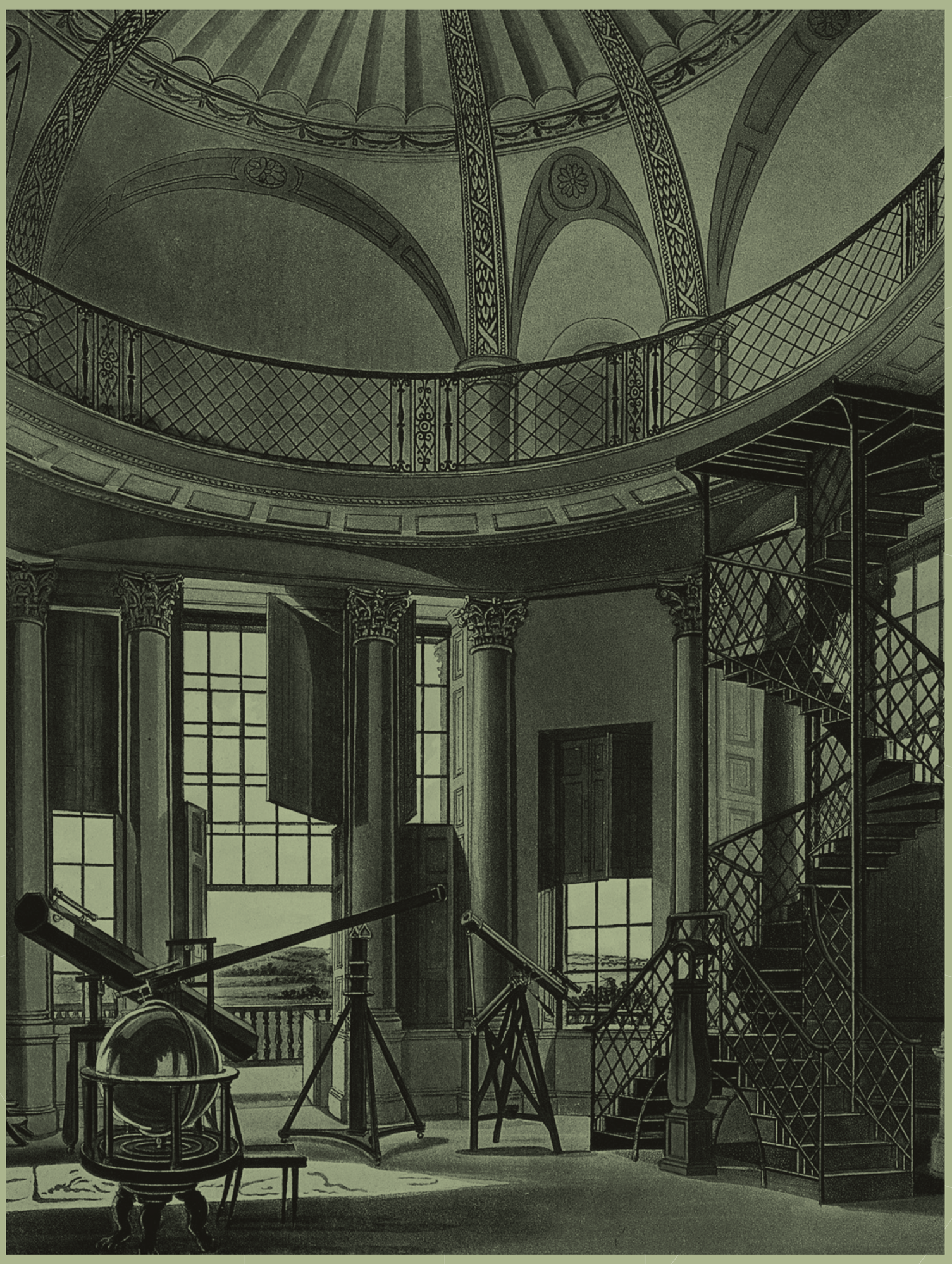
Throughout the 18th century Oxford was central in the development of Newtonian philosophy. Edmond Halley, the most famous English astronomer of his day, was Oxford's Savilian Professor of Geometry. Thomas Hornsby, Sedleian Professor of Natural Philosophy, founded the Radcliffe Observatory.

UNIVERSITY OF OXFORD
Mathematical Institute

Oxford Mathematics from Halley to Hornsby



The Radcliffe Observatory, built in the 1770s at the instigation of Thomas Hornsby, was the first academic establishment in Europe to combine teaching and original research in astronomy.

Time-line

1656	Edmond Halley born in London
1673	Halley enters The Queen's College, Oxford
1676–78	Halley's expedition to map the skies of the southern hemisphere
1678	Oxford University grants Halley his MA degree by Royal *Mandamus*
1687	Publication of Isaac Newton's *Principia Mathematica*
1704	Halley appointed Savilian Professor of Geometry
1705	Halley publishes his cometary researches
1710	Halley's edition of Apollonius's *Conics*
1717	James Stirling's book on Isaac Newton's classification of cubics
1720	Halley appointed Astronomer Royal
1721	James Bradley appointed Savilian Professor of Astronomy
1742	Halley dies in Greenwich and Nathaniel Bliss is appointed as his successor to the Savilian Chair
1763	Thomas Hornsby is appointed Savilian Professor of Astronomy
1764	Bliss dies and Joseph Betts is appointed as his successor
1766	Betts dies and John Smith is appointed as his successor
1782	Thomas Hornsby is appointed Sedleian Professor of Natural Philosophy
1797	Smith dies and Abraham Robertson is appointed as his successor
1810	Hornsby dies and Robertson succeeds him as Savilian Professor of Astronomy
	George Cooke succeeds Hornsby as Sedleian Professor of Natural Philosophy

Oxford Mathematics

Oxford Mathematics from Halley to Hornsby

Edmond Halley in Oxford

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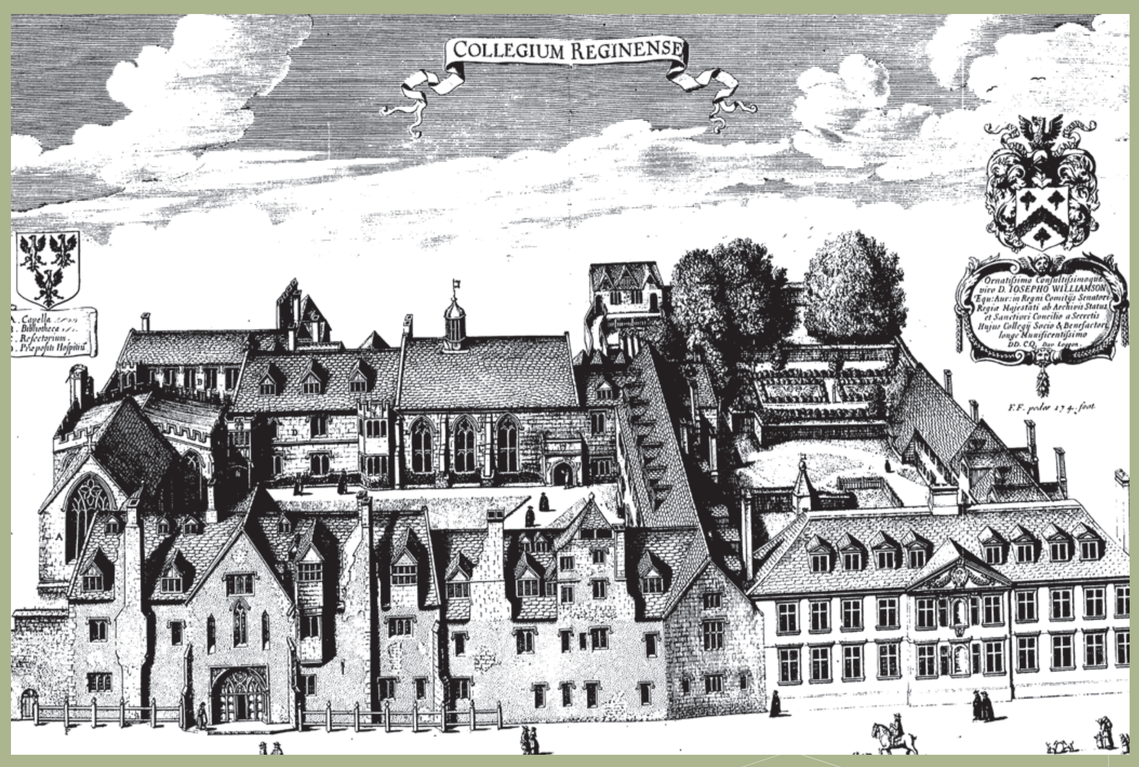
In 1704 Edmond Halley succeeded John Wallis as Savilian Professor of Geometry and remained in post until his death in 1742.

Halley as an undergraduate



Halley became a student at The Queen's College, Oxford, in 1673

Even at the age of 17 Halley astonished the University with his astronomical observations, made using a fine private collection of instruments that incorporated such technical innovations as telescopic sights and micrometers.

Halley was soon collaborating with John Flamsteed, the Astronomer Royal, and making astronomical observations at Oxford.

Mr. Edmund Hally's *Observations, concerning the same Occultation of* Mars *by the Moon, made at* Oxford, *Anno* 1676. Aug. 21. *P.M.*

Temp. Corr.

h.	′	″		°	′	″
11.43.30			*The center of* Mars *from the Nearest limb of the Moon,*	719½	12.	40
11.49. 2			*Again,*	571	10.	3
11.54.58			*Again,*	409	7.	12
12. 3.25			*The center of Mars from the North Cusp of* ☽,	1118	19.	41
12.10.28			*The gibbous part of Mars touched the Moons limb.*			
12.10.42			*Mars was wholly covered, being distant from the Cusp,*	963	17.	14
12.40.00			At this time a *Halo* encompassed the Moon, in whose Circumference was *Saturn*, the *Pleiades*, *Capella*, and the following of the foot of *Perseus*.			

While still an undergraduate Halley published in the Royal Society's *Philosophical Transactions* his observations of the occultation of Mars by the Moon, made in Oxford in 1676

In 1676 the 20-year-old Halley cut short his degree and sailed to St Helena (an island 16° south of the equator) with a set of new instruments to map and explore the skies of the southern hemisphere. Halley was fascinated by the mysterious objects they contained (such as nebulas and star clusters), which were not visible from European latitudes.

Although he had left Oxford without taking his degree, this disruption to his studies was to secure him an international reputation by the age of 22. When his *Catalogus Stellarum Australium* was published, following his return home in 1678, Halley's reputation as an astronomer was made. The Royal Society elected him one of its youngest ever Fellows at the age of 22, and Charles II commanded Oxford University to grant Halley his MA degree: this may be the first university degree conferred in explicit recognition of research achievement.

Halley becomes Savilian Professor

Oxford had launched Halley's career, but he was to hold no appointment in the University for a further twenty-six years. Halley was not attracted to routine teaching, and at this stage of his career he would have found the University too narrow and provincial for his intellectual energies. It was through his involvement with the Royal Society, at the heart of metropolitan and international English science, that he was able to exercise those talents with which he was best endowed – research, administration and diplomacy. Halley's temperament and social skills also played a strong role in his success: he combined one of the most original scientific minds of his time with an astute social sense, an affable disposition, a strong constitution, a keen sense of humour, and financial shrewdness.

Numbers 7 and 8 in New College Lane were the residences of the Savilian professors from 1672 to 1854. Those who occupied one or other of these two houses included John Wallis, Edmond Halley (for whom the University built the observatory on the roof of the left-hand house) and Thomas Hornsby.

Many of the areas of research that Halley had initiated were brought to maturity after his return to Oxford as Savilian Professor of Geometry in 1704.

Back in Oxford he set about securing his academic reputation within the University with a widely admired inaugural lecture:

'Mr Hally made his Inaugural Speech on Wednesday May 24, which very much pleased the Generality of the University. After some Complements to the University, he proceeded to the Original and Progress of Geometry, and gave an account of the most celebrated of the Ancient and Modern Geometricians. Of those of our English Nation he spoke in particular of Sir Henry Savil; but his greatest encomiums were upon Dr Wallis and Mr Newton, especially the latter, whom he styled his Numen etc.'

Oxford Mathematics from Halley to Hornsby

Halley's research activities

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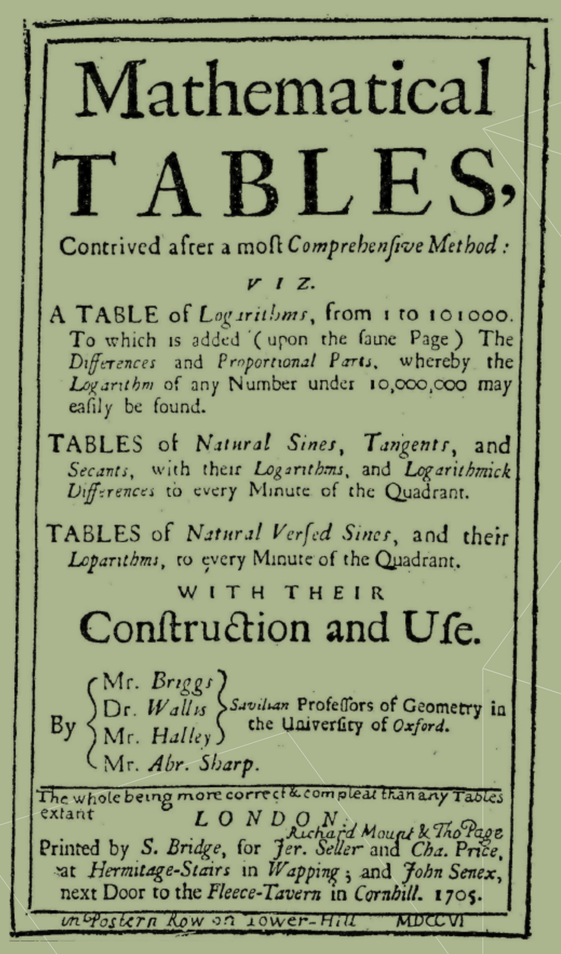
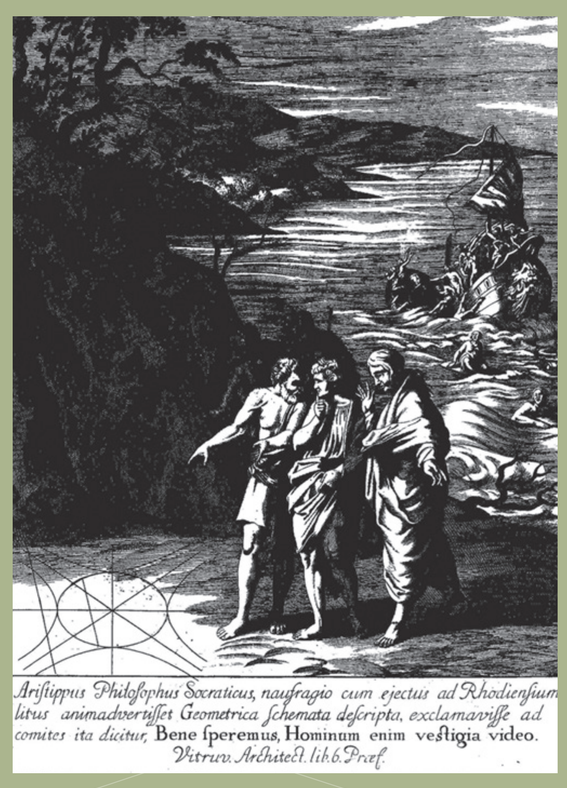
During his professorial years many of Halley's longstanding research interests came to maturity.

Halley's mathematics

Halley justified his appointment to the Savilian Chair of Geometry by wisely adopting a suggestion that he take up the preparation of what would become the definitive edition of Apollonius's *Conics*, a task left unfinished by his predecessor, John Wallis. Always an astute judge of people and situations, Halley realised that a scholarly edition of such a major classical geometer would silence those critics who accused him of being a gadfly and an opportunist, and would secure him the respect of the academic establishment.


Mathematical
TABLES,
Contrived after a most *Comprehensive Method*:
VIZ.
A TABLE of *Logarithms*, from 1 to 101000. To which is added (upon the same Page) The *Differences* and *Proportional Parts*, whereby the *Logarithm* of any Number under 10,000,000 may easily be found.
TABLES of *Natural Sines*, *Tangents*, and *Secants*, with their *Logarithms*, and *Logarithmick Differences* to every Minute of the Quadrant.
TABLES of *Natural Versed Sines*, and their *Logarithms*, to every Minute of the Quadrant.
WITH THEIR
Construction and Use.
By Mr. *Briggs*, Dr. *Wallis*, Mr. *Halley*, Mr. *Abr. Sharp*. *Savilian* Professors of Geometry in the University of *Oxford*.
The whole being more correct & compleat than any Tables extant
LONDON: Printed by *S. Bridge*, for *Jer. Seller* and *Cha. Price*, at *Hermitage-Stairs* in *Wapping*; and *John Senex*, Richard Mount & Tho Page next Door to the *Fleece-Tavern* in *Cornhill*. 1705.
in Postern Row on Tower-Hill MDCCVI

This 1705 book of tables indicates the cumulative contribution of Oxford mathematicians to a major 17th-century development. In his dedicatory letter to Halley the compiler, Henry Sherwin, remarked on 'It being universally acknowledged that by the Professors of Geometry in the Savilian Chair (viz. Mr Briggs, Dr Wallis, and Yourself) the logarithmical art hath received its greatest improvements'.


Aristippus Philosophus Socraticus, naufragio cum ejectus ad Rhodiensium litus animadvertisset Geometrica schemata descripta, exclamavisse ad comites ita dicitur, Bene speremus, Hominum enim vestigia video. *Vitruv. Architect. lib. 6. Præf.*

In 1570 Henry Savile's course of lectures on Ptolemy's *Almagest* began with the story of Aristippus. Shipwrecked on the coast of Rhodes, Aristippus was assured of the inhabitants' civilised nature when he discovered mathematical figures drawn in the sand. This classical reference provided an evocative image for the frontispiece to Halley's 1710 edition of Apollonius's *Conics*.

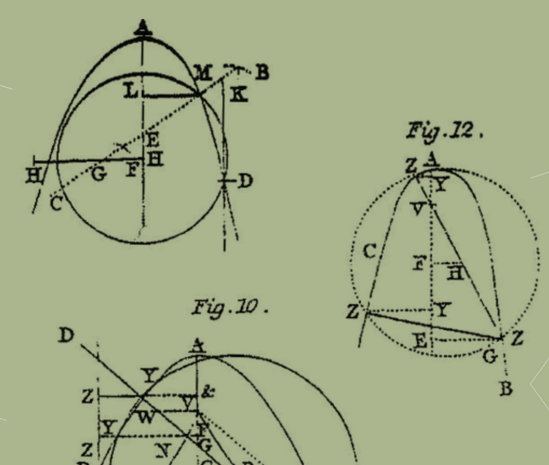


Fig. 12.
Fig. 10.

Diagrams from Halley's work on the roots of cubic and quartic equations, published in the Royal Society's *Philosophical Transactions* in 1687

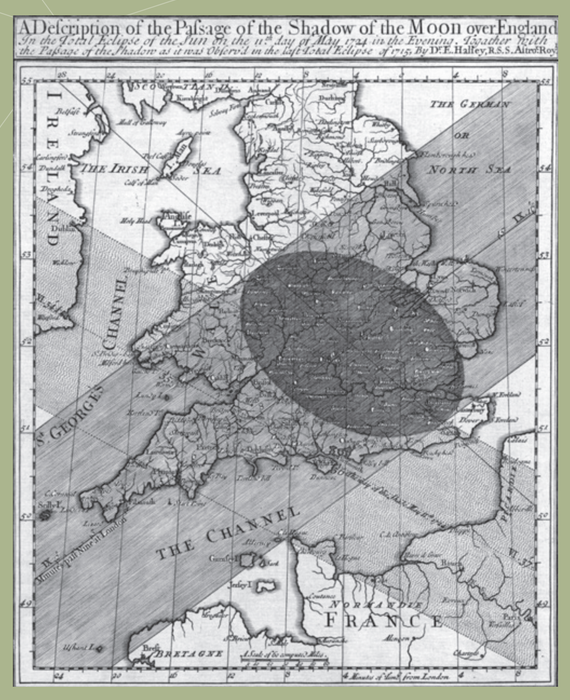
Halley's science

In the 17th century the Earth's magnetic field was a topic of serious study because of its importance to navigators. Halley developed a theory to explain the variations in the Earth's magnetic field.

His chart of magnetic variation over the Atlantic introduced the important and influential idea of using continuous lines to join points with the same value. This method of showing equal quantities on a map subsequently entered into international usage, to show contours, temperatures, depths, and other cartographic and geographical features.

Halley's chart of magnetic variation

Halley's concern with the public dissemination and understanding of science can be seen from the mass eclipse observation that he organised while in Oxford. In 1715, calculating that London would experience its first total eclipse of the Sun since 1140, he distributed maps all over England to solicit observations of local eclipse conditions, as well as to reassure citizens that it was a natural event, portending no harm to the new monarch, King George I.



Halley's mass eclipse observation

Oxford Mathematics

Oxford Mathematics from Halley to Hornsby

Oxford's Newtonian School

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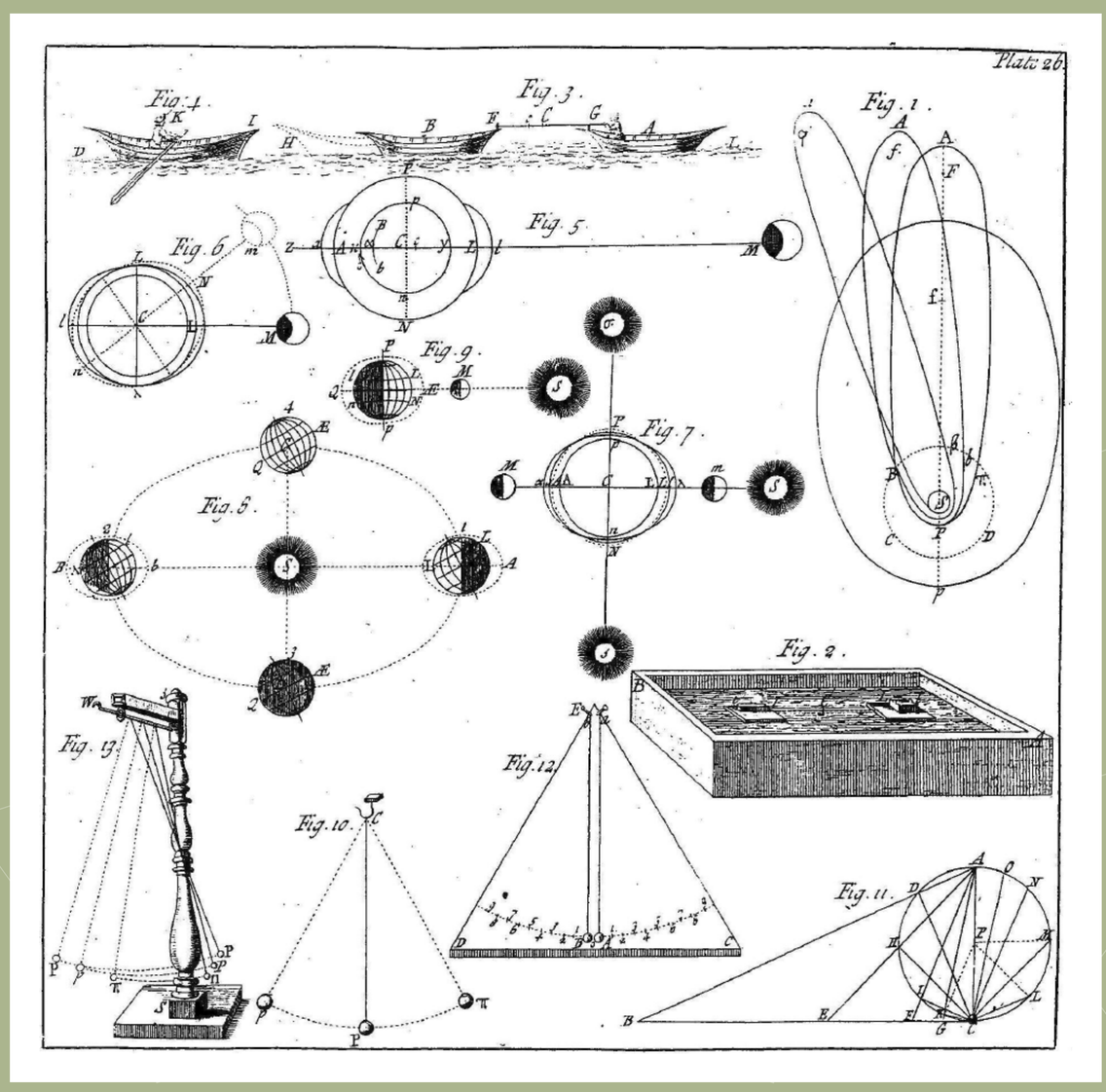
Throughout the 18th century Oxford became the centre for the development and promotion of Isaac Newton's ideas.

Newtonianism in Oxford

In the 18th century a group of mathematicians and scientists at Oxford University actively developed and promoted the ideas contained in Newton's *Principia Mathematica*. At a time when Newton was working on his lunar theory from London, it was in Oxford that his ideas were most actively fostered and disseminated.

One of the principal members of this group of Oxford Newtonians was John Theophilus Desaguliers who was of Huguenot descent.

Around 1710 he was actively lecturing on experimental philosophy in Oxford, and was appointed a lecturer at Hart Hall (now Hertford College). Desaguliers's great talent lay in the effective popularisation of Newtonian physics within the University, by means of elaborate models and machines. These were especially useful for communicating to non-mathematical audiences such abstract principles as waves or the dynamics of comets.



Newtonian experimental philosophy – 'to explain and prove experimentally what Sir Isaac Newton has demonstrated mathematically' – was developed and promoted in 18th-century Oxford. Desaguliers's *Course of Experimental Philosophy* gave several plausible demonstrations of Newton's third law of motion, involving boats, magnets, tides and pendulums.

Comets

With Newton's dynamical laws of gravitation at his disposal, Halley began to apply himself seriously to comets as astronomical bodies. While fitting observations of recent comets to elliptical orbits, he realised that the comet of 1682 might be the same as the bright one that had been observed previously in 1607, 1533, 1456, 1380 and 1305. Taking account of the perturbations of Jupiter, he predicted that the comet would return in December 1758: here Halley was alerting future astronomers to an event that he knew he would not live to see.

Halley's comet became his memorial when the comet duly returned on Christmas Day 1758 in the predicted region of sky.

This was much more than an interesting discovery: it was one of the most successful vindications of Newtonian theory, demonstrating the power of the new science to explain ancient hitherto mysterious phenomena, and showing them to be subject to the same predictable laws as the Sun, Moon, and terrestrial bodies.

IV. *Aſtronomiæ Cometicæ* Synopſis, *Autore* Edmundo Halleio *apud* Oxonienſes *Geometriæ Profeſſore* Saviliano, & Reg. Soc. S.

Halley published his cometary researches shortly after his appointment to the Savilian chair

The Old Ashmolean building (now the Museum of the History of Science) in Broad Street was used for lectures in Newtonian science throughout the 18th century

Oxford Mathematics

Oxford Mathematics from Halley to Hornsby

The 18th century

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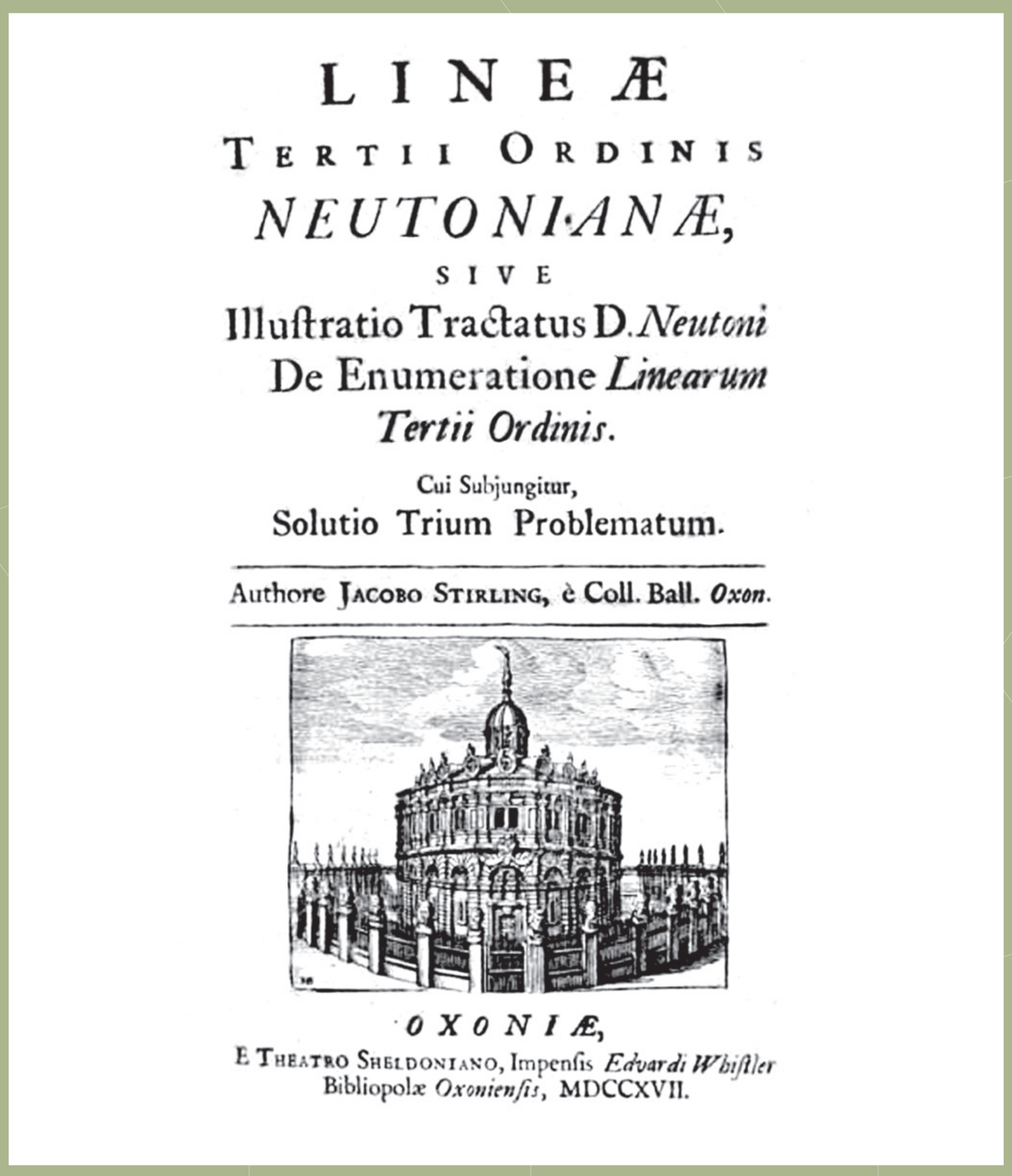
The 18th century saw little original mathematical research at Oxford, although mathematical teaching was available as part of a liberal education.

James Stirling

The 18th century was not Oxford University's most creative research period, and nor did the teaching there – or anywhere in England – produce mathematicians who equalled the best in continental Europe.

The late Stuart years saw the best mathematician that Oxford managed to produce in the 18th century. James Stirling was a Scot who studied at Balliol College from 1711 until about 1715, when he lost his scholarship on refusing to take the oath of allegiance to the new Hanoverian King George I and never graduated. Nonetheless, he was recognised as the brightest young mathematician around.

In 1717 Stirling's first book, *Lineae Tertii Ordinis Neutonianae*, was published in Oxford. This was a commentary on Newton's remarkable classification and enumeration of cubic curves, an impressive piece of work that most contemporary mathematicians had failed to appreciate. In what the Newton scholar D. T. Whiteside described as 'the turning-point in contemporary appreciation of the essential accuracy and technical accomplishment' of Newton's work, Stirling 'produced the first proficient exposition and percipient critique of Newton's tract, elaborating its presuppositions, [and] proving most of its undemonstrated theorems and arguments'. Newton subscribed for two copies of this book, and offered financial help to aid Stirling later in his career.



LINEÆ
TERTII ORDINIS
NEUTONIANÆ,
SIVE
Illustratio Tractatus D. *Neutoni*
De Enumeratione *Linearum*
Tertii Ordinis.

Cui Subjungitur,
Solutio Trium Problematum.

Authore JACOBO STIRLING, è Coll. Ball. *Oxon.*

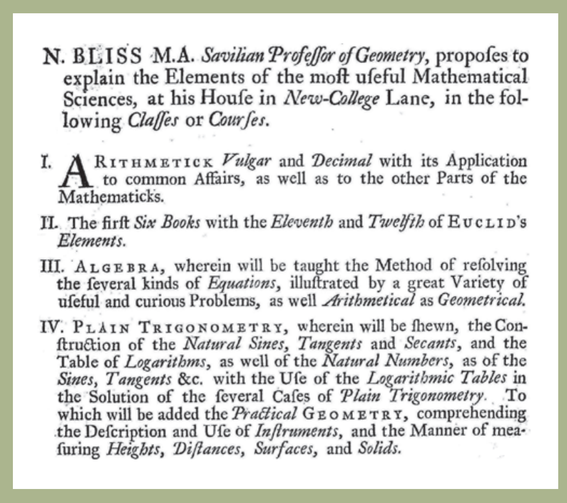
OXONIÆ,
E THEATRO SHELDONIANO, Impensis *Edvardi Whistler*
Bibliopolæ *Oxonienſis*, MDCCXVII.

James Stirling's brilliant book on Newton's cubic curves was the last book on contemporary research mathematics to be published in Oxford during the 18th century

The Savilian Professors

18th-century Oxford has often been thought of as a period sunk in decadence and academic slumber. The reasons for this diminution in Oxford's mathematical activity are complex, but some responsibility must be placed upon the professors. In particular, the Savilian Chair of Geometry at the start of this period was held by Edmond Halley, who later moved to Greenwich in 1720 to take up the post of Astronomer Royal. From then on he took little interest in promoting non-astronomical mathematics, or indeed in teaching at Oxford.

Throughout these years the Savilian Chairs of Geometry and Astronomy seem to have been essentially interchangeable in terms of qualification or inclination. The main interests of Halley's successor, Nathaniel Bliss, lay also in astronomy.



N. BLISS M.A. *Savilian Profeſſor of Geometry*, propoſes to explain the Elements of the moſt uſeful Mathematical Sciences, at his Houſe in *New-College* Lane, in the following *Claſſes* or *Courſes*.

I. ARITHMETICK *Vulgar* and *Decimal* with its Application to common Affairs, as well as to the other Parts of the Mathematicks.

II. The firſt *Six Books* with the *Eleventh* and *Twelfth* of EUCLID's *Elements*.

III. ALGEBRA, wherein will be taught the Method of reſolving the ſeveral kinds of *Equations*, illuſtrated by a great Variety of uſeful and curious Problems, as well *Arithmetical* as *Geometrical*.

IV. PLAIN TRIGONOMETRY, wherein will be ſhewn, the Conſtruction of the *Natural Sines*, *Tangents* and *Secants*, and the Table of *Logarithms*, as well of the *Natural Numbers*, as of the *Sines*, *Tangents* &c. with the Uſe of the *Logarithmic Tables* in the Solution of the ſeveral Caſes of *Plain Trigonometry*. To which will be added the *Practical* GEOMETRY, comprehending the Deſcription and Uſe of *Inſtruments*, and the Manner of meaſuring *Heights*, *Diſtances*, *Surfaces*, and *Solids*.

This advertisement for the mathematics lectures of Nathaniel Bliss in mid-century disproves the more extreme of the charges that Oxford mathematics was in academic slumber

It was not until Abraham Robertson's election in 1797 that an active mathematician once again filled the Savilian Chair of Geometry, but he moved over to the Chair of Astronomy in 1810. His successor in the Chair of Geometry, Stephen Rigaud, was a major contributor to the flowering of Newtonian historical scholarship in the 1830s, by which time he too had moved over to the Chair of Astronomy.

Nathaniel Bliss

Bliss's successor, the astronomer Joseph Betts, died in post after only one year. John Smith was then Savilian Professor of Geometry for over thirty years without being a mathematician – he taught anatomy and chemistry – and without being in residence during the time he spent as a physician in Cheltenham.

In 1737 William Hogarth drew Oxford scholars attending a lecture on *Datur vacuum* – few of them show much interest in the lecture

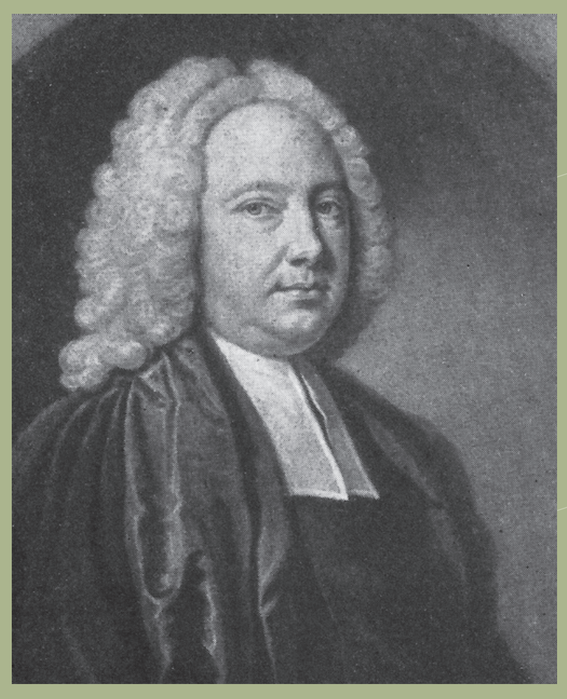
Oxford Mathematics from Halley to Hornsby

The Radcliffe Observatory

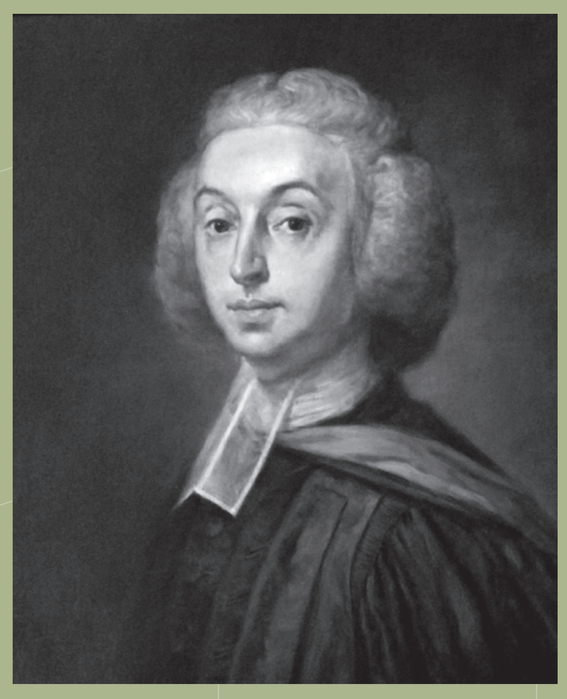
UNIVERSITY OF OXFORD
Mathematical Institute

The Radcliffe Observatory was built in the 1770s at the instigation of Thomas Hornsby.

Thomas Hornsby



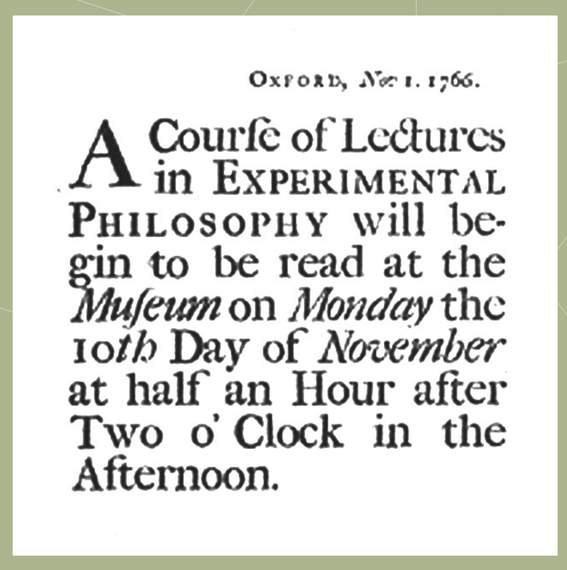
James Bradley was probably Oxford's greatest practical astronomical observer and the embodiment of Oxford's Newtonian tradition. He was Savilian Professor of Astronomy from 1721 until his death in 1762.



Thomas Hornsby succeeded Bradley as Savilian Professor of Astronomy, and held the post from 1763 until his death in 1810
(Reproduced courtesy of Green Templeton College, Oxford)

When James Bradley died in 1762, Thomas Hornsby of Corpus Christi College was elected to succeed him to the Savilian Chair of Astronomy. Twenty years later he also occupied the Sedleian Chair of Natural Philosophy. Hornsby formed a natural successor to Bradley, for he was an energetic teacher of astronomy and physics in the University.

By the middle of the 18th century, astronomy had become the most expensive of the sciences, and a serious astronomer needed hundreds of pounds at his disposal to acquire the instruments necessary to pursue fundamental research. Hornsby recognised that to advance astronomical studies at Oxford, the University needed a major observatory equipped with a full set of instruments, and to this end he petitioned the Radcliffe Trustees in 1768. Part of his petition was a request for facilities where he might 'read a course of lectures in Practical [observational] Astronomy; which I was the rather disposed to undertake as it had never been publicly attempted at any University'.



OXFORD, *Nov* 1. 1766.

A Courſe of Lectures in EXPERIMENTAL PHILOSOPHY will begin to be read at the *Muſeum* on *Monday* the 10*th* Day of *November* at half an Hour after Two o' Clock in the Afternoon.

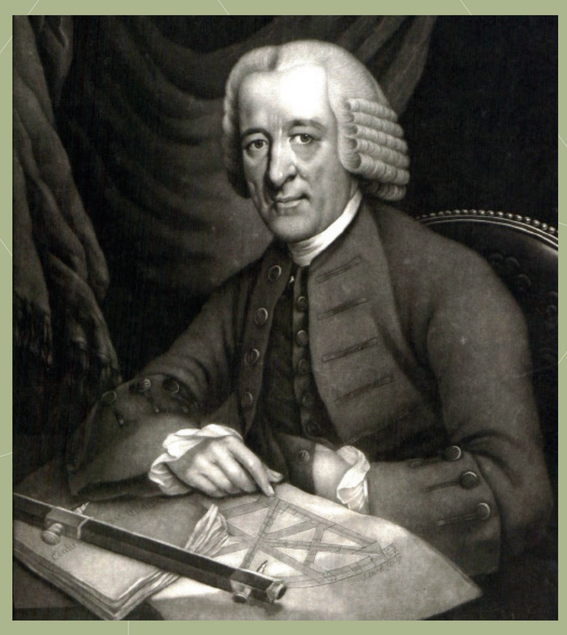
A notice of Hornsby's lectures

The Radcliffe Observatory

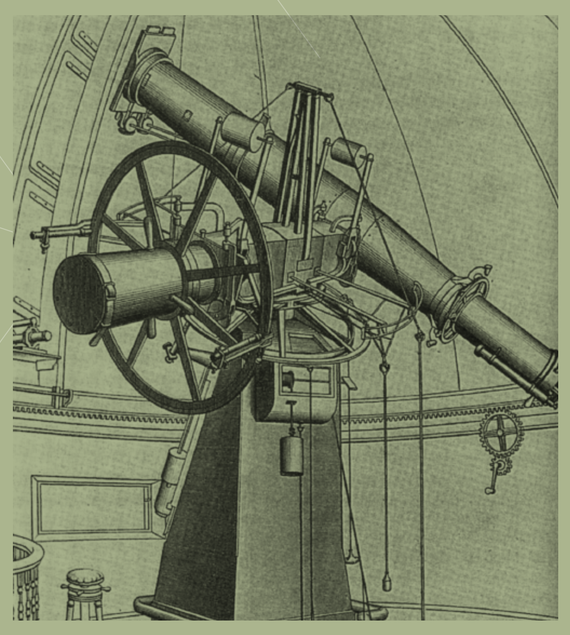
By the end of the 18th century the Radcliffe Observatory had become the best-equipped astronomical observatory in the world

The £40,000 Trust bequeathed by Dr John Radcliffe in 1714 had already provided Oxford University with a scientific library (the Radcliffe Camera) and an Infirmary, and the Trustees considered the provision of an astronomical observatory to be well within the spirit of the bequest. Land was acquired to the north-west of the city from St John's College, so that the observatory and its spacious grounds stood next door to the Radcliffe Infirmary along what is now the Woodstock Road. Plans were drawn up for an elegant stone building, with two wings flanking a magnificent central tower modelled on the Tower of the Winds in Athens. Thomas Hornsby commissioned the Observatory's instruments from John Bird, the greatest instrument maker of the age.

In 1979 the Radcliffe Observatory was incorporated into what is now Green Templeton College. More recently, the Radcliffe Infirmary site has been redeveloped and the Observatory building is adjacent to Oxford's new Mathematical Institute.



John Bird in 1776, at around the time that he constructed instruments for the Radcliffe Observatory



The Merz–Repsold heliometer equipped the Radcliffe Observatory for high-precision astrometric observations in the mid-19th century

These posters were conceived by Raymond Flood and Robin Wilson, with help from Dyrol Lumbard. The text is based on writings by Allan Chapman and the late John Fauvel.

Oxford Mathematics