O. are given in the R.G.O. reports for the periods 1980-1985 and 1985-1987.[16]

By about 1985 the R.G.O. at Herstmonceux was under threat once more, but complete closure was averted, perhaps as a result of the campaigns by staff and other astronomers. The decision to sell the Castle and its estate for development and to move the R.G.O. to Cambridge with a further reduction in complement was, however, announced in 1988. My arguments that the S.L.R. system should stay at Herstmonceux were accepted and it continues to operate successfully with funding from the Natural Environment Research Council.

I retired in July 1989[17], but I continued to make occasional visits to my office until the R.G.O. moved to a new building at Cambridge in the spring of 1990. The N.A.O. also moved to Cambridge, but the Time Department was closed. The archives were transferred to the Library of the University of Cambridge. The Tercentenary Sundial was moved to Cambridge. The move of the R.G.O. to Cambridge was a severe blow to the Astronomy Centre at the University of Sussex.

The R.G.O. at Cambridge 1990–1998

The new R.G.O. 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 the S.R.C.) was split into the Particle Physics and Astronomy Research Council (P.P.A.R.C.) and the Engineering and Physical Sciences Research Council. P.P.A.R.C. appointed a new Chief Executive and 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 R.G.O. was closed at the end of 1998 after 323 years. The R.G.O. staff held a reunion prior to the closure on a fine day in the summer of 1998.

Some staff went to La Palma and others to the Astronomy Technology Centre at the Royal Observatory at Edinburgh. A few found posts in the Institute of Astronomy at Cambridge or elsewhere in astronomy. The R.G.O. collection of photographic plates was transferred to a commercial store. Some of the Library books were added to the library of the Institute of Astronomy and the books of the Airy Collection were moved to the National Maritime Museum at Greenwich, but I understand that many books were last seen in disposal skips.

Concluding remarks

I am pleased to be able to conclude by noting that three of the R.G.O. activities for which I was responsible at Herstmonceux have survived. The N.A.O. is now based at the United Kingdom Hydrographic Office, part of the Ministry of Defence at Taunton, Somerset, after some years at the Rutherford Appleton Laboratory in Oxfordshire. The S.L.R. system is still in operation at Herstmonceux and contributes to the International Earth Rotation Service and to other projects. The R.G.O. Archives are now in the care of the Cambridge University Library.

During my retirement I have written a much more extended account of the R.G.O. activities at Herstmonceux but the draft (of some 360 pages) contains many uncertainties, as well as many typographical inconsistencies, and has remained unfinished for several years. Other former members of the staff have commented on parts of it, but there is no prospect of my taking them all into account in the foreseeable future as other activities make more immediate demands on my time. It is possible that I may be able to publish some of it on the Internet, but even this appears to me to be a daunting task. The draft and all the information and memorabilia that I have collected will, I hope, eventually be transferred to the R.G.O. Archives at Cambridge.

Herstmonceux Castle is no longer the home of the R.G.O., 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 was converted from offices and laboratories to bedrooms and lounges. The Equatorial Group is open as a Science Centre and a Lottery grant was received to bring the telescopes and domes into use again. The Tercentenary Sundial has been returned to Herstmonceux and is once again in the formal gardens with the bust of Flamsteed. The Centre published a small book containing the recollections of 8 former members of the R.G.O. staff.[18] These give details and comments on a wider range of the activities at Herstmonceux than I have included here, as well as photographs of some of the instruments.

During its long history the R.G.O. 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. Its major achievement after it had celebrated its Tercentenary was to build and operate the 'Northern Hemisphere Observatory' on La Palma. This was so successful that it no longer needed the support of a base in the U.K. and so, paradoxically, the success of the R.G.O. was the cause of its closure!

Notes and References

A note about sources: The references given below are intended mainly to provide sources of additional information, rather than to identify the sources of my statements, many of which are based on my own recollections. I have, however, attempted to check dates and other hard information against other, independent sources. In particular, I have made use of my set of the Information Bulletins that were circulated to the R.G.O. staff from 1952 onwards; these are available in the R.G.O. Archives in the Cambridge University Library. The R.G.O. house journal *Gemini* is another informal source of information and comment about the activities of the staff from 1982 to 1990.

1. Strictly, the name Royal Greenwich Observatory dates only from 1948 at the start of the move to Herstmonceux Castle from Greenwich, but it is also frequently used to include the earlier years when the Observatory was at Greenwich. The Royal Observatory at Greenwich (R.O.,G.) was known as the 'Old Royal Observatory' between 1948 and 1998.
2. McCrea, W. H. *The Royal Greenwich Observatory.* London: Her Majesty's Stationery Office, 1975.
3. This 3-volume set comprises the following individual volumes:

   3a. Forbes, Eric G. *Greenwich Observatory: The Royal Observatory at Greenwich and Herstmonceux 1675–1975. Volume 1: Origins and Early History (1675–1835).* London: Taylor and Francis, 1975.

3b. Meadows, A. J. *Greenwich Observatory: The Royal Observatory at Greenwich and Herstmonceux 1675–1975. Volume 2: Recent History (1836–1975).* London: Taylor and Francis, 1975.

3c. Howes, Derek. *Greenwich Observatory: The Royal Observatory at Greenwich and Herstmonceux 1675–1975. Volume 3: The Buildings and Instruments.* London: Taylor and Francis, 1975.

4. Beer, Arthur and Beer, Peter. (Editors). 'Proceedings of the Tercentenary Symposium of the Royal Greenwich Observatory.' *Vistas in Astronomy.* 1976, 20 (1-2), i-viii and 1-272.
5. All locations referred to in this paper are in England, unless otherwise indicated.
6. Howse, Derek. *Greenwich time and the longitude.* London: Philip Wilson, 1997. This book gives an account of this early period and of the later developments in the spread of the use of Greenwich time.
7. The units used to describe the instruments mentioned in this paper are those in common use during the period of this review.
8. Calvert, David and Martin, Roger. *The History of Herstmonceux Castle.* Herstmonceux Castle, Sussex: International Study Centre, 1994.
9. Wilkins, G. A. 'The making of astronomical tables in H.M. Nautical Almanac Office.' In: Campbell-Kelly, M., Croarken, M., Flood, R. and Robson, E. (Editors). *The History of Mathematical Tables: from Sumer to spreadsheets.* Oxford: Oxford University Press, 2003. Pages 294-303. This paper includes descriptions of the procedures and machines used at Herstmonceux and also illustrations of the Castle, the 1201 and 1909 computers and the R.G.O. tennis team in 1953.
10. Sadler, D. H. 'The bicentenary of the Nautical Almanac.' *Journal of the British Astronomical Association.* 1967, 77 (4), 237–243.
11. Sadler, D. H. *Man is not lost.* London: Her Majesty's Stationery Office, 1968.
12. Wilkins, G. A. 'The Genesis of the IAU Working Group on Astronomical Data.' In: André Heck. (Editor). *Organisations and Strategies in Astronomy.* Volume 7. Dordrecht, The Netherlands: Springer, 2006. Pages 355-366.
13. Wilkins, G. A. 'Project MERIT and the formation of the International Earth Rotation Service'. In: *Polar Motion: Historical and Scientific Problems.* Astronomical Society of the Pacific [A.S.P.] Conference Series. Volume 208. A.S.P. San Francisco, 2000. Pages 187–200.
14. Sadler, D. H. and Wilkins, G. A. 'Astronomical background to the International Meridian Conference of 1884.' *Journal of Navigation.* 1985, 38 (2), 191–199.
15. Malin, S. and Stott, C. *The Greenwich Meridian.* Southampton: Ordnance Survey, 1984.
16. Royal Greenwich Observatory. *Telescopes, instruments, research and services.* (1) *October 1 1980 – September 30 1985.* 128 pages, (2) *October 1 1985 – September 30 1987.* 36 pages.
17. Wilkins, G. A. 'Almost 40 years in the R.G.O. at Herstmonceux Castle.' *Gemini.* March 1989, Number 23, 16-18.
18. Wilson, A. (Editor). *Astronomers at Herstmonceux – in their own words.* Hailsham, East Sussex: Science Projects Publishing, 1999.

The author

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