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BARROW

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EARLY EDITIONS OF EUCLID IN ENGLAND

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THE text of Euclid's *Elements* has probably been more intensively studied in England than in any other country, and his *Data* is also well represented in English editions. The works came to mediaeval Europe, as did many of the Greek texts, by way of Arabic manuscripts carried to Spain and then translated into Latin; this was followed by the discovery of Greek manuscripts, comparison of different versions and finally the definitive Greek edition of Heiberg in 1883–88.

In 1570 England became one of the few countries to publish Euclid in the vernacular before the Latin edition of 1620, and there was a long tradition of studying geometry by the academic man in universities, by the practitioner requiring it for navigation and surveying, and by the mathematical amateur who has been so fruitful in English science. Later, as the age and standard for entering universities were raised, geometry was studied in the schools, where it mainly comprised learning by rote versions of the text attributed to Euclid, and took second place in prestige only to classics. It was not until the end of the nineteenth century that there was any extensive movement to write textbooks of geometry that were not essentially based on Euclid's arrangement.

The most comprehensive bibliography of editions of Euclid and works relating to them is by Riccardi, published in 1887 with various supplements up to 1893[1]. Pietro Riccardi (1828–98) was an Italian engineer, bibliographer and historian of Italian mathematics. His interest in geodesy and practical geometry led him naturally to a study of Euclid, and his comprehensive *Bibliografia matematica italiana*, begun in 1870, formed the basis for the Euclid bibliography. This is also comprehensive, but a high proportion of the entries had not been seen by Riccardi himself, and were lifted from other bibliographies, often rather obscure, and from contemporary booksellers' catalogues. He includes a number of probable 'ghosts' and several geometries with only the most tenuous connexion

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[1] P. Riccardi, 'Saggio di una bibliographia Euclidea', *Mem. Accad. Sci. Ist. Bologna*, 1887–93, ser. 4, tom. 8–9; ser. 5, tom. 1, 3.

bookseller in Cambridge); (Wing E.3405). It was reissued in Paris in the same year, but was apparently never translated into English.

Issued with the English edition of 1654 is Duhamel's *Elementa astronomica*, with the same imprint. Both were reissued in 1665, when the Duhamel, although still bibliographically separate, is mentioned on the main title-page. This has the imprint 'Cantabrigiae, excudebat J. Field, impensis Edwardi Story, 1665' (Wing E.3406).

The work is dedicated to Nicolas Fouquet, Minister of Finance to Louis XIV, who was rising to power in 1643, and the dedication is carried over into the English editions, although by early 1665 he was disgraced and in prison.

These are the smallest Euclids traced up to this time, certainly the smallest published in England. They are narrow duodecimos with rather cramped diagrams in the text. Certainly the 1654 edition would have fulfilled Barrow's desire for compactness, but it contains only the first six books, and was published only a year previous to the first of Barrow's own editions.

Georges Fournier (1595–1652) was one of the several Jesuits of the time with wide interests, who travelled extensively and wrote on geography, hydrography and fortification, and issued the Euclid in a genuine pocket-edition as an adjunct to these studies. There is an historical introduction on Euclid.

The English editions (1654 and 1665) were not of course published until after Fournier's death and were probably pirated. It is interesting that Barrow was clearly more familiar with the Tacquet edition, first published in Antwerp in 1654, than with the Fournier edition published in the same year in London and Cambridge.

ISAAC BARROW

When Isaac Barrow (1630–77) became a Fellow of Trinity College, Cambridge, in 1649, he first studied anatomy, botany and chemistry 'finding the times not favourable to men of his opinions in the affairs of the church and state . . .',[25] but eventually decided that these were not consistent with his oath to make Divinity the end of his studies. However he came to study geometry by the following process: 'While he read Scaliger on Eusebius he perceived the dependence of Chronology on Astronomy, which put him on the study of Ptolemy's *Almagest*, and finding that Book and all Astronomy to depend on Geometry, he applied himself to *Euclides Elements*, not satisfied till he had laid firm foundations . . . [and] published his Euclide in a less formal and a clearer method

[25] 'Some account of the life of Dr. Isaac Barrow to the Rev. Dr. Tillotson', [by A. H.] published in the preliminaries of Barrow's *Works*, 1683, London, vol. i.

that anyone had done before him'. This was done by using symbolical rather than verbal demonstrations after Oughtred, and abbreviating the proofs. Oughtred had applied his symbols only to part of the work; Barrow edited the fifteen books. He says in his preface that he has two aims: '. . . to conjoin the greatest Compendiousness of Demonstration with as much perspicuity as the quality of the subject would admit' and to produce a portable volume. He praises the French editor Tacquet as 'that most accurate Geometrician' and says that he would not have troubled to produce another edition, but that Tacquet gave only eight books, and the arithmetical books are necessary for the understanding of plane and solid geometry. It is worth noting that Tacquet did in fact publish an *Arithmetic* which was fairly solidly based on the later books of Euclid, but not until 1665, and it was not translated into English until 1703. Barrow says further in his preface that he has closely followed the footsteps of Peter Herigone 'upon a foresight that my speedy departure out of England would not allow me time to describe New . . .' He used only Euclid's own demonstrations, contracted, and there are a few corollaries.

Barrow's Euclid was used as a standard textbook for at least half a century, and its heavy use may account for the difficulty of establishing precisely the number of reprints. It is also undoubtedly the edition used by Newton, who was also at Trinity College.

Newton came up to Cambridge in 1661. The centre of gravity of mathematical studies, which had been in Oxford up to the fifteenth century and moved gradually to Cambridge in the sixteenth as both Recorde and Billingsley migrated there, was now firmly established in Cambridge, and Newton studied under Barrow, attending his lectures. Ball[26] mentions that he picked up a book on astrology, but found that he could not understand the geometry and trigonometry, so he bought a Euclid and was surprised to find how obvious the propositions seemed. He then read Oughtred's *Clavis* and Descartes *Geometry*. Ball says: 'At a later time on reading Euclid more carefully he formed a very high opinion of it as an instrument of education, and he even expressed regret that he had not applied himself to geometry before proceeding to algebraic analysis.' It would be interesting to know when he first read Euclid's *Optics*, not published in this country until the Gregory edition of 1703.

Barrow's *Elements* was published in Latin in 1665, when he was travelling through Europe and the Near East. He had little money, as his father had been a Royalist, but he was helped financially by James Stock, a London merchant to whom he later dedicated his edition of the *Data*. It seems likely that he left the text with the University Printer in Cambridge, and did not stay to see it through the press. It was printed at

[26] W. W. R. Ball, *A history of the study of mathematics at Cambridge*, Cambridge, 1889.

the expense of William Nealand, a bookseller working in Cambridge from 1653 to 1660, probably the same bookseller of that name who was at the Crown in Duck Lane, London, from 1640 to 1662. The first edition of the *Data* was printed in 1657, while Barrow was still abroad, and the two as issued together are recorded as Wing E.3292A, a work in two volumes duodecimo, while the *Data* is also recorded separately as E.3390 in octavo. E. 3392A is recorded as held in the British Museum, but in that copy, in which the two works are bound together, the *Elementa* is in duodecimo, signed in sixes, and the *Data* in small octavo, so there is no reason to suppose the two issues suggested by Wing.

The volume has the title: ' Euclidis Elementorum libri xv. breviter demonstrati, Operâ, Isaac Barrow ', and carries on the title-page a quotation from Hierocles, a Stoic of the second century A.D., which can be roughly translated: ' A knowledge of Mathematics is the purification of the rational mind.' There is also a dedication to Edward Cecil (son of the Earl of Salisbury), John Knatchbul and Francis Willughby, presumed to be pupils of Barrow. Willughby, the ichthyologist, was also a friend of John Ray, who became a Fellow of Trinity in the same year as Barrow. As Cecil and Willughby were certainly wealthy, it is possible that they had given some financial assistance to the publication.

There is also a preface to ' Benevuolo Lectori ', a flowery laudatory poem by Robotham, a colleague of Barrow at Trinity, on the works of Euclid, and a verse signed ' G.C.' on Barrow's personal qualities. There are explanations of notation and errata diagrams in the text and marginal references to previous sections.

The 1657 edition of ' Euclidis Data, succinctè demonstrata una cum emendationibus, quibusdam & additionibus ad elementa nuper edita operâ Mri. Is. Barrow . . .' was also printed in Cambridge by the University printer Joann. Field, at the expense of William Nealand. The dedication to D. Jacobo Stock—' amico suo & patrono singular '—which appears in all the Latin editions is not translated with any of the English editions.

The 1659 editions of the *Elementa* and *Data*, published on Barrow's return from the Continent, are recorded by Wing as E.3393; it is not clear how the apparent variant E.3393* recorded by the Library Company of Philadelphia differs from this. The pagination is continuous, but there are separate title-pages. Both are small octavos, printed in London, again at the expense of Nealand, but this time by Roger Daniel, a printer and bookseller of London and Cambridge, and a former University Printer.

This is similar to the 1655 edition, reset and incorporating most of the errata; there are additional errata in the University College London copy, but not in the British Museum copy. The diagrams are from the same plates.

The next edition recorded by Riccardi is 1665, which he cites from a secondary source as published in Cambridge by Field and Story. This is not recorded as a Barrow edition by Roberts[27] and it seems fairly clear from correspondence of dates and printers that the Fournier edition is ntended.

The 1676 edition does not strictly belong in an account of English Euclids, but it is mentioned for completeness in the Barrow sequence. It was published in Osnabrück, ' apud Johan Georg. Schwänderum ', with continuous pagination of *Elementa* (1676) and *Data* (1675), the latter ' nunc denuo revisa, & à cunctis erroribus expurgata '. The British Museum copy has errata incorporated in the text in manuscript. It has not been possible to trace any particular connexion of Barrow with Osnabrück, nor any reason why there should be a demand for a locally printed Latin Euclid edited by an Englishman. By 1675, Barrow had been back in Cambridge for some time; he may have made contacts in Osnabrück on his travels in Germany during 1655–59, or the work may simply have been pirated. The diagrams are from new plates.

The 1678 edition (Wing E.3394), of London ' typis J. Redmayne, Prostant autem apud J. Williams & J. Dunmore ', is similar to the Osnabrück edition and was the first to be printed after Barrow's death. Wing records it as a duodecimo and lists the British Museum as a location, but that copy is clearly a small octavo. This item is listed by the Library Company of Philadelphia as E.3394* and octavo. Bound in at the end of the British Museum copy is a pamphlet of 24 pages with the same imprint, and the title: ' Lectio Reverendi et Doctissimi Viri D. Isaaci Barrow beatæ memoriæ, in qua Theoremata Archimedis de Sphæra & Cylindro, per methodum Indivisibilium investigata, ac breviter demonstrata exhibentur.'

The *Elementa* of this edition was largely reprinted in 1685 (Wing E.3395) with most of the preliminaries reset and new plates for the diagrams. It was printed in London, ' apud Car. Mearne, Bibliopolam Regium ' and was ' prioribus mendis typographicis nunc denum purgata '. The British Museum copy is also bound by Mearne. It was issued with a 1678 edition of the *Data* in small octavo.

Several of the editions recorded around this time appear to be ' ghosts '. None of the other Barrow editions listed by Riccardi was seen by him. The 1679 edition quoted from Vachtchenko-Zakhartchenko[28] and also recorded by Graesse[29] is said to be a duodecimo. Graesse also correctly

[27] S. C. Roberts, *A history of the Cambridge University Press 1521–1921*, Cambridge, 1921.

[28] Vachtchenko-Zakhartchenko [a Russian bibliography of Euclid, 1482–1880], cited by Riccardi (ref. 1) as 1879[6]. No copy has been located in this country.

[29] J. G. T. Graesse, *Trésor des livres rares et precieux, etc.*, Dresden, 1859–69, 8 vols.

records the 1659 edition as octavo, but he records the Osnabrück edition as a reimpression of the 1653 edition, but this could be a misprint for 1659, where the date is given in Roman figures. The 1668 edition quoted by Riccardi from Libraiao Zambeccari is probably that of 1678, also dated in Roman numerals, and the 1691 edition quoted from Libraiao Schiepatti as a folio is particularly unlikely, as the characteristic of the Barrow Euclids is their compactness. It is, however, possible that there were other reprints.

It is significant that after two Latin editions, Barrow issued one of the *Elements* alone in English in 1660 (Wing E.3397). He presumably translated it himself from the 1659 edition with incorporated corrections. It is a small octavo, rather larger than the 1659 edition, with the author's preface also translated, the Robotham verse repeated in Latin, but the verse by 'G.C.' omitted. None of the English editions of *Elements* or *Data* includes the dedications. The title-page is in red and black, including the quotation from Hierocles, and it is printed again by R. Daniel for W. Nealand. The plates are as in the early Latin editions. Riccardi records that it includes Archimedes' *Theorems of sphere and cylinder*, but these are not in the British Museum copy.

The second English edition, the only Barrow Euclid to be a numbered edition, is not recorded in Wing. It was published as a duodecimo in 1686, printed for Christopher Hussey and 'E.P.' in Little Britain. 'E.P.' is presumably E. Playford, bookseller of Little Britain, successor to John Playford who died in 1685. His only other recorded publication is a book on navigation published in 1685. Christopher Hussey was printing from 1678 to 1705, mainly theological and mathematical books. It seems that there was a market for the Barrow Euclid outside the general academic circle. They say on the title-page that it is 'very carefully corrected', and the spelling has certainly been modernized. For the first time, the diagrams are gathered together and printed on fold-out leaves; they are engraved by Tho. Cross junior, but are fewer than appear in the 1660 text.

Watt[30] records that this edition was reprinted in 1696, 1715 and 1751. The 1696 edition might be a reprint, but, as Watt does not record the 1696 Dechales edition, it might also be that. The 1715 edition cannot be traced anywhere else, and the 1751 edition is certainly reset.

The 1705 edition, printed by E. Redmayne, is a small octavo, similar in layout to the 1686 but reset, and the diagrams are back in the text. The author's preface is replaced by a briefer 'Note to the Reader' setting out Barrow's aims. E. Redmayne was working in Jewen St., presumably with William Redmayne. It also includes a text of Archimedes' *Theorems on the sphere and cylinder* 'investigated by the method of indivisibles and briefly . . . demonstrated by the Reverend and Learned Dr. Isaac Barrow,

[30] R. Watt, *Bibliotheca Britannica*, Edinburgh, vol. i, 'authors', 1824.

never before [published] in England ' (Riccardi must have been confusing the 1660 edition with this). It was however published in French in 1652, and issued as a pamphlet with the 1678 Latin Euclid.

The next London edition (not in Riccardi) was again a small octavo, printed and sold in 1714 by W. Redmayne of Jewen Street, R. Mount on Tower Hill and B. Sprint in Little-Britain. Richard Mount published other books on geometry and navigation. This contains the fifteen books of the *Elements*, and Archimedes' *Treatise*, with ' To the Reader ' and Robotham's poem, but has in addition the *Data*, with Marinus's preface (the latter not in Latin editions) and a *Brief treatise of regular solids* by Foix. The Hierocles quotation on the title-page is without attribution in this and later editions. There is no indication of who is responsible for choosing and editing the contents of the volume.

The 1722 edition has the same contents with 16 more pages of 'a supplement containing some practical corollaries deduced from some of the most material propositions in Euclide ' (by Henry Wilson). It is printed by J. Redmayne, for J. & B. Sprint and A. Ward in Little-Britain, and T. Page and W. Mount on Tower Hill. William Mount had just succeeded his father Richard, and Thomas Page was his son-in-law.

Thomas Haselden edited in 1732 a similar text, printed by Daniel Midwinter the younger, with ' some hundreds of errors of the former impression corrected '. The preface ' To the Reader ' signed ' I.B.' is paraphrased, perhaps retranslated from the first edition of 1660. The pagination is irregular and pp. 385–414 are misnumbered 485–514. Haselden, who died in 1740, was a schoolmaster, latterly headmaster at the Royal Academy, Portsmouth. He published work on Mercator's chart and was concerned with the teaching of mathematics for navigation.

The last Barrow edition was published in 1751. It contains the *Elements*, Archimedes' *Theorems*, the *Data* and Foix's *Regular solids* ' corrected and illustrated with copper plates [which fold out]. Appendix on logaithms.' It was published by J. Barrow for W. & J. Mount (John Mount was the son of William). There is a frontispiece engraving of Isaac Barrow, ' To the Reader ' as in the Haselden edition and another ' To the Reader ' signed by J. Barrow, saying amongst other things ' as the work has been often printed since his [father's] death, and by that means several errors committed, I have at the request of the Booksellers concerned in this treatise, revised.' The previous woodcuts (probably actually wood engravings) had worn out and been replaced by copper ones. The poem by Robotham has been omitted.

The Barrow Euclid was not acknowledged as the basis for any other, but it was clearly influential as the first cheap and compact, but reliable and complete edition, available first in academic circles and later to students of mathematics and navigation outside the universities.