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## ABOUT THE COVER: BILLINGSLEY'S EUCLID IN ENGLISH

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Before Gutenberg invented movable type, the *Elements* of Euclid was accessible only through some manuscripts. The first printed version came along roughly 25 years later, when Erhard Ratdolt in Venice produced the first printed *Elements* in 1482. And a splendid work it is, with beautifully engraved decorative initial letters and borders. It also provided generous outer margins that contain the necessary engravings of geometric figures. As with most printed material of the time, what we would now expect to find on a title page appeared at the end as a colophon. There one found information on the author, the title, the origin of the work, the name of the printer, and the date. There was only one more edition of the *Elements* in the 15th century, the period that produced books that are now called incunabula [5].

The first part of the 16th century provided another twelve editions, still in Latin or occasionally Greek, and it was not until 1570, almost a century after Ratdolt, that an edition appeared in English, in a translation by Sir Henry Billingsley, one-time Lord Mayor of London. It contained an influential preface by John Dee, an advisor to Queen Elizabeth I. This too was a remarkable edition, not only making Euclid available to a wider audience, but also providing a milestone in the history of printing, as we shall see.

Ratdolt's edition was beautifully decorated, with a most pleasing layout of pages. Billingsley's translation could not quite match that, but it had a title page that has been admired for well over 400 years. It is this title page that we want to describe in some detail (see Figure 1). In this edition the text itself was enhanced with many engravings too but also sometimes with devices of which Ratdolt would have been unaware: so-called *volvelles*, small paper cutouts that were glued to the pages so

Thanks to Leonard F. Klosinski for his technical assistance in scanning the title page and for lending us his copy of the *Nuremberg Chronicle*.


FIGURE 1. Title page of Euclid's *The Elements* from Sir Henry Billingsley's translation, published in 1570.

that the reader could pull them up off the page to form three-dimensional figures. It may not have been quite up to the fancy computer graphics we can use today, but for 1570 it was pretty good! And it made the figures in some chapters much easier to visualize and understand. Unfortunately, glue was probably not quite up to the standards of quality of the ink and paper at the time and in many surviving copies, the volvelles have been lost.

Let's move on to that title page, though. The overall shape is that of the floor of a basilica, with the apse at the top (which in antiquity did not hold an altar, but which in Christian Europe did). This along with the scythe held by the central figure at the very top suggests a medieval origin, in spite of the presence of classical figures. This almost satyr-like creature with wings (unlikely for a satyr!) is shown with a disconsolate friar, a curious group indeed. As we can see the page contains a central cartouche with the title, the names of the author and translator, the publisher and the date. It reads:

> The Elements of Geometrie of the most auncient Philosopher Euclide of Megara. Faithfully (now first) translated into the Englishe toung, by H. Billingsley, Citizen of London. Whereunto are annexed certaine Scholies, Annotations, and Inventions, of the best Mathematicians, both of time past, and in this our age.
>
> With a very fruitfull Preface made by M. I. Dee, specifying the chiefe Mathematicall Sciences, what they are and whereunto commodious: where, also, are disclosed certaine new Secrets Mathematicall and Mechanicall, untill these our daies, greatly missed.

S. Orgel suggests in [3] that "I.B." in the lower left corner of the page might imply that the woodcut was made by John Bettes, a recognized wood engraver of the time. Supporting the cartouche are on the right a caryatid, in fairly conventional form, and on the left a telamon, seemingly in the form of a satyr. Both stand on pedestals that look like integral signs, but it's a century too early for that. Above the cartouche is a large globe with, on the left, Ptolomeus pointing to the stars and Marinus on the right with a compass measuring something on the globe and looking at Strabo below drawing a map. Under the globe we see on a ribbon "*Virescit Vulnere Veritas*" (Truth flourishes from wounds). Below Ptolomeus we see the poet-astronomer Aratus and below him Hipparchus, an astronomer whose only surviving work is a commentary on a poem of Aratus. On the right below Strabo, a geographer, is the historian Polybius who mapped the Roman Empire and did some early work on cyphers and steganography. So on the left we see scholars viewing the stars; on the right, those measuring the earth. Below all of these are charming images of women representing the quadrivium of the seven liberal arts (Geometria, Arithmetica, Astronomia, and Musica—each appropriately occupied, respectively, with compass, straightedge, and square; a table of numbers; a celestial globe; and a lute and musical score). Below those, in the center, is Mercury holding a caduceus in his right hand, not the usual left. That may be a clue that all is not what it seems here.

Going back to the cartouche, we see that the author is given as Euclid of Megara. That's not the Euclid of the *Elements*. Our Euclid is of Alexandria and the two were separated by roughly 100 years. All right, it was a common error at that time and various other editions up to 1570—twelve in Latin—contained the same mistake. In fact, Ratdolt also listed Euclid of Megara as the author of the *Elements*. And

then there's a question of the relevance of the set of scholars above the quadrivium. These men may have made some measurements that contributed to astronomy and surveying or map making, but those names, with the exception of Ptolemy, are not going to be known to many mathematicians. That's because this title page was not originally meant for Euclid's *Elements* at all, as was pointed out recently by F. D. Fasanelli and V. F. Rickey in their work on frontispieces [2]. The authors cite the findings of J. Barrow-Green [1]. The woodcut was commissioned by the publisher John Daye for a geography book he published eleven years earlier, *Cosmographical Glasse*, by William Cunningham, where the cast of characters on the title page was more appropriate. Only the contents of the cartouche are different: this one reads,

> The Cosmographical Glasse, conteinyng the pleasant Principles of Cosmographie, Geographie, Hydrographie, or Navigation, compiled by William Cunningham Doctor of Physicke . . .

The obvious explanation is that the printer was being thrifty. After all, movable type was cheap, pictures almost certainly costly. There are distinguished precedents for this in earlier printing. In 1493 Anton Koberger in Nuremberg printed one of the first great picture books, Hartmann Schedel's *Weltchronik*, usually known as the *Nuremberg Chronicle*, a famous history of the then-known world (it went to press two months after Columbus returned from America). It was lavishly illustrated with 654 very beautiful woodcuts, largely by Michael Wolgemut, but in some cases based on Albrecht Dürer's drawings. (Koberger, Wolgemut, and Dürer lived in the same neighborhood in Nuremberg.) The woodcuts were often hand-colored and showed portraits of kings and bishops, views of great cities of the world, and events of history. But one has to be careful. Adrian Wilson in [6] explains that the printer commissioned only so many woodcuts and often used them over and over. So many kings look exactly alike, and the same is true of clerics and other historical figures. The view of Mainz, for example, is exactly the same as that of Lyon, Bologna, Naples, and one or two others. Koberger, when it came to illustrations, had a sort of one-size-fits-all attitude. So John Daye of London was not the first printer to save money on illustrations. S. Orgel claims that the Euclid title page was used on at least a dozen different books [3].

V. Remmert has also written about this practice [4]. It was more common when illustrations were woodcuts than later when printers were more likely to use copper engravings. With larger press runs one had to be concerned about the life of the woodcut or the engraving. Wood was strong and could be used over and over, with, in this case, only the contents of the central cartouche changing from book to book. Copper plates wore out more quickly so a plate might suffice to produce one book but not more. With wood the cartouche solution was easily handled but, for technical reasons, with copper the substitution for the contents of a cartouche was more difficult to carry out successfully.

Anyway, the title page of the first English version of the *Elements* of Euclid is a tour de force of design and execution. It's entertaining in its many details, evocative and challenging, even if, perhaps, it is something of a fraud.

## References

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