

## JAMES FERGUSON: A COMMEMORATION

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**Abstract:** James Ferguson (1710–1776) was a renowned author and lecturer on scientific subjects and maker of scientific instruments. His *Astronomy Explained upon Sir Isaac Newton's Principles of 1756* was an extremely popular non-mathematical exposition of Newton's ideas in English. He wrote numerous other books, some of which remained in print until the mid-nineteenth century. Ferguson rose from humble beginnings as a shepherd in north-east Scotland to become a wealthy lecturer, author and Fellow of the Royal Society, enjoying an international reputation. April 2010 marked the three hundredth anniversary of Ferguson's birth, and the present short communication briefly commemorates this event.

**Keywords:** James Ferguson, eighteenth century astronomy, astronomy popularisation, astronomy education, orreries, astronomical instruments.

### 1 INTRODUCTION

James Ferguson was born in April 1710 and the present note commemorates his tricentenary in 2010. Ferguson (1710–1776; Figure 1) is best remembered for his orreries and other scientific instruments and as an astronomer, author and lecturer on various scientific subjects, including astronomy. In 1756 he published *Astronomy Explained upon Sir Isaac Newton's Principles*, which presented a clear, non-mathematical account of Newton's ideas. It proved extremely popular and helped to bring the new astronomy to a wider audience.

Ferguson was born in north-east Scotland to poor parents who eked a meagre living from a smallholding. He had little formal education, but from a young age was fascinated by astronomy and showed an aptitude for mechanical devices. His early adult life was spent in Scotland, mostly working as a painter of portrait miniatures. In 1743 he moved to London and developed a career as an author and lecturer on astronomy and other scientific subjects. In the eighteenth century there was a great demand for public lectures on scientific subjects in both London and the provinces (e.g. see Inkster, 1982). Typically, such lectures would be a combination of entertainment and spectacle and serious instruction. Ferguson's work inclined to the latter rather than the former.

Ferguson's reputation rests on his work as an author and lecturer. He earned considerable renown, being elected a Fellow of the Royal Society, was awarded a pension by George III and his reputation spread overseas. In addition to *Astronomy Explained* he wrote several other books, some of which remained in print until the mid-nineteenth century. The sources for Ferguson, including those used in the preparation of this note, are discussed in Section 6 and not referenced elsewhere here. References for other individuals and subjects are given at the appropriate place in the text.

### 2 A LIFE IN TWO PARTS: SCOTLAND AND LONDON

James Ferguson was born on 25 April 1710 at Core-of-Mayen, Rothiemay, Banffshire, north-west of Aberdeen in Scotland. His parents were John Ferguson, a tenant farmer who rented a smallholding and his wife Elspeth Lobban. James was the second of at least six children. He learnt to read by listening to his father

teach his elder brother a catechism. Ferguson had little formal schooling, just three months at the grammar school in nearby Keith. However, at the age of seven or eight an interest in mechanics was awakened by watching his father jack up the low roof of their cottage, and he was soon making models of mills and spinning wheels. Between 1724 and 1726 he worked as a shepherd for James Glashan, a local farmer, and in the evening he passed the time by making maps of the constellations using beads and string.

In 1728 Ferguson was offered a position by a local gentleman, Thomas Grant of Achoynaney, where he

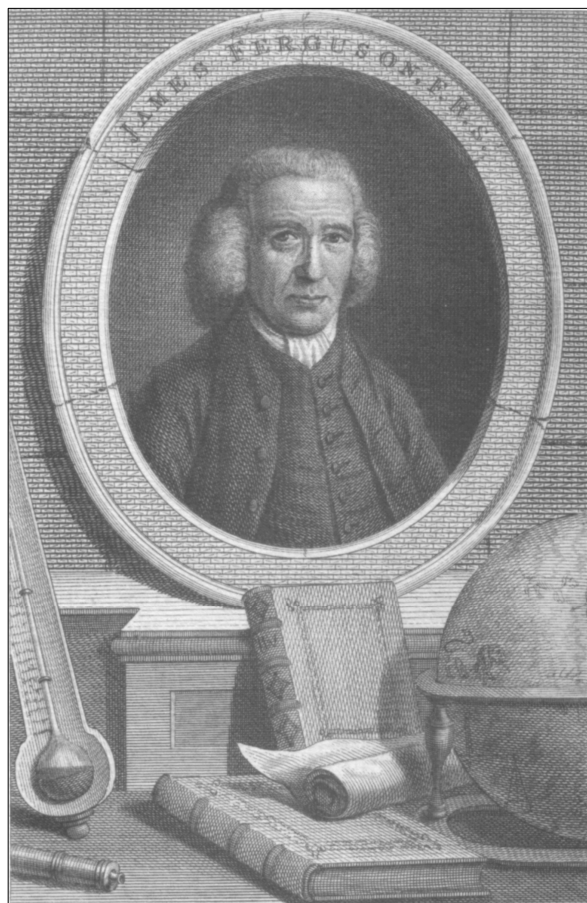


Figure 1: James Ferguson, FRS (1710–1776). This engraving by Thomas Cook formed the frontispiece to the posthumous second edition of *Select Mechanical Exercises*. The central portrait is based on a mezzotint by John Townsend.

was taught mathematics and other subjects by Alexander Cantley, Grant's butler and himself a self-taught

polymath. In 1730 Cantley left for other employment and Ferguson returned home, where he followed var-

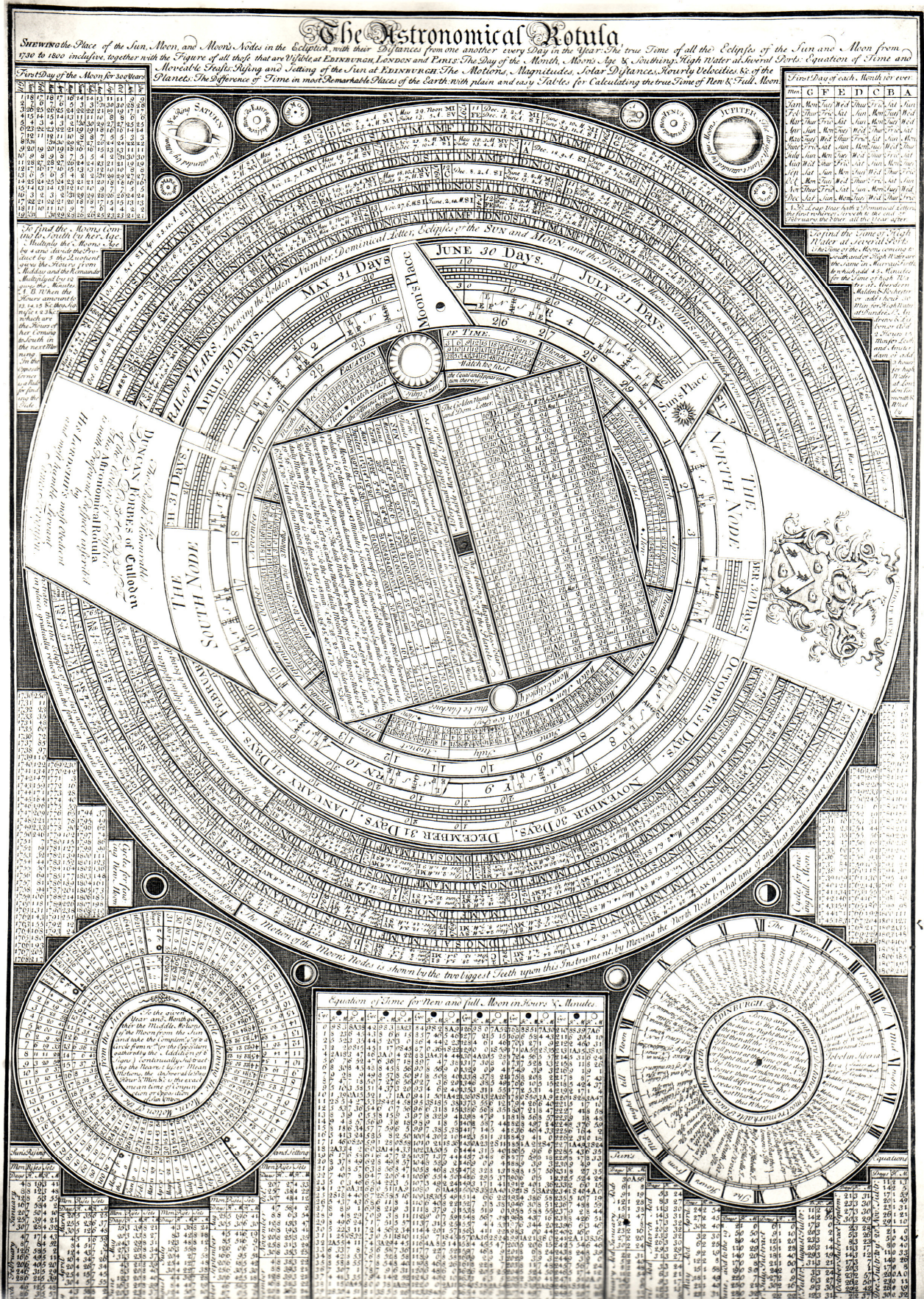


Figure 2: The Astronomical Rotula of 1742. For a close-up of part of The Astronomical Rotunda see Figure 2a, opposite (item T.1974.186, reproduced courtesy of The Trustees of the National Museums of Scotland, who retain copyright).

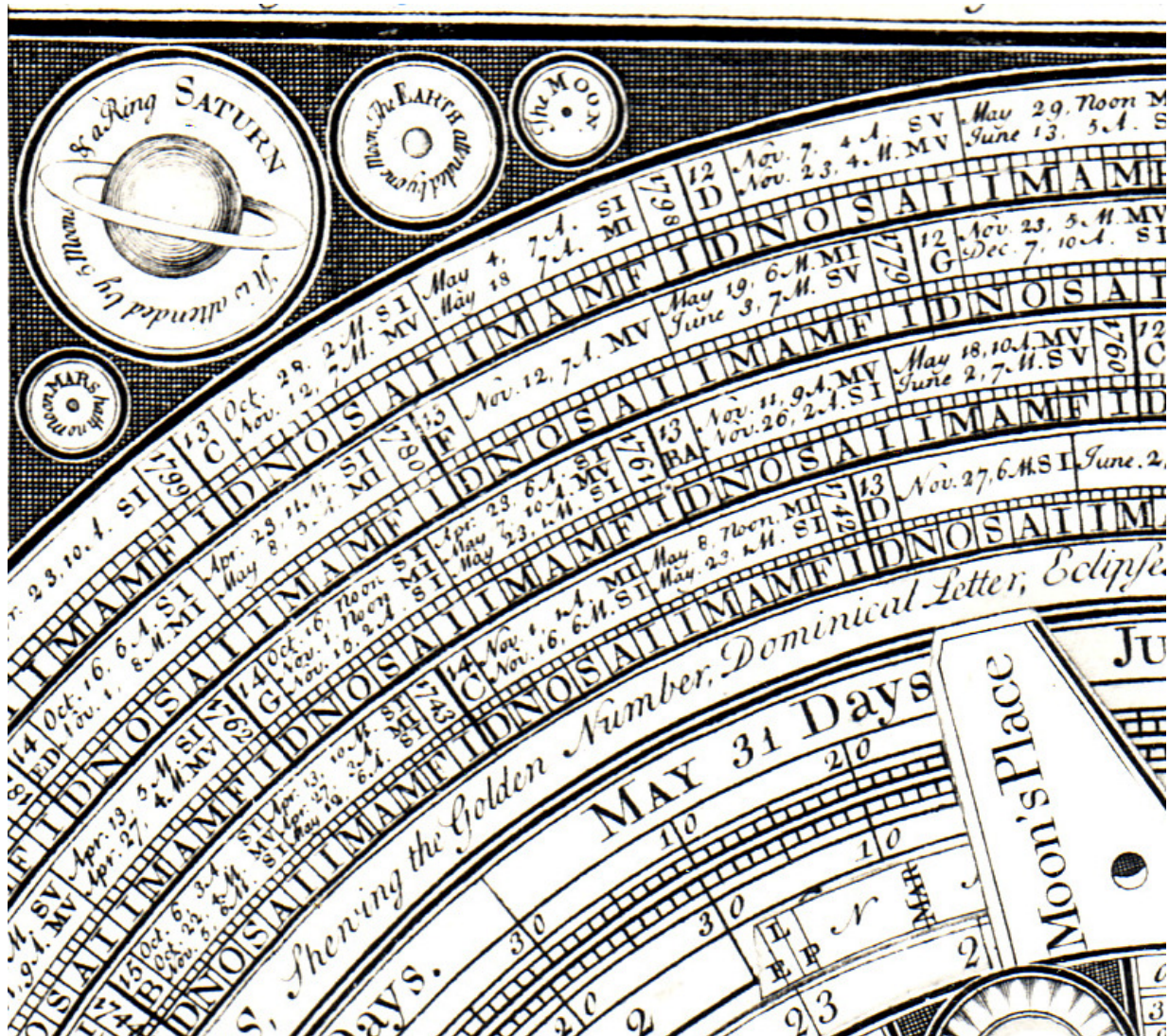


Figure 2a: Detail of *The Astronomical Rotula* of 1742 showing some of the inscribed circles (item T.1974.186, reproduced courtesy of The Trustees of the National Museums of Scotland, who retain copyright).

ious occupations. He made a terrestrial globe, the first that he had ever seen, from the instructions in a copy of Patrick Gordon's *Geographical Grammar* which Cantley had given him. He also made his first clock, out of wood, and a watch with a whalebone spring.

Between 1732 and 1734 Ferguson resided with Sir James Dunbar of Durn, where he maintained clocks and repaired machinery. He decorated two spheres on the gateposts of Durn House, Sir James' residence at Portsoy, as a pair of terrestrial and celestial globes. Their principal axes were correctly aligned towards the celestial pole so that they acted as sundials. Sir James' sister, Lady Dipple, became Ferguson's patron and took him to Edinburgh to train as an artist, though he showed little aptitude for landscapes. He did, however, become a limner, or painter of pen and ink portrait miniatures. This occupation would provide the basis of his living for a quarter of a century. In 1734 to 1736, while staying in Edinburgh, Lady Dipple introduced Ferguson to Lady Jane Douglas of Merchiston Castle. Later at her invitation he would visit the Castle, staying in the room where John Napier had invented logarithms (for Napier see e.g. Gladstone-Millar, 2003). Around this time Ferguson taught himself medicine, intending to become a physician. He

subsequently practised around Keith but was unsuccessful, not least because his bills were often unpaid.

Ferguson married Isabella Wilson (1719–1773) in 1739. Around the same time he moved to Inverness, resumed limning for a living and also took up his astronomical interests again. He invented an astronomical instrument with four rotating plates or 'volvelles' to show the positions of the Sun and Moon and to predict eclipses. He showed it to Colin Maclaurin (1698–1746; see, e.g. Hall, 2007), then Professor of Mathematics at Edinburgh, who became his friend and patron. Maclaurin had the device engraved and published in Edinburgh in 1742 as the *Astronomical Rotula* (Figure 2). After being shown Maclaurin's orrery, which had concealed an inaccessible wheelwork, Ferguson was able to work out for himself the necessary gearing. Maclaurin was sufficiently impressed to ask Ferguson to demonstrate and lecture on the orrery to his students. This demonstration marked the start of Ferguson's many lecturers.

In 1743 Ferguson moved to London. The reasons for his relocation are unclear. He may have perceived it would offer a better market for his miniatures, and, indeed, they would provide most of his income until the late 1750s.

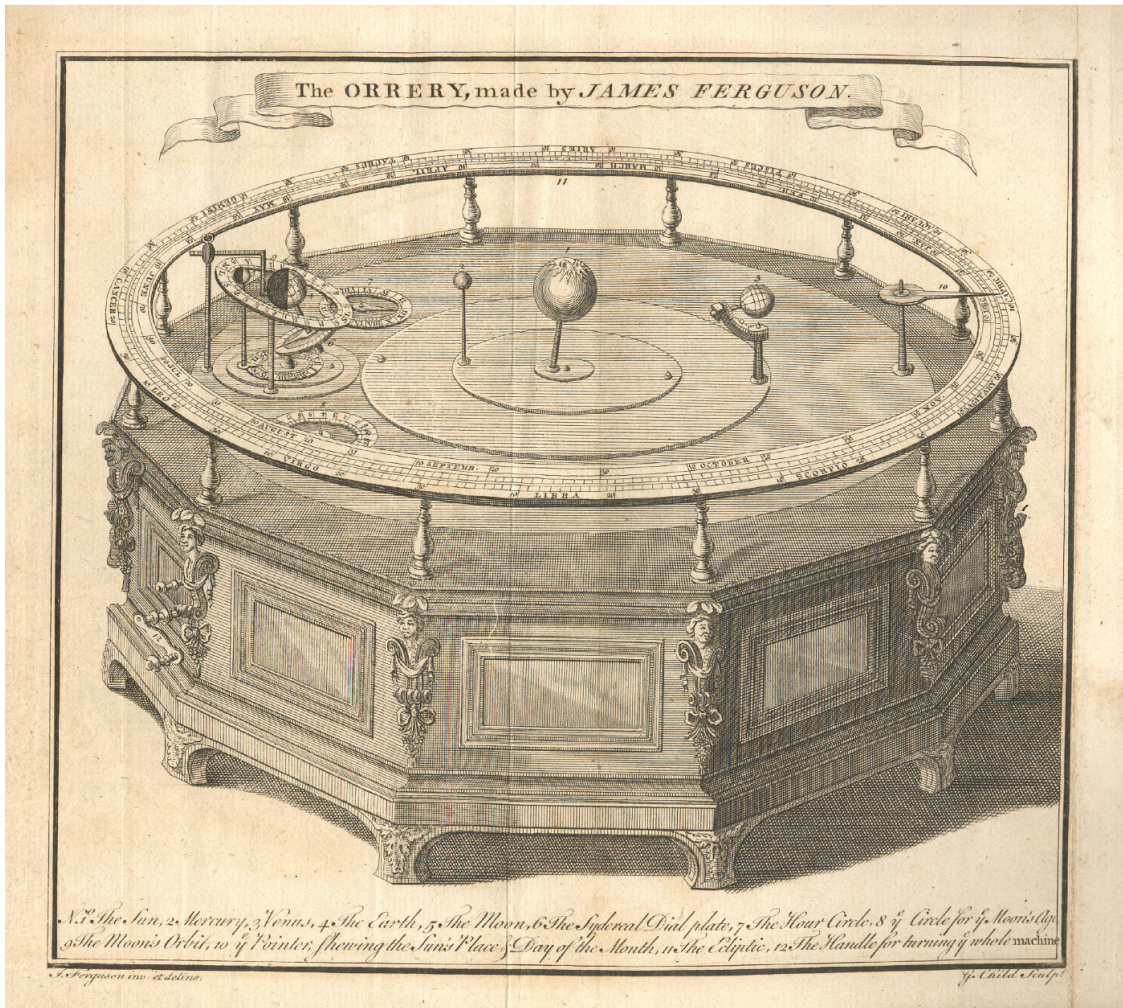


Figure 3: Ferguson's Venus orrery. This instrument was designed to show the orbit, axial inclination, seasons and related phenomena of Venus, as deduced from the observations of Francesco Bianchini (1662–1729) which suggested (entirely erroneously) a rotation period of about 24 hours and a rotation axis highly inclined to the ecliptic. The original engraving was for his book, *The Use of a New Orrery* (1746), and was reused as the frontispiece for the first edition of *Astronomy Explained* (1756). A paper describing the orrery and discussing the seasons that would result from Venus' supposed highly inclined axis of rotation was Ferguson's first communication in the *Philosophical Transactions*.

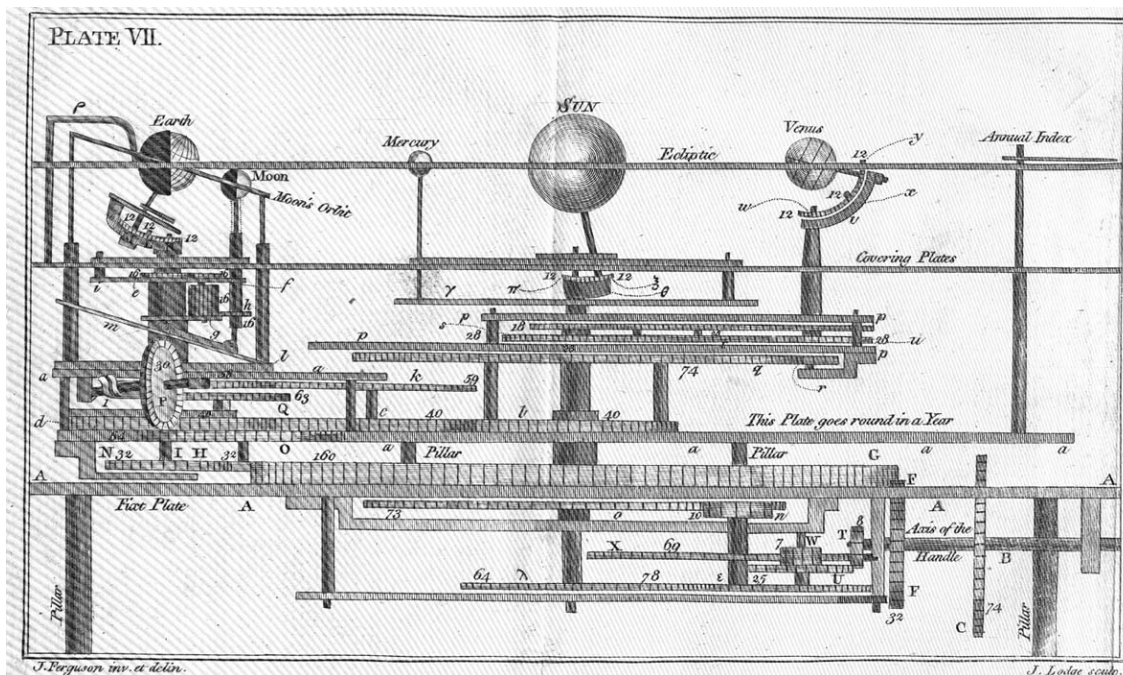


Figure 4: The wheel-work for the Venus orrery (Figure 3), from *Select Mechanical Exercises* (1773).

However, he took the opportunities offered by the metropolis to develop his other interests. Initially Ferguson's patron was the Rt. Hon. Stephen Poyntz, who tried to obtain training for him as a mathematics tutor, but Ferguson could not afford the apprenticeship. Poyntz then commissioned miniatures of his family from Ferguson in order to be able to recommend him. Ferguson remained based in London for the rest of his life, mostly living in either the areas around The Strand and Fleet Street or in Marylebone. From 1755 to 1757 he bought, ran and then sold, a business selling globes. Otherwise he continued as a limner, while developing his career as a lecturer, author and inventor on which his reputation now rests.

In late 1767 or 1768 Ferguson moved to his final address, 4, Bolt Court, Fleet Street (where Dr Johnson was briefly a neighbour). He legally separated from his wife, Isabella, in 1773. They had four children: Agnes (b. 1745), James (b. 1748), Murdoch (b. 1752) and John (b. 1753). James Ferguson died at home in Bolt Court on 16 November 1776 of 'gravel and other ailments.' He is buried in Old Marylebone churchyard, Marylebone High Street, Westminster, near Isabella and his oldest son, James. His estate amounted to the then very considerable sum of £6,000, which seems to have been accumulated largely through thrift and sound investment.

### 3 CAREER AS A LECTURER AND AUTHOR

James Ferguson's reputation rests on his work as a lecturer, author and inventor, starting with the *astronomical rotula* and orreries that he made shortly before moving to London in 1743. Though he is principally remembered as an astronomer he lectured on a range of other scientific subjects, most notably mechanics, horology and chronology. He also made forays into hydraulics, pneumatics, electricity and, briefly, optics (though he does not seem to have been comfortable with the last).

Shortly after moving to London Ferguson developed the *trajectorium lunare* to demonstrate that the Moon's path is always concave to the Sun. He displayed this device before the Royal Society in 1744. From 1744 he began giving lectures in his lodgings, illustrating them with the *trajectorium lunare* and other models. These lectures proved popular and successful. He lectured in London for the remainder of his life and later gave lecture tours in the provinces.

Ferguson's first published book was *The Use of a New Orrery* (1746; see Figure 3). He proved a prolific author, and numerous pamphlets, papers and several major books followed. Some of his more important books are listed in Table 1. Many of them went through numerous editions and remained in print until the mid-nineteenth century. Ferguson's first major work, and his first commercial success, was *Astronomy Explained upon Sir Isaac Newton's Principles* (1756), which described Newtonian astronomy without mathematics. It was not the first attempt to introduce Newtonian astronomy to a wider audience. For example, as early as 1719 John Harris (ca 1666–1719) had published *Astronomical Dialogues between a Gentleman and Lady*, in which a lady and gentleman discuss Newton's system of the world in non-mathematical terms (King and Millburn, 1978). None-

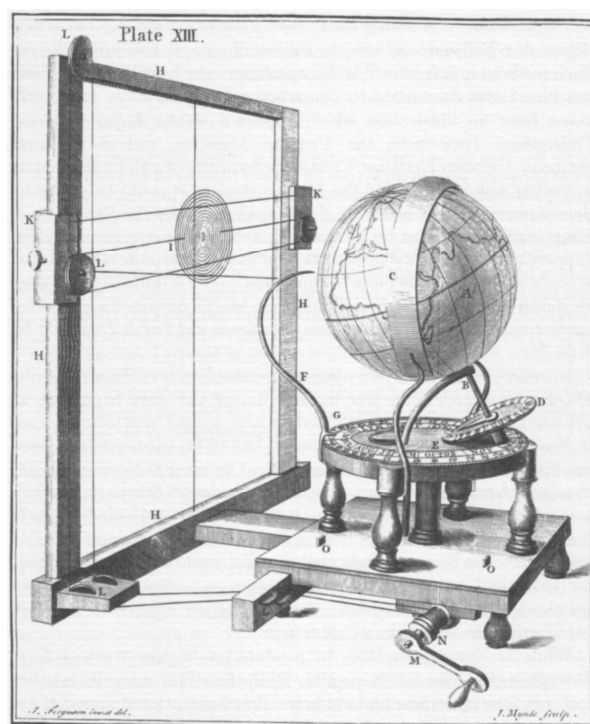


Figure 5: Ferguson's eclipsareon from *Astronomy Explained* (1756). This instrument demonstrated the time, duration and frequency of eclipses at any point on the globe.

theless, *Astronomy Explained* was extremely successful and went through several editions and numerous re-printings. It secured Ferguson's reputation, allowed him to give up limning and may have contributed to his decision to sell his globe-making business.

Amongst Ferguson's books (Table 1) *Astronomy Explained* and *Lectures on Select Subjects* were serious scientific texts; the others were less substantial, and as their titles suggest his books often tied in with his lectures. The success of Ferguson's books may be attributed to their unpretentious style, clarity of exposition, avoidance of mathematics and, not least, their numerous striking and attractive illustrations; Ferguson was a skilled and imaginative draughtsman (see Figures 2-7). His last major book, *The Art of Drawing in Perspective* (Figure 7) appeared in 1775, less than a year before his death and nearly thirty years after *The Use of a New Orrery*. In the later 1760s he adapted

Table 1: Ferguson's major books. The date of first publication is listed.

1746	<i>The Use of a New Orrery, Made and Described by James Ferguson</i>
1756	<i>Astronomy Explained upon Sir Isaac Newton's Principles</i>
1760	<i>Lectures on Select Subjects in Mechanics, Hydrostatics, Pneumatics, and Optics; with the Use of the Globes</i>
1767	<i>Tables and Tracts, Relative to Several Arts and Sciences</i>
1768	<i>The Young Gentleman and Lady's Astronomy Familiarly Explained in Ten Dialogues</i>
1770	<i>An Introduction to Electricity, in Six Sections</i>
1773	<i>Select Mechanical Exercises: Shewing how to Construct Different Clocks, Orreries, and Sun-dials</i>
1775	<i>The Art of Drawing in Perspective Made Easy to Those who have no Previous Knowledge of the Mathematics</i>

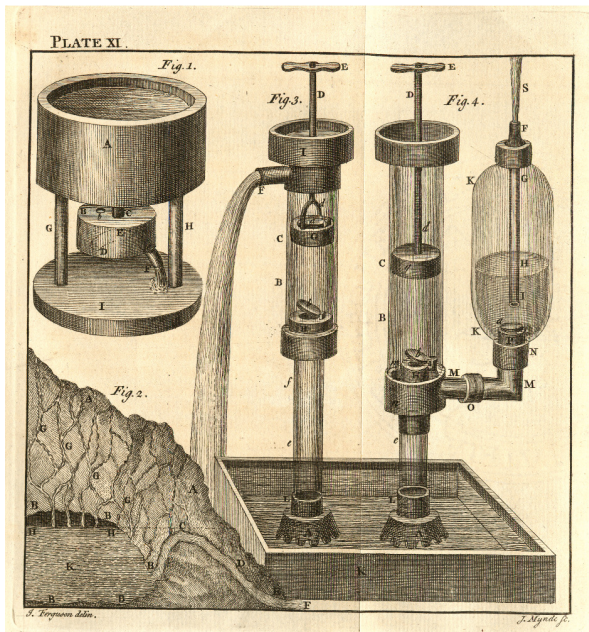


Figure 6: A plate from *Lectures on Select Subjects* (1760) illustrating the action of pumps. The pump chambers are shown as transparent to illustrate the principle of operation. Ferguson used a model of a similar device in his demonstrations.

material from several of his books as articles for the *Encyclopaedia Britannica* (which was first published in Edinburgh between 1768 and 1771). As well as his books Ferguson also published a number of minor works on various subjects, including tracts, prints and contributions to periodicals. The tract, *A Plain Method of Determining the Parallax of Venus* (of which two editions were published in 1761, prior to the transit in June of that year), might serve as an example.

In addition to lecturing in London Ferguson also gave lecture tours in provincial cities in England and Scotland. His tours divide naturally into two periods: 1749-1755 and 1765-1774, separated by the period

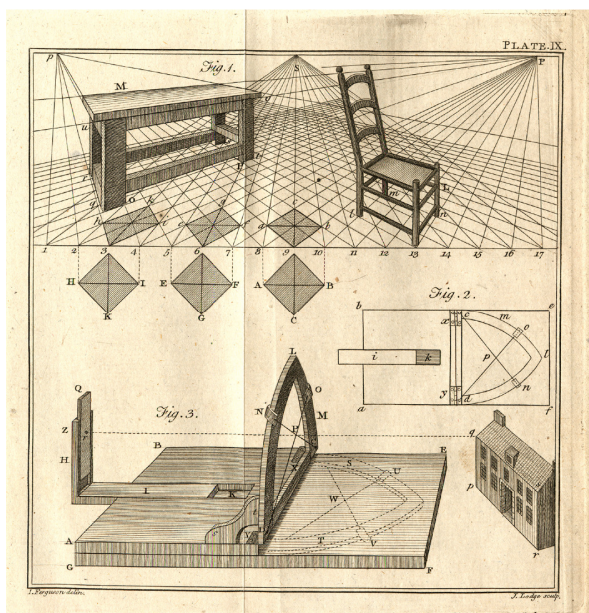


Figure 7: An engraving from *The Art of Drawing in Perspective* (1775). Items of furniture illustrate the use of perspective. An instrument to assist with the correct construction of perspective is also shown.

when he ran a globe-making business and was preparing, publishing and revising *Astronomy Explained*. During the earlier period, 1749-1755, he was touring primarily as a limner looking for commissions, but would also give a five-lecture course on astronomy if there was demand. The later tours, 1765-1774, were principally to give lectures and he offered a twelve-lecture course on 'Experimental Philosophy'.

Ferguson continued to make orreries, versions of the *astronomical rotula* and other astronomical devices (Figure 5). His lectures were illustrated with demonstrations using ingenious models of his own construction (e.g. see Figure 6). He made many such devices to illustrate principles in mechanics, hydraulics, etc, and his books contain numerous attractive illustrations of them. Ferguson was never a commercial clock-maker, though he had built and maintained clocks in Scotland, and he retained a strong interest in wheel-work, particularly for reproducing astronomical phenomena. He devised several new types of timepiece, including a 'three wheeled clock' which was a modification of a design by his friend Benjamin Franklin.

Ferguson did not routinely make and reduce astronomical observations, though he did observe eclipses and sunspots. One notable achievement occurred during the solar eclipse of 1 April 1764, which he observed from Liverpool during a tour. Describing his observations in the *Philosophical Transactions* for 1765, Ferguson noted that "... little tremulous bright specks ..." at the onset and cessation of totality, which he correctly surmised were "... owing to a dent or valley in that part of the limb of the Moon." He had observed 'Baily's Beads' some 70 years before Francis Baily gave his name to the phenomenon (though Luminet (2007) notes that the appellation arose informally from Baily's evocative description rather than any claim to priority).

In addition to his scientific pursuits Ferguson was also interested in, and wrote on, topics in historical and biblical chronology and aspects of theology (though the distinction would have been less apparent in the eighteenth century). His *Tables and Tracts* (1767) covers a diverse range of unconnected topics, including, for example, how to gauge a vat or cask, eclipses, Jewish dry measures and instructions for drawing a meridian line.

James Ferguson received numerous honours. In 1761 he was granted a pension of £50 *per annum* by King George III. In 1763 he was elected a Fellow of the Royal Society and unusually was exempted the admission fee and annual contribution on account of his "... singular merit and circumstances." In 1770 he was elected to membership of the American Philosophical Society.

#### 4 FERGUSON'S LEGACY AND ENDURING INFLUENCE

James Ferguson was never a practical astronomer. He was, however, a significant figure in the development of orreries and similar devices, and amongst the lecturers who brought the new experimental philosophy and Newtonian astronomy to a popular audience in eighteenth century Britain.

Ferguson's books and articles were widely read and had a lasting influence. Several went through numer-

ous editions and reprintings, in some cases continuing, with revisions by later hands, into the mid-nineteenth century. Similarly, reprinting of his autobiography kept his story current. Indeed, the events of Ferguson's life inspired the novel the *Story of the Peasant Boy Philosopher* (1854) by Henry Mayhew, albeit relocated from Scotland to Wales.

### 5 THREE HUNDREDTH ANNIVERSARY

April 2010 marked the three hundredth anniversary of Ferguson's birth, and this event was commemorated on 15 April in a public lecture on Ferguson's life and work given by Professor Roland Paxton. This talk formed part of the programme for the 2010 Edinburgh International Science Festival and was organised by the Edinburgh Bibliographical Society. The National Library of Scotland, also in Edinburgh, organised a small public exhibition of Ferguson's notebooks, drawings and instruments which ran from 18 March to 28 April. In addition to the present short communication, the anniversary was also briefly mentioned in the Summer 2010 issue of the Society for the History of Astronomy's *Bulletin* (see Davenhall, 2010).

### 6 SOURCES AND SURVIVING ARTEFACTS

The definitive modern biography of Ferguson is *Wheelwright of the Heavens* by Millburn and King (1988) who give a detailed and thoroughly researched account of his life and work. They include as appendices an abridged bibliography and a list of manuscripts. Also Ferguson has entries in the *Biographical Encyclopedia of Astronomers* (Baum, 2007) and the *Oxford Dictionary of National Biography* (Rothman, 2007).

Millburn (1983) published a detailed annotated bibliography of Ferguson's works, including books, tracts, prints and periodical articles. This publication comprises a short-title list in a printed booklet and a detailed bibliography on two microfiches, which are enclosed in the back cover of the booklet. It was self-published and is now difficult to obtain. Copies are held in the libraries of the Royal Astronomical Society and the Royal Observatory Edinburgh, and in the National Library of Scotland.

The principal primary source for Ferguson's early life in Scotland is a short autobiography that he included in the *Select Mechanical Exercises* of 1773. Millburn and King reprint it in its entirety as their Chapter 2.

The first full biography of Ferguson was the *Life of James Ferguson, FRS* (1867) by Ebenezer Henderson (1809–1879; see Bayne, 2004; Neale, 2003), an astronomer, antiquarian and author originally from Dunfermline. The *Life* was a long-standing project for Henderson. As a young man he had chanced on a copy of the *Select Mechanical Exercises* while browsing an Edinburgh bookstall in 1827. He was intrigued by Ferguson's story and determined to find out more about him. Forty years later he delivered a detailed, authoritative account. Though he lacked some of the resources available to modern scholars he had access to some material that is now lost. Unfortunately in some cases he was deliberately misled by his correspondents. Henderson published a slightly revised second edition in 1870 (Figure 8) and a mod-

ern reprint has recently been published by Cambridge University Press.

The principal collections of Ferguson's manuscripts are held by the National Library of Scotland and the University of Edinburgh, which holds his commonplace Book. Additional material is held by the Royal Society, the British Library, the Royal Society of Edinburgh and numerous other institutions. On-line versions of all of Ferguson's books, and many of his minor publications, are available as part of the *Eighteenth Century Collection On-line* provided by Gale Cengage Learning. A search of this resource for items published between 1740 and 1780 with 'James Ferguson' as the author yielded 56 results, though not all are by the present James Ferguson. Due to the popularity of Ferguson's books, and the large number of copies printed, the more common ones are still readily available from on-line second hand booksellers for a reasonable price.

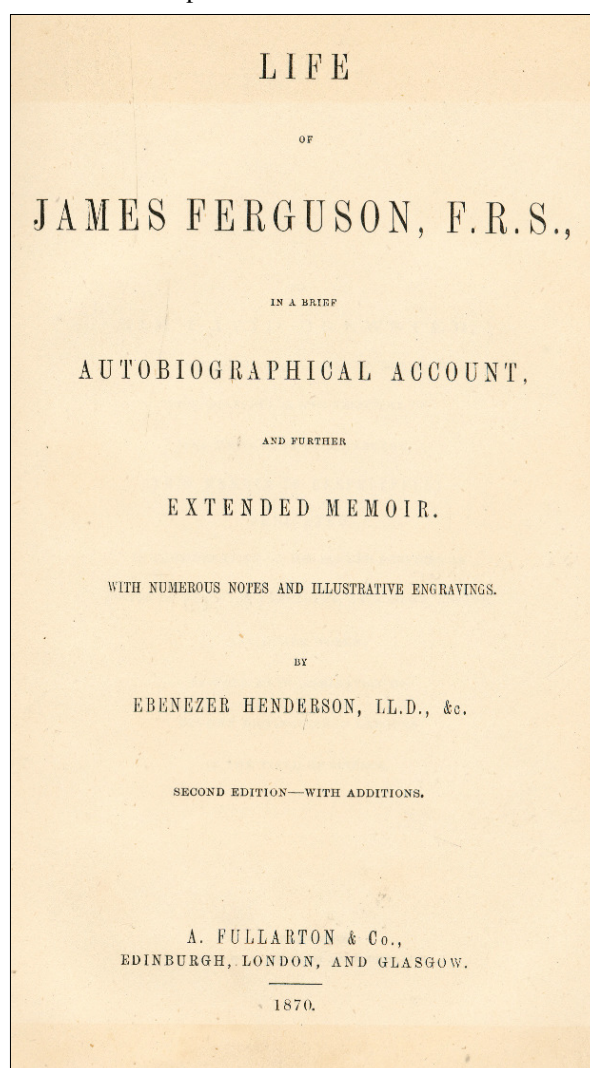


Figure 8: The title page of Ebenezer Henderson's *Life of James Ferguson, FRS*, second edition (1870).

On Ferguson's death, and following provision in his will, the apparatus used for demonstrations during his lectures passed to his friend Dr William Buchan (1729–1805; see e.g. Gavine 1982; Lawrence, 2006; Ruhräh, 1931), then resident in Edinburgh, who gave public lectures with them, though probably only briefly. Next they passed from Dr Buchan to Dr John

Coakley Lettsom (1744–1815), who used them for the private instruction of his family and friends rather than public lecturers. The collection was dispersed following Dr Lettsom's death and is now largely lost. A few are now held by the National Museums of Scotland in Edinburgh, which also holds an example of Ferguson's *Astronomical Rotula* (Figure 2). Some items, including a telescope reputedly made by Ferguson during his time at Durn House, some miscellaneous apparatus used during his lectures and seven of his portraits are held by Banff Museum. Rather more examples of Ferguson's globes have survived and several major collections hold examples, including the National Maritime Museum, Greenwich; the British Library, London; and the National Museums of Scotland.

## 7 CONCLUDING REMARKS

This short communication commemorates the three hundredth anniversary of Ferguson's birth. It is largely based on the modern secondary sources for Ferguson listed in the first paragraph of the preceding section, but particularly Millburn and King's 1988 book.

## 8 ACKNOWLEDGEMENTS

I am grateful to Professor Roland Paxton, Dr David Gavine and Mr William Johnston for useful discussions and for comments on a draft version of the manuscript. In addition, Professor Paxton kindly provided copies from his own collection of all the illustrations used in this article except Figures 1 and 2. Figure 1 is taken from Millburn and King (1988), while I am indebted to Dr Alison Morrison-Low (National Museums of Scotland) for Figure 2. I am also grateful to Dr Morrison-Low for providing details of items associated with Ferguson in the National Museums of Scotland and to Mrs Rosemary Sanderson and Mr James Cowie for similar information for the Banff Museum.

Finally, I would like to thank Ms Karen Moran for providing me with access to the Library of the Royal Observatory Edinburgh, while part of the computing infrastructure used in preparing the manuscript was provided by the University of Edinburgh. Access to the Eighteenth Century Collections On-line was under a subscription provided by the JISC (Joint Information Systems Committee).

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