Astronomy in Oxford & neighbourhood

A: Observatories within the University

B: College observatories:

Wadham, Merton, Corpus, Magdalen, Keble

C: Private observatories:

Shirburn, Blenheim, Norman Pogson, John Phillips.

Other 18th century amateurs: Rev. Edward Stone, George Margetts.

D: Principal office holders:

The Savilian chairs

Savilian professors, Radcliffe Observers.

E: Meteorology:

The Benson Observatory, 1913; Gordon Dobson

F: Other Oxfordshire notables:

The Rollright Stones; Burford Priory

Museum

Observatories extant:

Oxford University Obs., Radcliffe, University Physics Dept.

Sources for the History of the Oxford Observatories

Introduction

Roger Bacon (1210-1294), a Franciscan friar, had rooms in the old watch tower upon Oxford's Folley Bridge. There, in 'Friar Bacon's study' he certainly made numerous experiments with lenses, but Henry King found no proof that he used two lenses held in a frame to invent spectacles, and there is no evidence that he used lenses in combination, or in tubes.[1] Leonard Digges (1520-1559), a mathematician and surveyor of Oxford benefited from reading Bacon's papers and also conducted

numerous optical experiments, including, apparently, the use of a primitive reflecting instrument probably consisting of a crude mirror and a lens, and since a closed tube is not necessary for observing stars, King suggests that Digges may have invented a form of simple reflecting telescope.[2]

The significant early astronomy in the county has been associated with the colleges, especially Merton in the 14th and 15th centuries. Then, after the founding of the Savilian chairs of astronomy and geometry in 1619, the unusually enlightened terms of their endowment brought a succession of the most able men in the country to Oxford University. They taught astronomy and natural philosophy – and three became Astronomer Royal at Greenwich. In addition, the private observatories at Shirburn Castle and Blenheim Palace are well known. Beyond, it is not yet clear whether the concentration of resources within Oxford inhibited amateurs in the periphery of the county. There is no reason why that should be so, why vicars or skilled artisans in parishes beyond the University of Oxford should not have observed and reported their observations, as they did in many other counties. But they have yet to be identified here.

Much remains to be done, and all help will be welcome, but a start is made by recording the principal observatories.

[1] Henry C. King, *The History of the Telescope* (Dover, New York, 1955), 27-28.

[2] King (1955), 28-29.

A: Observatories within the University, and principal instruments

Oxford City:[1]

Sir Henry Saville, Warden of Merton College, in 1619 founded and endowed the Savilian chairs of Astronomy and Geometry.

1) The ‘Mathematical Tower’ of the Schools Quad, later known as the Bodleian Tower of the Bodleian Library quadrangle, in the centre of Oxford, a university observatory (c.51°45′N 1°15W). This was a typical seventeenth century mathematical tower, deliberately built with five floors, to display the five orders of classical architectural columns, and to provide a high observing platform. The University made available the top room of the tower for the use of the Savilian professor of astronomy, together with the flat roof above on which he could mount his portable instruments. It was used between 1619 and 1772 by the Savilian professors Greaves, Ward, D. Gregory, Bradley and Hornsby. Initially Greaves only had an Astrolabe of 1559 made by Thomas Gemini of London for Queen Elizabeth I (now displayed in the MHS), and apparently given by her to the University, and thence passed to the first Savilian professor.

The original first suite of instruments was then:

- 1637 a 78-inch radius mural quadrant by Elias Allen of London, used by Greaves, and now in the MHS.

- c.1640 a mural sextant of 73-inch radius, maker unknown, also in the MHS.

- c.1697 a clock

- c.1769 a transit instrument of 43 inch focal length on a 2 feet axis, by John Bird of London; Hornsby took this with him to the Radcliffe Observatory in 1773, and is now in the MHS (see Howse 1986).

2) The Savilian Professor's House, in New College Lane, provided by New College for the use of the professor. A small observatory built c.1705 by Edmund Halley on the roof of the house [2]. It is believed that no fixed instruments were used there. It was only large enough to hold about three people, had only one small window on each side, and would have been used for teaching practical astronomy with hand-held instruments. From a draft surviving catalogue (short list) of fixed stars for use at 'New College Lane', we may assume that Thomas Hornsby used, or perhaps intended to use before he realised how heavy and awkward it would be to carry his instruments up there, his 43-inch transit of 1760 or his 32-inch quadrant of 1767 there [3]. The Observatory was used by Professor William Donkin 1842–60 only as a teaching observatory (see Howse 1986) .

3) The Ashmolean Museum (the Old Ashmolean Building).

In about 1730 James Bradley is known to have used a portable transit instrument from the lower half landing on the principal staircase, with a view south over the city (see Howse 1986).

4) The City Wall (off New College Lane), University, for the Savilian professor (see Howse 1986).

From about 1740 to 1760 Nathaniel Bliss sometimes used fixed instruments mounted on the massive section of the old city wall immediately adjacent to the two houses of the Savilian professors of Astronomy and of Geometry.

5) Corpus Christi College Observatory, private, the Savilian Professor's.

From about 1763 to 1773 Hornsby used his new portable mural quadrant of 32-inch radius by John Bird with a 1¼-inch object glass by Dollond, from the window of his room. He took this instrument with him to the new Radcliffe Observatory which he founded in 1772, and installed it in the Students' Observatory there. The instrument is now in the MHS (see Howse 1986).

6) Radcliffe Observatory, private trust, 1772 to 1935, used by the Savilian professor until 1839 (51°46′N 1°15′W); used by Professors Hornsby, Robertson, S.P. Rigaud.

Instruments:

1772 mural quadrant 32-inch R/1¼-inch OG by Bird/Dollond in 1767; Hornsby's, from Corpus (now MHS).

1772-1838 mural quadrant, south 8 feet R/3-inch OG by Bird/Dollond (now Science Museum, London – SML).

1773 mural quadrant, north 8 feet R/3-inch OG by Bird/Dollond (now MHS).

1773 transit instrument 4-inchOG/8 feet FL by Bird/Dollond, adapted by Simms in 1843 (now MHS).

1773 transit instrument 43-inch FL by Bird (c.1769) from Schools Tower (now MHS)

1773 zenith sector 11-foot 8-inchFL/3½-inch OG by Bird (now MHS).

1774 equatorial sector 2½-inch OG/5 feet FL by Bird (now MHS).

1774 4½-inch refractor of 10 feet FL by Dollond 1774 (now MHS)

1774 3½" Dollond refractor on portable mount (now MHS).

1812 8-inch Herschel Newtonian reflector of 7 feet FL, c.1795, given by Duke of Marlborough (now MHS).

1836 mural circle 4.1-inch OG/6 feet FL by Thomas Jones of London, (now MHS).

1849 heliometer 7½-inch OG by Merz & Repsold ('The Oxford Heliometer' dismounted 1907, now SML).

1861 5-inch transit circle of 1854 'the Carrington' by Troughton & Simms (MHS).

1861 7¼-inchWellington refractor/OG of 1834, reconstructed for sunspot obs.

1887 10inch Barclay refractor by Cooke & Sons (of 1862 – since 1935 at

Marlborough College Obs.).

1903 24-inch photo/18-inch visual Grubb Double Equatorial (now at Mill Hill Obs.).

In 1930 the Radcliffe Trustees accepted the offer of Lord Nuffield for the Observatory site, urgently needed for expansion of the city's hospital, and decided to relocate the Radcliffe Observatory to South Africa, re-equipping with a 74-inch reflector. Between October 1933 and December 1934 Radcliffe Observer Harold Knox-Shaw took considerable care over disposal of the instruments. In October 1933 he offered Robert T. Gunther for his Museum of the History of Science established in 1927, the historical instruments provided that they were properly exhibited. These included six instruments by John Bird among 14, plus two other items [4].These included the Carrington Circle which had been in continuous use at the Radcliffe Observatory from 1862 to 1903, the principal instrument of the Observatory, and three catalogues had been published from observations made with it. Upon those, and the observations made by Manuel Johnson with the 43-inch Transit of 1760 by Bird modified by Simms, the fame of the Radcliffe Observatory chiefly rested.

In 1934 the Trustees offered the Double Equatorial to the University, but the University would or could only consider accepting it if on a 'temporary mount'. Knox-Shaw told Professor Harry Plaskett that he objected strongly to this proposal to save £10,000; it was not practical, and amounted to frittering away the resource [5]. At the intervention of Astronomer Royal Frank Dyson the Double Equatorial was given to London University's Mill Hill Observatory; in recent years it has been thoroughly refurbished, and is in regular use (see Howse 1986).

7) The University Museum Observatory, teaching observatory 1860-75 (demolished 1885); the first observatory purpose built by the University [6].The fate of the instruments is not known:

- Donkin's 4-inch transit instrument

- Small brass altazimuth instrument.

- 1849 clock.

8) The University of Oxford Observatory, 1875.

- 12¼-inch Grubb refractor, 1875 (now at Keele University)[7].

- 13-inch De La Rue photographic reflector of 1849 (now in MHS store)

- 1887 the 4-inch Barclay meridian circle (of 1862, by Troughton & Simms).

- 1897 13-inch Grubb astrograph (coaxial with the refractor, fate unknown).

- 1935 Vertical Solar Telescope, a Cassegrain reflector with 12½-inch primary mirror

and 6-inch convex with 16-inch coelostat, by Grubb Parsons.[8]

Adam Hilger Ltd supplied three 6-inch flint glass prisms (£585) for a 30-foot Littrow Spectroscope, and a 6-inch achromatic object glass (£120). Professor Plaskett believed that the prisms were unique as regards their large size and their high optical quality [9]. In 2008 the telescope is still in situ, on top of the brick De la Rue pier in what is now the North Tower.

- The 35m Solar Telescope of 1955, by Grubb Parsons. A Cassegrain reflector with a 51cm/20¼-inch primary mirror figured on fused silica, and a coudé focus. £16,300 (including a gift from Professor D.A. Jackson) was made available by the University in 1948 for the telescope, its building, and high dispersion spectroscope [10].

[1] The primary reference is Howse, pp. 78-80 with input from Gerard L'E. Turner and Tony Simcock; then A.V. Simcock, The Ashmolean Museum and Oxford Science 1683-1983 (Oxford: Museum of the History of Science, 1984) – still available from the MHS; excellent on early astronomy.

[2] H. E. Bell, 'The Savilian Professors' Houses and Halley's Observatory at Oxford', *Notes and Records of the Royal Society of London*, **16**, 2 (Nov., 1961), 179-186.

[3] Working draft catalogue of fixed stars made by Thomas Hornsby for use at New College Lane and the Radcliffe Observatory, Oxford, c.1780, MHS MS Radcliffe 22, and a fair copy MS Radcliffe 23.

[4] University of Oxford Archive, Registry Papers, UR6/AST/3, Radcliffe Observatory, Disposal of Instruments 10/33 – 12/34), which lists the instruments under discussion, folio 9.

[5] University of Oxford Archive, Registry Papers, Letter Harold Knox-Shaw to Plaskett, letter 2 Jan 1935, UR/AST/4C.

[6] Roger Hutchins, *British University Observatories 1772–1939* (Ashgate, 2008), pp. 42-3.

[7] The instrument is owned by the Physics Department, and mounted in their hilltop observatory. They consider the instrument priceless, and it is extensively used. The optics remain in first-class condition and the only major modification has been replacement of the weight drive by a variable speed synchronous motor operating through the original gear train. Dr Ron Maddison, University of Keele, letter 5 Sept. 1990 to RH.

[8] Henry C. King, *The History of the Telescope* (Dover, New York, 1979) pp.388-390.

[9] Plaskett to H.M. lodge, Clerk of Accounts, University Chest, letter 30 November 1934, UC/135/3.

*[*10] H.H. Plaskett, 'The Oxford 35m Solar Telescope', *MNRAS*, **115** (1955), 542-9.

1. Other college observatories:

Merton College

The first significant astronomy at Oxford achieved international renown before the Reformation. A couple of Fellows of Merton College, mathematicians of exceptional ability as well as medical physicians, created the first school of astronomy in England.

John Ashindon or Ashinden, also called Eastwood (in one reference of 1338) was according to Anthony Wood the greatest mathematician and astronomer ever produced by Merton College. He inspired a succession of students applying themselves to mathematics and astronomy over the next 150 years. Most of their work was removed from the college library in a cart during a Visitation in the reign of Edward VI, when such books and manuscripts relating to natural science were regarded as profane or worse, and were burned or sold as scrap paper.[1] Ashindon's colleague was William Rede (c.1325–85).

At that time the best astronomical tables predicting the positions of the Sun, Moon and planets for astrologers and navigators, were the Alphonsine Tables produced at Toledo in 1272. Ashindon and Rede are believed to have used astrolabes to make

observations from the south part of the city wall that is also the boundary of Merton College garden. They made improved calculations including the mean longitude of each planet for every 20 years, and published tables adapted for the latitude of Oxford that were a distinct improvement on the Spanish tables [2.] Two 14th Century astrolabes have survived for display in the Old Library. The Merton astronomers of the fifteenth century were not as accomplished, but the reputation had been established [3].

Wadham College

There is a tradition that Christopher Wren observed from the window above the main entrance. Certainly from 1649 onwards as a Gentleman Commoner he dined at high table, and was encouraged by the Warden, John Wilkins, who had a special interest in telescopes. In 1655 they built an instrument of 80 feet focal length to observe the Moon, and Wren observed Saturn. Wren experimented with grinding lenses, designing a micrometer, and devising various improvements for telescopes [4].

Corpus Christi College (c.1763-77)

Has been noted above, Thomas Hornsby observing from his room there. There is a splendid and unusual combination of sundial surmounting a perpetual calendar pillar, in the front quad (see Howse 1986).

The Magdalen College Observatory (1857-1902)

In 1855 Charles Daubeny, Professor of Botany, influenced by John Phillips, gave to the College a 5½" Cooke refractor. It was mounted upon the roof of an especially designed and strengthened 'Telescope Room' (then detached, but now part of the enlarged Daubeny Building built against the Botanic Garden wall), and provided with a run-off shed. This was the first purpose-built college observatory in Oxford. At the turn of the century Professor H. Hilton used the telescope to observe double stars from Webb's Celestial Objects (1868, second edition) [5].

Keble College

In January 1889 the College received 'An Equitorial (sic) from a Mr Lowe', and shortly afterwards the College voted £25 to house it.[6] Elsewhere a Dallmeyer telescope was mentioned, without noting its size. Unfortunately the records for the next decade are missing, and nothing is known of whether the telescope was used, where it was located, or its fate. The donor may have been Hubert Foster Lowe (1861-1938), mathematician and chemist, who obtained a First in 1882 and stayed on in Oxford until 1884 as a physics demonstrator.

[1] George C. Brodrick, Memorials of Merton College (Oxford, 1885), p. 200.

[2] Robert T. Gunther, *Early Science in Oxford*, **11** (Oxford, 1937).

[3] Robert T. Gunther, 'The Merton School of Astronomy', *Early Science in Oxford, 2 'Astronomy'* (Oxford, 1923), 44-69.

[4] Gunther, 2 (1923), pp. 81, 82; Henry C. King, *The History of the Telescope* (Dover, new York, 1955), pp. 74, 99.

[5] R. Hutchins, 'Magdalen's Astronomy Observatory', Magdalen College Record 1990, 44-51.

[6] Gifts & Benefactions register (ref. KC/BEN 1/1), and minutes of College Trustees Meeting 18 January 1889. I am very grateful to Mr Rob Petre, College Archivist, for this information.

[7] Robert Fox (ed), *Physics in Oxford 1839-1939* (OUP, 2005), p. 133.

Private Observatories

Even more elusive than a search for amateur observatories, it has been very difficult to find note of any amateur observers. Oxford's Dr Allan Chapman, author of The Victorian Amateur Astronomer (1998, second edition 2008) knows of no such observatories in Oxfordshire. He believes that the pattern across the country in the eighteenth and nineteenth centuries was that where a local worthy such as John Lee or William Lassell emerged and undertook or sponsored serious astronomy, or a particularly active society such as the Leeds or Manchester became newsworthy, then 'a region would bloom with astronomers'. Perhaps the relative dearth of notable independent or artisan astronomers in the county periphery is because the shire was home to one of the only two residential universities before the mid nineteenth century. Hence Chapman's suggestion is substantiated by young Thomas Hornsby and Nathaniel Bliss both cutting their astronomical teeth at Shirburn Castle before finding their potential within the University – Hornsby as founder of the Radcliffe Observatory, and Bliss in the chair of Geometry and the opportunity to observe with Bradley.

Shirburn Castle - active 1739 until c.1800.

The Earl of Macclesfield's Observatory, private (51º39′N 0º58′W)[1]

Parker, George (c.1697–1764) [2], second Earl of Macclesfield, inherited the mostly brick-built castle of 1377 with four corner towers and a gate tower. He was elected a Fellow of the Royal Society in 1722, and remained friends with and was influenced by William Jones (1675–1749) who had taught him mathematics and with whom the earl continued his studies at Shirburn.

The Earl was also a friend of James Bradley who in 1739 helped him erect an observatory in the grounds. Its location is not now known, but it had three rooms including a bedroom for the earl when he wished to rest after observing late. It was equipped with what was probably then the finest suite of instruments anywhere:

- 1740-87 a transit instrument of 5 feet focal length by Sisson of London.

- 1741 a mural quadrant of 5 feet radius by Sisson of London.

- c.1740 two clocks by Tompion and by Graham, both of London.

- 1748 a Huygens object glass of about 120 feet focal length, loaned by the Royal Society.

- 3-foot 6-inch, 6 feet and 14 feet focal length refractors, the latter with a micrometer. These instruments would have had non-achromatic object glasses of only about 1-inch to about 2¼-inch diameter.

The Earl observed personally from June 1740 almost until his death. His assistants continued the transit observations until 1787, and the quadrant observations from 1743 to 1793. In 1742 his constant influence achieved for Bradley, his frequent guest and occasional assistant, the post of Astronomer Royal. At about this time he trained two estate workers. Thomas Phelps had started his life as a stable-boy, while his colleague, John Bartlett, had been a shepherd. Later the earl 'had their portraits engraved as part of a picture of the interior of his observatory. The now elderly ex-peasant boys are shown elegantly dressed and wigged, holding a discussion at the eyepiece …'.[3] Thomas Phelps discovered the Great Comet of 1743. In 1769 the Observatory's three refractors were used to observe the transit of Venus.[4]

The Shirburn Castle Observatory was very significant. An observatory is only as useful as its capable observers and the number and continuity of trained assistants. Before 1773 the University had nothing to match its instruments. Bradley, Bliss and Hornsby were anxious to work there, did so, and good work was achieved and reputations made.[5] The Earl ensured that two assistants were adequately trained and maintained. In parliament the earl jointly led the move for Britain to adopt the Gregorian calendar in 1752. He was described as the greatest mathematician and astronomer in Europe.

Extensive alterations were effected to the castle and grounds in the eighteenth century, and later no trace of the observatory remained [6] (See Howse 1986).

Blenheim Palace Observatory, private (51°50′N 1°21′W)[7] active c.1772–1800. George Spencer (1739–1817), the fourth Duke of Marlborough, had many interests but his chief scientific interest was astronomy for which he had a passion.[8] He had given land to the University to make possible the building of the Radcliffe Observatory. There he learned from Thomas Hornsby the techniques for using Bird's instruments. Unlike Shirburn where the Oxford astronomers went to observe, Hornsby only went to Blenheim to teach the Duke how to observe, and he did not employ anybody capable of directing the observatory and rendering it scientifically useful, nor is he known to have had any trained assistant [9] (See Howse 1986).

The Duke built an observatory on the south-east tower of his palace in about 1780, [10] perhaps in anticipation of the Venus transit, was elected a Fellow of the Royal Society in 1786, and in 1789 began erecting another observatory on the south-west tower, but there is no mention of either after 1840. His equipment, the finest available and purchased at enormous cost, was:

- 1771 a 6 feet focal length transit instrument by Jesse Ramsden of London.

- c.1786 a 6 feet radius rotatable pillar quadrant on vertical axis by Ramsden of London. This was a novel design, greatly admired, and led to Ramsden's commission for a similar instrument for the Palermo Observatory.

- 1795 a Gregorian reflector with 18-inch mirror of 12 feet focal length (FL) by James Short (c.1742 and costing 800 guineas, rebuilt by Thomas Short in 1770) – the Duke's 'Great Telescope' – and brought in 1795 to Blenheim from Marlborough House in London.[11]

- a small reflector by Tully (now MHS)

- a mahogany tube on pillars, formerly part of a coudé telescope (now MHS).

The first recorded observations with the transit instrument were made in 1781. The divisions on the scale of the quadrant were tested to an accuracy of one arc second or less, while Bird's quadrant at the Radcliffe Observatory had an error of several arc seconds since it had not been subjected to a similar innovative and rigorous test as that devised by Ramsden [12].

I have found no details of the observatory staff employed by the duke at Blenheim. Some found him remote in public, but a warmer personality at home. At Blenheim distinguished tourists were sometimes received by the family, but in 1802 the by then reclusive duke deeply offended Admiral Nelson by sending out refreshments to him in the park [13]. The duke also had an observatory at Sion Hill, as well as keeping the Great Reflector at Marlborough House for occasional viewing when he was in London. The transit and quadrant have not survived, and there is no known illustration of them. The Great Reflector was the first of three and now the only survivor; in 1812 the duke gave it to the University which passed it to the Radcliffe Observatory, and it is now displayed in the Museum of the History of Science (MHS) Oxford.

Sir James South gave a splendid 3¼-inch achromatic refractor of 4 feet focal length by Tully c.1840 to Sir John Winston Spencer-Churchill (1822-83) the seventh duke, and his widow in 1884 gave it in his memory to the Radcliffe Observatory so that it is now in the MHS [14]. His successor George (1844-92) the eighth duke had some interest in astronomy but more in physics and chemistry, and owned several sophisticated spectroscopes [15].

[1] Howse, p. 80.

[2] Clarke, A.M., revised by Owen Gingerich, 'Parker, George, second earl Macclesfield', *ODNB*, **42** (2004), 670- 71.

[3] Allan Chapman, *The Victorian Amateur Astronomer: Independent Astronomical Research in Britain 1820- 1920* (Wiley, 1998), p. 146 but ascribed to Blenheim instead of Shirburn, and p. 342 note 15.

[4] *Philosophical Transactions of the Royal Society of London*, vol. lix, cited by Gunther, 2 (1923), p. 93.

[5] An important point made by Tony Simcock to RH, personal communication (e-mail) 23 June 2008.

[6] 'Oxfordshire', 8, *The Victoria County History* (1964), pp. 181 and 183.

[7] Source, Derek Howse and Tony Simcock, from Derek Howse, 'The Greenwich List of Observatories', Journal for the History of Astronomy, 17, 4 (Nov. 1986) 100 pages, p. 66.

[8] Anita McConnell, *Jesse Ramsden (1735–1800): London's leading Scientific Instrument Maker* (Ashgate, 2008), 86-93.

[9] Tony Simcock to RH, personal communication (e-mail) 23 June 2008.

[10] The location in the south-east tower, i.e. at the back of the palace, above the Duchess's cabinet, noted in The Victoria County History, Oxford vol. 12 (1990), p. 456

[11] The location of the reflector in London, and its transfer to Blenheim in 1795 is noted by McConnell,Jesse Ramsden, p. 92.

[12] McConnell, *Jesse Ramsden*, p. 92.

[13] *The Victoria County History*, Oxford vol. 12 (1990), p. 459.

[14] R.T. Gunther, *Early Science in Oxford*, 2 (1923), p. 313.

[15] I am grateful for this information from Tony Simcock, 'Physics Beyond the Colleges', in Robert Fox and Graeme Gooday (eds.), Physics in Oxford 1839–1939 (OUP, 2005), 163-4.

Other 18th Century amateurs:

Stone, Revd. Edward (1702-1768) the only Oxfordshire amateur of the eighteenth century that we know of is a graduate of Wadham College who was vicar of various north Oxfordshire parishes, and resided at Chippenham in Gloucestershire. He is known to have observed the 1761 Venus transit, probably from Shirburn Castle since he was a friend of the Earl [1] (see *ODNB*).

Margetts, George (1748–1808), native of Woodstock, an ingenious wheelwright who became a renowned watch and clock maker in London. His expertise in making astronomical watches and marine chronometers was such that some horologists regard him as being almost on a par with John Harrison. He was author of works on lunar distances and finding latitude at sea (1790), of longitude tables (1794), invented a navigational slide rule, also made orreries, and was patronised by the Duke of Marlborough.[2]

[1] Allan Chapman to RH, letter 23 June 2008.

[2] The only surviving link between him and Oxford is one clock face bearing his name, in the Museum of the History of Science, Oxford. I am grateful to Tony Simcock for this note.

Other 19th Century amateurs:

Norman Pogson's Garden, Observatory Street, Oxford, private, 1852-58.

Pogson, Norman Robert (1829–1891) learned astronomy while working from 1845 as a voluntary assistant to John Hind at George Bishop's Regent Park Observatory. In the summer of 1850 Bishop appointed him with a small salary in order to help make ecliptic charts. Newly married and with a baby to support, Pogson in October 1851 joined the Radcliffe Observatory as Manuel Johnson's second assistant. Soon afterwards he rented rooms in Observatory Street, a terrace with gardens. Therefore he was a professional astronomer, his official duties at the Radcliffe Observatory being to work the Bird transit circle, and to reduce those observations next morning. However, after he had observed the designated transit stars, in his own time he went to the tower room and there 'on the south front' [lower roof] used the Berlin star charts, and the 10-foot 7-inch aperture mounted equatorially', and one of the Observatory's clocks in the tower room, to search for minor planets [1]. Since the 10-foot Dollond was only of 4½-inch aperture and not mounted equatorially, this reference in 1863 to a 7-inch aperture suggests that it was the Wellington Telescope of 7¼-inch given to the University in 1834. Pogson was rewarded with the discovery of three minor planets (now known as asteroids). For the discovery of Isis in May 1856 he was awarded the Lalande Medal. He followed with Ariadne in April 1857 and Hestia in August of that year. Each of these was duly announced by the Observatory.

Further, motivated by the necessity to build his reputation and seek advancement, probably upon Admiral William Smyth's recommendation he borrowed from John Lee of Hartwell House one of the Admiral's old instruments, now unused there. This was a rather unwieldy 3¾-inch wooden tube refractor of c.1821. Using this instrument from the garden of his home, between 1852 and 1858 Pogson constructed seven charts extending to magnitude 12 [2]. He published a catalogue of 53 variable stars, with notes on each [3], and these enabled him to discover altogether ten variable stars [4]. Hence the discoveries that made his reputation as an astronomer were a result solely of his private observations during this time. One of the earliest systematic observers of variable stars, he had noticed the relative brightness of the stars in the magnitude scale proposed by Hipparchus. Pogson estimated the relative brightness of a star in decimal tenths of a magnitude. He then needed a ratio between the apparent magnitude of the star and the next above or below, and believed that it was logarithmically proportional to the brightness. Needing a precise scale extending to faint stars, in 1856 he proposed that a difference of five magnitudes should correspond exactly to a brightness ratio of 100 to 1. This Pogson Ratio was in 1906 adopted as the standard photometric method of designating a star's magnitude [5].

Allan Chapman reproduces a plate of an observer he believes to be Norman Pogson standing at Dr Lee's Hartwell House Observatory with a refractor on a portable 'Varley-type' mount. It is likely that this is the 3½-inch instrument loaned by John Lee

and used by Pogson in his own time from his garden in Observatory Street, Oxford [6].

Professor John Phillips's Observatory, (1862-74) private, beside the Keeper's House at the University Museum.

Phillips, John (1800-1874) achieved a considerable reputation as a geologist, became Professor at King's College London, and FRS (1834), professor in Dublin (1844) and from 1832-59 was Secretary of the BAAS. In 1853 he came to Oxford as Deputy Reader in geology, became Reader in 1859.

From an early interest in astronomy, Phillips became very interested in what is today comparative planetology. He sought to compare features, especially 'walled plains', craters or cusps, possibly volcanic, on the Moon and then on Mars, with those on Earth, and to observe any visible changes. In 1852 he proposed to the BAAS a new method for co-operative observing and mapping the Moon, Mars, and sunspots, by observers with telescopes of about the same power, and this was adopted. His friend Thomas Cooke of York promptly lent him a 6¼-inch telescope. An accomplished artist, Phillips completed his drawing of crater Gassendi in May 1853. Then to maximize the effectiveness of his presentation to the BAAS, he worked to secure a photograph with the same instrument, and did display it. Phillips was thereby the first in England to exhibit photographs of a celestial object [7]. It was only after 1857 that Warren De La Rue took up lunar photography and exceeded Phillips's effort of 1853.

After removing to Oxford in 1853 he lived during term-time in the house of his friend Professor Daubeny opposite Magdalen (who he influenced to establish an observatory in 1855). Upon moving in 1862 to the Keeper's House beside the new University Museum, Phillips purchased a 6-inch Cooke refractor for 300 guineas, and the Royal Society gave him a grant sufficient to house it in a small observatory (which was still standing in 1891[8]). Since the Savilian professor William Donkin was in poor health and did not observe, Phillips now became the active observer in the University, and during the ensuing three years a series of research papers tackling what could be learned of the physical nature of the Moon, Mars, and the Sun, were influential. He forged the first active Oxford link with Warren De La Rue, who in 1873 became a key benefactor to the new University Observatory. In 1864 W.R. Birt proposed a variation of Phillips's co-operative observing, this led to formation of the Selenographical Society, and this too engaged De La Rue since it provided an application for his new experiments in photographic mapping.

Meanwhile, still regularly observing the Moon, Phillips turned to the favourable opportunities to observe Mars at its close oppositions in 1862 and 1864. His original 1865 water-colour map of Mars was an equatorial projection, designed by him (as stated on the original) to be folded on the zero meridian of longitude. It is thus, along with the Dutch observer Friedrich Kaiser's map of 1864, one of the first two Mercator maps of Mars. The black and white engravings reproduced in several works do not do it justice. The colour original is better in many ways than those by Green and Schiaparelli in 1877. Phillips then took 14 of his drawings made in the autumn of 1862 'in order of meridian line' [of longitude] and constructed a globe of Mars and mounted it on a wooden frame. This made it possible for the first time to determine the principal features drawn by different observers [9].

In 1873 Phillips offered his telescope to the new Savilian professor Charles Pritchard. In swiftly changing circumstances, this offer became the catalyst for a new University Observatory. Phillips used his experience of the University and his status on committees to gain University support, immediately amended for completed in 1875 to incorporate the gift of Warren De la Rue's famed photographic reflector, the contents of his observatory, and, crucially, the salary of an assistant.

[1] For his using the Radcliffe's equatorial, see *MNRAS*, **13** (1853), p. 54, and Radcliffe Observatory, Results of Astronomical Observations (1863). Seven of Pogson's personal observing Notebooks survive, Museum of the History of Science, MS Radcliffe 57-63 (books 1 to 7); in No. 1 we find mention of his need of the transit clock for this work, and in notebooks 5 and 6 there is mention of his also using the handier Dollond 3½-inch refractor also with the ring micrometer.

[2] For an illustration which Dr Allan Chapman believes to be of Pogson with that telescope in Dr Lee's garden, see his *The Victorian Amateur Astronomer* (Wiley, 1998), Plate 6, p. 61. For his observing method, see *Radcliffe Observatory Observations*, Vol. 15.

[3] See *MNRAS*, **16** (1856), pp. 185-7.

[4] For the announcement of the star discovered in 1858 see *MNRAS*, **18** (1858), pp. 283-4.

[5] Roger Hutchins, 'Pogson, Norman Robert', *Oxford Dictionary of National Biography*, **20** (2004),

[6] Chapman, Victorian Amateur, p. 61, Plate 6. `

[7] The second original photo, together with Phillips letter of 20 July 1853, is in the Archive of the Royal Society.

[8] See plan of the Oxford University Museum by Alfred Robinson, 1891.

[9] R. Hutchins, 'Professor John Phillips at Oxford 1853-74; catalyst for the University Observatory', option thesis (Oxford, 1992), copies in MHS, Magdalen, and Bodleian libraries.

1. **Principal Office Holders**

The Savilian professorships at Oxford: The excellence and utility of the early work at Merton College inspired a Warden (head of the College), Sir Henry Saville, to endow in 1619 two new mathematical chairs in the university, the Savilian chair of Astronomy, and the Savilian chair of Geometry. Unusually, his inspiration was to stipulate a condition that appointment to these chairs was open to anyone, provided that they did not hold a clerical office. This innovation made the chairs unusually useful, for they attracted applicants on merit. Several men first held the chair of Geometry and then achieved transfer to the chair of Astronomy when it became available (i.e. Halley, Rigaud), and incumbents of either chair sought the readership in experimental philosophy which was lucrative because the attendees at lectures

paid a fee. From 1772 to 1839 the professor of Astronomy was also the observer at the Radcliffe Observatory which had been built for the use of the University's professor, with the additional benefit of free accommodation in an excellent house on that site. The holders of the Savilian chair of Astronomy are.

The Savilian Professors of Astronomy

(the Assistants at the University Museum of 1875 are listed in Hutchins (2008), Table 6.2).

1619 John Bainbridge (*ODNB*)

1643 John Greaves (*ODNB*)

1649 Seth Ward (*ODNB*)

1661 Christopher Wren (*ODNB*)

1673 Edward Bernard (*ODNB*)

1691 David Gregory (*ODNB*)

1708 John Caswell

1712 John Keill (*ODNB*)

1721 James Bradley (*ODNB*)

1763 Thomas Hornsby (*ODNB*)

1810 Abraham Robertson (*ODNB*)

1827 Stephen Peter Rigaud (*ODNB*)

1839 George Henry Sacheverell Johnson (*ODNB*)

1842 William Fishburn Donkin (*ODNB*)

1870 Charles Pritchard (*ODNB*)

1893 Herbert Hall Turner (*ODNB*)

1932 Harry Hemley Plaskett (*ODNB*)

1960 Donald Eustace Blackwell

1988 George Petros Efstathiou

1999 Joseph Ivor Silk

(ii) The Radcliffe Observers

(the Assistants and Computers, with their dates of service, are listed in Guest (1991), Appendix B).

Thomas Hornsby (1733-1810) 1771-1810 (*ODNB*)

Abraham (or Abram) Robertson (1751-1826) 1810-1826 (*ODNB*)

Stephen Peter Rigaud (1774-1839) 1827-1839 (*ODNB*)

Manuel John Johnson (1805-1859) 1839-1859 (*ODNB*)

Robert Main (1808-1878) 1860-1878 (*ODNB*)

Edward James Stone (1831-1897) 1879-1897 (*ODNB*)

Arthur Alcock Rambaut (1859-1923) 1897-1923 (*ODNB*)

Harold Knox-Shaw (1885-1970) 1924-1950

Andrew David Thackeray (1910-1978) 1950-1974 (post abolished)

1. **Meteorology**

It may seem errant to include here two observatories which were not astronomical, but they are justified by the significance of their work, and perhaps by the close association between the sciences of meteorology and astronomy.

It may be argued that the most enduringly useful work of the Radcliffe Observatory is its very long continuity of meteorological records made at the same site. These were complemented by the work at the Benson Observatory which became one of five in the United Kingdom reporting daily to the Meteorological Office. Then Gordon Dobson after 1920 at his private laboratory on Boars Hill and then on Shotover Hill, undertook pioneering research in atmospheric physics and discovered the ozone layer.[1] The potential of this work led Professor Lindemann in 1930, anxious to build the research of the University's Clarendon Laboratory, to seek to divert the funds from the sale of the Radcliffe Observatory to building a new Institute of Cosmical Physics within which Dobson would use the Radcliffe Double Equatorial telescope to advance his research. This led to a major controversy, and Lindemann was eventually frustrated in 1935. Nevertheless the perception of the relevance of Dobson's work to one specialized are of astronomical physics surely warrants mention of his laboratory here.

Dobson's Laboratories on Boar's and Shotover hills, 1924-73

Gordon Miller Bourne Dobson (1889–1976) was a physicist and ingenious experimentalist who became a pioneer of atmospheric physics. His life-long study of atmospheric ozone led to an understanding of the structure and circulation of the

stratosphere. In 1920 he was recruited to Oxford University's Clarendon Laboratory as Lecturer in Meteorology.

Early experiments led in 1924 to his building a laboratory shed at his home on Boar's Hill, by 1925 making and calibrating several spectrographs. In 1928 and 1929 he extended his experiments world-wide, the photographic plates with their spectra being returned to Oxford. Simultaneously at Boar's Hill he designed and built a photoelectric spectrophotometer. In the early 1930s he did important work on atmospheric pollution. In 1936 Dobson moved his home to Shotover Hill, and build a substantial brick laboratory there.

During a long university career of lecturing and demonstrating, Dobson became a Professor and received many honours, but his attachment to the Clarendon Laboratory was nominal; 'his fundamental advances in the study of the upper atmosphere, including the discovery of the ozone layer, were made at meteorological stations he set up at his own expense' at his private laboratories, where all his principal research was undertaken and benefited from Royal Society and DSIR grants for apparatus and assistance.[2] Dobson did much to establish Oxford's reputation in atmospheric research.

The Mete0rological Observatory, Benson, 1913

The home of William Henry Dines F.R.S. (1857–1927).[3] Widely known as "The Benson Observatory", it was established by William Henry Dines. Dines was independently wealthy, and inherited from his father and passed to both his sons a love of meteorology.[4] Although unsalaried, so an 'amateur', he held an official position as Director of Experiments on the Upper Air from 1905 to 1922, was President of the Royal Meteorological Society 1901–02, and elected FRS in 1905. A colleague described him as having the extremely rare combination of research insight, ability to design the necessary instrument, to make it himself, to use it to advantage, and then to analyse the results, so that he was 'the last and the greatest of the amateurs who built up the science'.[5]

Following the Tay Bridge disaster in 1879, when that bridge collapsed due to wind pressure, in 1885 the Meteorological Society established a Wind Force Committee to report on the measurement of wind velocity and the corresponding pressure in pounds per square foot. This was a subject which had engaged Astronomer Royal George Airy in his capacity as scientific adviser to the government. Dines realised that the cup anemometer was inadequate, and he started developing the pressure tube anemometer to detect and record each gust of wind, and each transient change of direction, so as to determine the wind pressure per square foot, so that between 1892 and 1895 four were erected at different sites, and in 1904 a Dines–Baxendall anemometer was erected at the Johannesburg Observatory and another at the Coates Observatory near Paisley.

The stratosphere had been discovered in 1893, and Dines began upper air research in 1901. From 1906 to 1913 he worked from beside his home Pyrton Hill House, near Watlington, Oxfordshire, flying meteorographs from a box kite with winding gear off that hill. Dines was the first British observer, with C.J.P. Cave, to fly a balloon meteorograph. They analysed 200 flights to correlate temperature to cyclonic activity

and to atmospheric pressure, a relationship now known as ‘the Dines compensation’ [6].

Dines needed to fly his instruments higher and frequently, using sounding balloons. This led him to design a cheap and sturdy instrument weighing only two ounces, and an ingenious calibration device. He built a simple, reliable, and cheap pressure tube anemometer. In 1913 Dines moved to Benson, purchased a house, and a portable building from Boulton and Paul at a cost of £459-15s-3d., the latter met by the Meteorological Office. Dines thus established the Benson Observatory, and began daily reports to the Meteorological Office now at Kew. His was now one of five observatories (the others were Kew, Eskdale, Valencia Co. Kerry, Falmouth and Aberdeen) each having their own speciality in addition to routine recording [7].

After 1918 Benson Observatory became a centre of notable scientific activity. Dines had been addressing the nature of cyclonic and anti-cyclonic movement in the upper atmosphere. He now also investigated solar radiation from the atmosphere, and radiative heating rates from the ground to 16 kilometres height, including the effect of clouds. His most important contribution was an instrument to measure night-time radiation.[8]Benson is a well-known frost-pocket, sometimes recording the lowest night-time temperatures in the UK.[9]This minor climatic quirk may have led to the village’s part in the development of modern meteorology, with an important meteorological observatory being located in the village in the late 19th Century. Upon the opening of the RAF Benson airfield in 1939 a purpose built Met Office was built within the station perimeter. The observatory site, a cul-de-sac, has been developed with modern housing and is named Observatory Close.

[1] Tony Simcock, ‘Physics Beyond the Colleges’, in Robert Fox and Graeme Gooday (eds.), *Physics in Oxford 1839–1939* (OUP, 2005), 162-3.

[2] Tony Simcock, ‘Physics beyond the Colleges’, in Robert Fox (ed), *Physics in Oxford 1839-1939* (OUP, 2005), p. 162; also Jack Morrell, in same volume, p. 239-40. See also biographical notice www.atm.ox.ac.uk/user/barnett/ozoneconference/dobson.htm

[3] C.J.P. Cave, ‘Mr W.H. Dines, FRS’, *Nature*, **121**, No. 3037 (14 January 1928), 65–6.

[4] The Dines Dynasty, a family of meteorologists, *Proceedings of a Royal Meteorological Society Special Group for the History of Meteorology, at the Science* Museum, 23 October 1993 (Science Museum, 1995), 67 pages, copy in the MHS.

[5] C.J.P. Cave, ‘Mr W.H. Dines, FRS’, *Nature*, **121** (14 January 1928), 65-66, p. 66.

[6] William Pike, ‘William Henry Dines (1855-1927)’, *Weather*, **60**, 11 (2005), 308-15.

[7] ‘The Dines Dynasty’ (1995), p. 29.

[8] ‘The Dines Dynasty’ (1995), p. 24.

[9] J.F.P. Galvin and J. McGhee, ‘Meteorology at Benson, Oxfordshire’, *Weather,* 60, **11** (2005), 319–25.

F: Other Oxfordshire notables:

Farrar, Adam Storey (1826-1905), born in London (see Durham for more details)

Harriot, Thomas (1560-1621), born in Oxford and educated there at St Mary Hall. Harriot was without doubt the first person to draw the first map of the Moon, or of an astronomical object, observed through a telescope, on July 26, 1609, over four months before Galileo. A scholar and sometime tutor to Sir Walter Raleigh, he provided navigational expertise and helped design Raleigh’s ships. He accompanied his 1585 expedition to Roanoak Island. There he made a vital contribution because he learned the language of the natives

On his return to England he worked for the Henry Percy, 9th Earl of Northumberland, at the Earl’s Syon House, west London, and became a prolific mathematician and astronomer to whom the theory of refraction is attributed. In 1607 his view of the great comet that became Halley’s Comet turned Harriot’s attention towards astronomy. In early 1609 he bought a “Dutch trunke” (telescope), invented in 1608, and his observations from Syon House are credited as being the first use of a telescope to observe and record an astronomical object. He also observed sunspots in December 1610, and the satellites of Jupiter. A crater on the Moon was belatedly named after him in 1970; it is on the Moon’s far side and hence unobservable from Earth.

Hooke, Robert (1635-1733), born in Freshwater, Isle of Wight, educated Wadham College Oxford. There between 1655 and 1662 he built some of the earliest Gregorian telescopes, and studied the rotation of Mars and of Jupiter.

A good Wikipedia entry states that one of the more-challenging problems tackled by Hooke was the measurement of the distance to a star (other than the Sun). The star chosen was Gamma Draconis and the method to be used was parallax determination. After several months of observing, in 1669, Hooke believed that the desired result had been achieved. It is now known that Hooke’s equipment was far too imprecise to allow the measurement to succeed. Gamma Draconis was the same star James Bradley used in 1725 in discovering the aberration of light.

Hooke’s *Micrographia* contains illustrations of the Pleiades star cluster as well as of lunar craters. He performed experiments to study how such craters might have formed. Hooke also was an early observer of the rings of Saturn, and discovered one of the first observed double-star systems, Gamma Arietis, in 1664. After 1662 he lived principally in London, and the place he observed from, and instrument, remains to be clarified here.

Milne, Edward Arthur (1896-1950), born Hull, educated Cambridge where he was assistant director of the Solar Physics Observatory 1920-24. After professing at Manchester in 1928 he was appointed the first Rouse Ball Professor of Mathematics at Oxford. There he made important contributions to theoretical astrophysics by developing his theory of ‘kinematic relativity’, which for a time rivalled Einstein’s

relativity. His enduring legacy is that with Professor Harry Helmsley Plaskett in 1930 he co-founded the Oxford School of Astrophysics (see: Yorkshire: East Riding; Cambridgeshire; *ODNB*; Obit., *MNRAS*, **111** (1951), 160-72).

Plaskett, Harry Hemley (1893-1980), born in Toronto, Canada. From the Dominion Astrophysical Observatory he was head-hunted by Harlow Shapley to join Harvard Observatory in 1928 in order to establish a graduate programme in astrophysics. An outstanding leader in modern observational astrophysics with experience of solar work, and solid contributions to stellar and nebula astronomy, at the instigation and persuasion of E. Arthur Milne, in 1928 the new Rouse Ball professor of Mathematics at Oxford, he was appointed in 1931 to succeed Turner as professor and Director of the Oxford University Observatory. Arriving in 1932 he found the obsolete observatory involved in intense controversy between the University and the Radcliffe Trustees. Plaskett adroitly side-stepped the University politics and in 1935 gained a new Grubb solar telescope, having argued that the weather at Oxford made it possible to glean sufficient first-rate observations for really useful and interesting work for students. With Milne, he established in 1935 the first formal School of Astrophysics in the country. Plasktett contributed to solar physics for some 63 years. As President of the RAS it was Plaskett who first, in 1946, suggested the Isaac Newton 100-inch reflector for Britain, which was finally completed in 1967. See: ODNB, and Hutchins (2008).

Plummer, Henry Crozier Keating (1875-1946), born at St Giles's Road, Oxford, the eldest son of William Plummer (1849-1928), the new senior assistant at the Oxford University Observatory. Henry Crozier obtained a first in maths finals, and a second in natural science (physics) 1898, and was appointed by Professor H.H. Turner to be the first graduate Second Assistant at the University Observatory. In 1912 he was appointed Andrews' professor of astronomy in the University of Dublin, Royal Astronomer of Ireland, and Director of the Dunsink Observatory – thus becoming the only Oxford graduate between 1842 and 1939 to direct a British observatory. For his interesting but difficult tenure at Dunsink until 1921 (see *ODNB*, Hutchins 2008).

Pritchard, Charles (1808-1893), born Alderbury (see Shropshire). Educated in Cambridge, an outstanding teacher and communicator, and Council member of the RAS, in 1870 at the age of 62 he was appointed Savilian professor of Astronomy in the University of Oxford, the last cleric to be appointed to a chair of natural science there. He had long been an amateur astronomer, but did not himself observe at Oxford, where at the new Observatory completed in 1875 he relied upon his First Assistant William Plummer. Unable to achieve relevance to the students due to the then lamentable state of the mathematics curriculum at Oxford, he oversaw two programmes of research that gained RAS and Royal Society medals, and undertook a portion of the Carte du Ciel project, thereby putting the new observatory on the international map and making it a worthwhile appointment for his successor, Herbert Hall Turner (see *ODNB*; Hutchins 2008). For Pritchard's achievements in Oxford, with William Plummer as his First Assistant, see ODNB, and Hutchins (2008).

The Rollright Stones

This late Neolithic small circle of ragged limestones on a hill top two and a half miles north west of Chipping Norton, is notably almost a true circle of 38 Megalithic yards

(of 2.72 feet) diameter.[1] The circle probably dates to about 2,900 to 2,200 B.C. It also has an isolated monolith pillar, the King Stone, nearby, as well as a much older barrow burial. www.rollrightstones.co.uk/index.php/stones outlines attempts to understand the stones.

The King Stone led to speculation that it indicated a deliberate celestial alignment. However, excavations have shown that the King Stone is associated with a cairn, and no astronomical or calendar significance can be proven for the Rollrights. Instead this small regional circle, like many others, may be associated to the people manufacturing and trading in valuable stone axes, and may have been a distribution place.[2]

Sundials:

There are many fine sundials in Oxford. See The City of Oxford Sundial Trailwww.sundials.co.uk/~oxford.htm. The three outstanding ones are:[3]

Corpus Christi College has one of the two most splendid sundials in Oxford, in the front quadrangle has a tall sundial of 1581 by Charles Turnbull surmounted by the College emblem, a pelican. The perpetual calendar around the plinth dates from 1606.

All Souls College has Oxford's most magnificent and most accurate sundial, formerly on the chapel but since the 1870s on the south front of the Codrington Library. It was designed in 1659 by Christopher Wren, at that time Gresham Professor of Astronomy, two years before he became Savilian professor, and is said to have cost £32.

Brasenose College has a very fine sundial of 1719 mounted on the north wall of the Old Quad.

[1] E.C. Krupp, *In Search of Ancient Astronomers* (London, Chatto & Windus, 1979), 41-42.

[2] Aubrey Burl, *Prehistoric Stone Circles* (Shire Publications, 2005), 19-20, 30, 32.

[3] See also Gunther, 2 (1923), 108-122.

Museums

Museum of the History of Science [MHS], Old Ashmolean Building, Broad Street, Oxford, OX1 3AZ

Keeper: Dr Silke Ackermann; Enquiries: 01865 277280 museum@mhs.ox.ac.uk

(The MHS has a number of important telescopes on display, a website on-line catalogue with many photos, and the Archive holds a wealth of historical material relating to astronomy in Oxford and historic observatories in Britain and beyond). The Radcliffe Heliometer (1849) is in the London Science Museum's store.

Observatories extant:

The buildings of the Oxford University Observatory (1875-1983), including two towers and domes, have not had any connection with astronomy for more than two decades, and are not accessible to the public. The exterior can best be viewed from the University Parks, or from within the Science Area (but security restrictions on access may apply) where they are almost immersed among modern buildings.

The Radcliffe Observatory

Closed and moved to South Africa in 1935. The magnificent observatory building and tower of 1786 – the finest Georgian building in Oxford, and adjacent Heliometer Tower of 1849, lie within and are owned by Green Templeton College. No instruments are housed there (but several are displayed in the Museum of the History of Science). The buildings are usually open to the public on one Heritage Open Day each year – usually a Saturday in September.

The web site www.gtc.ox.ac.uk includes a virtual tour of the College, history and images of the Observatory, and contact details for enquiries.

The University's Physics Department currently operates one observatory on top of the Physics Building, which houses The Philip-Wetton Telescope, an 0.4 meter Meade reflector (1995) for student use. The Physics Department has an outreach programme for school visits.

See www.physics.ox.ac.uk/schools/telescope.htm for further details.

Sources for History of the Oxford Observatories:

Adam, Madge G., 'The Changing Face of Astronomy in Oxford (1920-1960)', *QJRAS*, **37** (1996): 153-79.

Birley, Jeffery (ed.), *A History of the Radcliffe Observatory Oxford* (Green College, Oxford, 2005) – superbly illustrated (£10 + p&p from the College).

Gunther , Robert T., *Early Science in Oxford*, Vol 2 'Astronomy' (Oxford, 1922).

Roger Hutchins, *British University Observatories 1772-1939* (Ashgate, 2008).

Guest , Ivor, *Dr John Radcliffe and his Trust* (London: Radcliffe Trust, 1991).

A.D. Thackeray, *The Radcliffe Observatory 1772-1972* (London: Radcliffe Trust, 1972).

The City of Oxford Sundial Trail www.sundials.co.uk/~oxford.htm.

Societies and organisations

Bicester Astronomy Club (BAC), founded 2017. Meeting held at Bure Farm - no other details on facebook.

Chipping Norton Amateur Astronomy Group (CNAAG), founded 2005. Members meet several time a year at the Methodist Church Hall, Chipping Norton.

Oxford University Space and Astronomical Society (OUSAS) - University members and their families - appears defunct since 2016.

Rutherford Appleton Laboratory, Didcot, Oxfordshire, participates in outreach and international meetings, see:www.scitech.ac.uk/PandS/Events/events.aspx

Useful addresses:

The Bodleian Library

Main Enquiry Desk, Bodleian Library, Oxford University Library Services, Broad Street, Oxford OX1 3BG

reader.services@ouls.ox.ac.uk

01865 277162

(The Archive holds those of the University Observatory 1875 onwards, and various correspondences of the University's astronomers. The Library holds the Radcliffe Trust Records with a wealth of material relating to the Radcliffe Observatory 1772-1935).

Keeper of the Archive: Mr Simon Bailey enquiries@oua.ox.ac.uk

Oxfordshire Record Office

St. Lukes Church, Temple Rd, Oxford, OX4 2HT, 01865 398200

Oxford Local Studies

Oxfordshire Studies, Central Library, Westgate, Oxford, OX1 1DJ
01865 815749 oxfordshire.studies@oxfordshire.gov.uk

(A rich collection, excellent facilities, skilled staff. But there are threats of reduced days open, or merger with ORC, so essential to check before visiting).

Oxfordshire Society for Family History

Highly organised, friendly and helpful. Check: www.ofhs.org.uk