Science in the age of Copernicus

Science in the Age of Copernicus

Owen Gingerich

THE CENTURY spanning the fall of Constantinople (1453) to the death of Copernicus (1543) was the era of Erasmus and Machiavelli, of Dürer and da Vinci; it saw the discovery of the New World, and the Reformation. Into this intellectual ferment came also a powerful cosmological idea, the concept that the earth was not, as men had long supposed, fixed at the center of all Creation, but that it spun and moved about a stationary sun. This rearrangement, propounded and defended by Nicolaus Copernicus, provided the spark that became the Scientific Revolution.

The same century saw the explosive spread of printing with movable type, an innovation that brought swift power to the forces of change, including the reform of astronomy. Without printed texts, Copernicus would have lacked his essential research materials. Even five decades earlier he could scarcely have found the information needed to make his *De revolutionibus orbium coelestium* a major landmark of science. And without printing, his manuscript might have languished, virtually forgotten, in the Frombork Cathedral library.[1]

The quinquecentennial of Copernicus' birth, internationally celebrated in 1973, and the importance of printed books for the Copernicus achievement, made a Houghton Library exhibition almost inevitable.[2] Nevertheless, the design of a Copernican display faced two special obstacles. In the first place, Copernicus himself published very little: although Harvard's collection of rare books boasted two

[1] See Owen Gingerich, "Copernicus and the Impact of Printing," *Vistas in Astronomy*, XVII (1975), 201–218.

[2] The same idea occurred to libraries around the world; four of the best exhibition catalogues are "Copernicus and the New Astronomy," The British Museum, London, 1973; "Nicolas Copernic ou La Révolution Astronomique," Bibliothèque Nationale, Paris, 1973; "The Scientific Press at the Time of Copernicus 1530–1550," Harlan Hatcher Graduate Library, The University of Michigan, Ann Arbor, 1973; and "Nicolaus Copernicus 1473–1973/His *Revolutions* and His Revolution," with an historical essay by Seymour L. Chapin, Linderman Library, Lehigh University, Bethlehem, Pa., 1973. This last exhibition was based primarily on the private collection of Robert B. Honeyman.

copies of the first edition of his great *De revolutionibus* (1543) as well as the far greater rarity, the *Narratio prima* (1540) by Copernicus' disciple Rheticus, two works do not make an exhibition. And secondly, the *Rara Astronomica* exhibition mounted only three years before had already displayed many of Houghton's finest astronomical treasures.[2]

Fortunately, Houghton's resources proved more than adequate. By using such themes as Copernicus' library, his printer Petreius, the 1543 "annus mirabilis" in publishing, and the early dissemination of the Copernican cosmology, it was possible to build an informative and visually exciting exhibition limited to books of the fifteenth and sixteenth centuries, and restricted to an overlap of only 20% with the 1970 show. "Science in the Age of Copernicus" opened at Houghton Library in January 1973, and, after a temporary interruption for another show, continued through Commencement.

Of course, the exhibition's themes were not established abstractly. By 1973 I had embarked on a Copernican census that had taken me to many libraries throughout the world, and in the previous year I had visited Uppsala University Library, which now houses the major extant part of Copernicus' own working library.[4] At that time, the Copernican books were widely scattered in the Uppsala collections, and it took most of a morning to fill out all the call slips. Eventually the books were all assembled in one place so that Charles Eames (the American designer and architect who had accompanied me to Sweden)[5] and I could photograph them (Plate II). No personal letters nor mementos remain from Copernicus himself; only a few books are to be found, plus some business correspondence, and the great holograph manuscript copy of his *De revolutionibus* preserved at the Jagiellonian University in Cracow. In the Uppsala University Library it was enormously exhilarating for me to see so many of the Polish astronomer's books side by side once more, and my ensuing examina-

[3] Owen Gingerich, "Rara Astronomica," HARVARD LIBRARY BULLETIN, XIX (1971), 117–139.

[4] A useful list of books owned by, or available to, Copernicus is found in L. Jarzębowski's *Biblioteka Mikołaja Kopernika*, Toruń, 1971. An earlier list, of the Copernican books now found in Sweden, is E. Barwiński, L. Birkenmajer and J. Łoś, *Sprawozdanie z Poszukiwań w Szwecyi* (Kraków, 1914), pp. 94–119. See also J. Dobrzycki, "The Uppsala Notes," *Studia Copernicana*, XIII (1975), 161–167.

[5] See Owen Gingerich, "A Conversation with Charles Eames," *The American Scholar*, XLVI (1977), 326–337.

tion of his manuscript annotations made me feel that a flesh-and-blood Copernicus really did once exist.

Armed with a knowledge of Copernicus' library, I began to investigate Houghton's holdings of the same titles. Several rare and spectacular items were immediate choices in this category: the great 1486 Ulm woodcut atlas (Plate III), and the Bovillus *Liber de intellectu* (1510). Other works included the first edition of Ptolemy's *Almagestum* (1515) and Stoeffler's handsome *Calendarium Romanum magnum* (1518); for these, colored photographs taken by Mr. Eames and myself, showing Copernicus' marginal annotations in the Uppsala copies, were included in the Houghton display cases.

Furthermore, Copernican scholars have deduced that the astronomer had access to other titles not in the group now at Uppsala. The most notable of these is the Regiomontanus *Epytoma in Almagestum Ptolemei* (1496), whose splendid frontispiece had brought it into the Department of Printing and Graphic Arts, a gift of Philip Hofer, '21. In the same category is a far rarer piece that Harvard has in a very pretty copy from the collection of William King Richardson: the encyclopedic *De expetendis et fugiendis rebus* (1501) of Giorgio Valla.

Another source that Copernicus had, at least in part, was not actually printed until after his death: *Scripta clarissimi mathematici Joannis Regiomontani*, which contained an important set of Renaissance observations. After the exhibition, when I was photographing some of the books for this article, I suddenly realized that the annotations were in the handwriting of Michael Maestlin, the teacher of Kepler. This identification is further confirmed in [Albert Curtz], *Historia coelestis* (Augsburg, 1666), which reprints and attributes to Maestlin some of the manuscript remarks found in the Harvard copy. (For an illustration of the Maestlin annotations, see Plate III of the "Rara Astronomica" article.)

In the three years between the *Rara Astronomica* and the Copernican exhibition, Harvard acquired several interesting astronomical books dating from early in the sixteenth century. One of the finest of these is the first edition of Gregor Reisch's often-reprinted *Margarita philosophica* (1503), the gift of David P. Wheatland, '22 (Plate IV). Another is an early astronomical volvelle book, Sebastian Münster's *Organum uranicum*, a purchase that almost completes Harvard's set of major astronomical works with moving parts (Plate VI).

These were chosen for display along with a copy of Oronce Fine's *Planetarum aequatorium*, which contains an exceedingly scarce, complete, uncut set of parts for a rather complex paper planetary computer.

The focus of the entire exhibition was Copernicus' *opus magnum*, in both the first and second editions, together with the first announcement of the heliocentric theory in the *Narratio prima*. Although copies of the *De revolutionibus* are highly prized, they are not particularly rare: nearly fifty copies of each edition are found in North America, with the 1566 edition slightly less common than the 1543 *editio princeps*.[6] In contrast the *Narratio prima* is truly scarce; the only other examples in America are at the Yale Historical Medical Library, the Dibner Library at the Smithsonian in Washington, the Bullitt collection at the University of Louisville, and the R. S. Honeyman collection. The Harvard copy, the gift of Harrison D. Horblit, '33, is part of a splendid group of six octavos in an early blind-stamped pigskin binding (Plate I).

In 1973 Harvard lacked the *De lateribus et angulis triangulorum*, the small mathematical section of *De revolutionibus* that was published as a textbook in Wittenberg in 1542, a year before the publication of the full treatise in Nuremberg. Mr. Horblit lent his own copy, and subsequently through his generosity and that of the Friends of the Harvard College Library, this example was acquired at the Sotheby auction of the first part of the Horblit library (Plate IX).

Those who follow Houghton's exhibitions will recall that the first of the central pair of display cases generally contains the *pièce de résistance* of the show. The exhibit-maker is challenged to come up with something almost as spectacular for the second case of the pair. In this instance it was easy, for David Wheatland had recently presented a *second* exemplar of the 1543 edition to Harvard; his gift, being a particularly fine example, had gone into the first case, freeing the Richardson copy as the centerpiece for the second case, which was devoted to the 1542/43 "wonder year" in scientific publishing. The other items were the Vesalius *De humani corporis fabrica* and the Fuchs herbal, *De historia stirpium*, both visually far more powerful than the Copernicus. The trilogy formed a stunning combination of distinguished scientific first editions.

[6] My detailed census of the first two editions of *De revolutionibus* will be forthcoming in about 1979 in the *Studia Copernicana* series of the Polish Academy of Sciences.

"Science in the Age of Copernicus" further emphasized the significance of printing for the scientific revolution by devoting a case to the Nuremberg printer Johannes Petreius.[7] Petreius first added scientific titles to his inventory in 1532, and by the 1540s he had become the leading publisher of science north of the Alps, although by no means limiting himself to scientific books. Petreius not only printed the most important astronomical work of the century (the *De revolutionibus*), but also the leading mathematical text, Cardano's *Ars magna* (1545). Because Harvard's own example of the *Ars magna* has a disappointingly scruffy title page, Mr. Wheatland cheerfully lent his own example for the occasion. Another Petreius imprint shown was Witelo's *Optics* (1535), a book especially interesting in a Copernican context because Rheticus took a copy of this edition to Copernicus in Poland in 1539, perhaps as part of the psychological arm-twisting to persuade the reluctant astronomer to send his life's work to the printer (Plate VIII).

Further research into Harvard's holdings revealed that the dissemination of the Copernicus doctrine, particularly in England, furnished a strong sub-theme. Key items in this section were Giordano Bruno's *La cena de le ceneri* (1584) (Plate X) and his *De l'infinito universo et mondi* (1584), each found in only one other copy in America (and both of ours are the gift of Mr. Horblit). To represent mathematics in England, we chose the first Euclid in English, the Daye London edition of 1570, an item borrowed from the American Association of Variable Star Observers in Cambridge. Happily this embarrassing lack in the Harvard collection has meanwhile been filled: the 1570 Euclid was among a group of early mathematical books from the collection of the late C. Doris Hellman generously donated by her husband, Morton Pepper, '27. A second borrowed Daye imprint in the same case, Cuningham's rare *Cosmographical Glasse* (1559) has now also come to Harvard, from Philip Hofer as part of his continuing series of gifts to the Department of Printing and Graphic Arts.

Although the central focus of a Copernican exhibition was neces-

[7] See Joseph C. Shipman, "Johannes Petreius, Nuremberg publisher of scientific works, 1524–1550, with a short-title list of his imprints," in Hellmut Lehmann-Haupt, ed., *Homage to a Bookman: Essays on Manuscripts, Books and Printing written for Hans P. Kraus on his 60th Birthday* (Berlin, 1967), pp. 147–162.

sarily on the exact sciences, some natural sciences were appropriate as part of the emerging scientific ambiance of the sixteenth century. Thus in addition to medicine and botany, illustrated by the Vesalius and the Fuchs as well as by Otto Brunfel's *Herbarum vivae eicones* of 1530, geology and zoology rounded out the exhibition, with Agricola's *De re metallica* (1556) and Gesner's *Thierbuch* (1557) as the most memorable examples.

Houghton's resources allowed a quinquecentennial commemoration that illuminated some of the relatively unexplored interactions between sixteenth-century science and publishing, such as the vital role that a library of printed materials played in Copernicus' research, and the development of specialty printers for scientific publishing. As the foregoing account has suggested, Harvard's holdings are not static but are continuously growing in key scholarly areas. For a final demonstration of this strength, I must remark on an unusual item that would have been exhibited except that it was not acquired until 1974. It is a collection of late sixteenth-century book catalogues, including one from Heinrich Petri, printer of the 1566 second edition of Copernicus; dated 1595, the Petri book list[8] shows the 1566 *De revolutionibus* still to be in print, twenty-nine years after its republication in Basel (Plate XI). Since twenty-three years separate the Nuremberg and Basel editions, and since the editions were of virtually the same size, we can safely hypothesize that the second edition in 1566 was printed about the time the 1543 edition went out of print. I cannot help but remark that while forty other American libraries have the 1543 *De revolutionibus*, only Harvard has this ephemeral bookseller's catalogue; such a holding typifies the unique research material available in Cambridge through the continuous support of Harvard's many friends.

In presenting the catalogue of "Science in the Age of Copernicus," it is my pleasure to thank the efficient staff of Houghton Library, especially Professor William H. Bond, Sidney Ives, Carolyn Jakeman, Martha Shaw, and above all for his collaboration in arranging the exhibition, Roger E. Stoddard. In addition, I must gratefully acknowledge my own assistants: Joan Jordan, who unflinchingly carried

[8] Number 4 in the volume of book lists, *Librorvm tabernae et officinae Henricpetrinae, per Henricvm Petri, et Sebastianvm Henricpetri, fil. editorum, index, vsque in praesentem annum ⊂IↃIↃXCV* (Basel, 1595) (B4469.654.5*).

out the fastidious typing of the labels, and Barbara Welther, who worked in countless ways to assemble the exhibition.

Catalogue
(in chronological order)

1.

Claudius Ptolemy. *Cosmographia.* Ulm, 1486.

In addition to the books in his personal library, Copernicus used and sometimes annotated volumes owned by the Frombork (Frauenburg) Cathedral chapter. The Cathedral copy of this issue of the first woodcut atlas provided longitudes for towns needed in his astronomical work. The first edition of Ptolemy's *Cosmographia* with maps appeared in Bologna in 1466, two years after the first printing of the text. Like the rival Rome edition of 1478, its copper-plate charts were based on the manuscript of Dominus Nicolaus Germanus, a Benedictine monk from Saxony. Germanus himself supervised an enlarged and more accurate woodcut version in Ulm in 1482, which was reissued with slight changes in 1486 (Plate III). Harvard also owns a second copy of this handsome, hand-colored atlas, with a variant setting of the type (Typ Inc 2580.2).

Gift of A. Hamilton Rice, 1954. Inc 2580(A).

2.

Alfonso X. *Tabulae astronomiae.* Venice, 1492.

Copernicus obtained this second edition of the *Alfonsine Tables* while a student in Cracow, or so we may judge from the binding of his own well-thumbed and heavily annotated copy now preserved at Uppsala University. The tables enabled astronomers to predict the position of the sun, moon, and planets for any arbitrary time, but Copernicus used them to deduce the important parameters of the Ptolemaic theory. A copy of the first edition printed by Ratdolt, Venice, 1483, is also found at Harvard (Inc 4389).

Gift of Robert Wheeler Willson, 1927. Inc 5188.

3.

Johannes Regiomontanus. *Epytoma in Almagestum Ptolemei.* Venice, 1496.

This epitome by Regiomontanus and Peurbach is not merely an abridgment of Ptolemy's *Almagest*, for it adds new data and alternative mathematical constructions. Its printed appearance in 1496 gave a significant impetus to Copernicus' astronomical researches. The Polish astronomer may have obtained a copy during his graduate study in Italy. He used numerical data available only from this work, but his personal copy has not been located.

Gift of Philip Hofer, 1941. Typ Inc 5197.

4.

Giorgio Valla. *De expetendis et fugiendis rebus.* Aldus, Venice, 1501.

Valla's massive compendium "on things to be sought and to be avoided" is

the first encyclopedia both written and published after the introduction of movable type. Although the copy used by Copernicus is now unknown, the star list in his *De revolutionibus* derives in part from the twenty-three pages of star tables in the astrological section of this compilation.

Gift of William King Richardson, 1950. WKR 10.2.1.

5.

Gregor Reisch. *Margarita philosophica.* Freiburg, 1503.

It is quite likely that Copernicus knew this popular Renaissance encyclopedia, for it was widely reprinted in numerous editions. The contents followed the pattern of the trivium — logic, rhetoric, and grammar — and the quadrivium — astronomy, music, arithmetic, and geometry — and each section opened with an appropriate full-page woodblock (Plate IV). Harvard's first edition is bound in blind-stamped pigskin with the original metal clasps; it includes the rare foldout map of the world that shows America.

Gift of David P. Wheatland, 1972. Typ 520.03.736.

6.

Carolus Bovillus. *Liber de intellectu.* Paris, 1510.

According to Lynn Thorndike, these dozen tracts depict "relationships between angels and men, heavens and earth, the intellectual and physical worlds, or between almost anything and anything else." Erasmus considered it unreadable, but Copernicus annotated his copy of the 1511 issue.

Degrand Fund, 1921. MLb 1280.31*.

7.

John of Glogau. *Tractatus preclarissimus in judiciis astror[um].* Cracow, 1514.

This scarce tract on astrology is a posthumous publication of Copernicus' astronomy teacher at the University of Cracow. Harvard has a number of such early Cracow imprints, virtually unavailable elsewhere in America.

Gift of Philip Hofer, 1946. Typ 556.14.428.

8.

Georg Peurbach. *Tabulae eclypsium.* Vienna, 1514.

Peurbach founded the Vienna school for the reform of astronomy in the mid-fifteenth-century, but his eclipse tables were not published until 1514. Copernicus apparently had access to a manuscript copy, for he used numerical data from the tables in his earliest astronomical calculations.

Gift of Philip Hofer, 1939. Typ 522.14.683F.

9.

Claudius Ptolemy. *Almagestum.* Venice, 1515.

This beautifully printed Latin version made available for the first time Ptolemy's complete epicyclic theory and the observations on which it rested. Perhaps Copernicus at last realized, when he obtained his copy of this text,

how formidable a task awaited any astronomer who wished to promulgate a new and working cosmology.

Gift of Robert Wheeler Willson, 1927. Gp 120.22F*.

10.

Johannes Stoeffler. *Calendarium Romanum magnum.* Oppenheim, 1518.

At the Lateran Council (1512–17) Stoeffler was commissioned to revise the calendar, and this richly illustrated work resulted. It served as a model for the presentation of the Gregorian Calendar in 1582. Copernicus recorded his own eclipse observations in a copy now at the Uppsala University Observatory Library.

Gift of David P. Wheatland, 1969. *fGC5.St653.518c.

11.

Pietro d'Argellata. *Chirurgia Argelate cum Albucasi.* Venice, 1520.

Copernicus studied medicine for two years in Padua, from 1501 to 1503, without, however, completing a medical degree. (His doctorate from Ferrara was in canon law, based on his earlier studies at Bologna.) A 1499 edition of Argellata's surgery was one of the medical books in his library. The text consists of a series of lectures given at Bologna on Avicenna.

Gift of Harrison D. Horblit in memory of Mark M. Horblit, II, 1959.
*fIC.Ar367.480cf.

12.

Otto Brunfels. *Herbarum vivae eicones.* Strassburg, 1530.

This beautiful book, filled with woodcuts not only artistic but accurate, ushered in a new era of botanical illustration. Hans Weiditz, one of the best engravers of the age, cut the woodblocks of this first herbal true to nature. Though he recorded the plants with the precision of a draftsman, the artist in him always triumphed.

Arnold Arboretum Deposit.

13.

Johannes Regiomontanus. *De triangulis.* Petreius, Nuremberg, 1533.

When young Georg Joachim Rheticus journeyed from Germany to Poland to investigate for himself the new heliocentric cosmology, he brought along several new scientific books as gifts for Copernicus. Among them was the first edition of Regiomontanus' book on trigonometry. Regiomontanus had worked as an astronomer and as the first astronomical printer in Nuremberg in the 1470s, but he died before printing his work on triangles. The manuscript was rediscovered by the Nuremberg scholar Johann Schöner in the 1530s, and it was through his efforts that Johannes Petreius first added scientific titles to his catalogue. Copernicus apparently used this work to insert several new trigonometrical propositions into his *De revolutionibus.*

Sheldon Fund, 1945. *fGC.R2636.533d.

14.

Vitellionis mathematici doctissimi Περὶ Ὀπτικῆς. Petreius, Nuremberg, 1535.

Petreius printed this thirteenth-century text of Witelo's *Optics* at the height of his career, soon after he had added scientific titles to his production (Plate VIII). This is the second of three Petreius imprints that Rheticus presented to Copernicus in 1539. In 1975 Harvard acquired the third of these titles: Petrus Apianus' *Instrumentum primi mobilis* of 1534 (*fGC5.Ap34.534i).

Gift in memory of Professor and Mrs. A. L. Rotch, 1942.

*fGC5.T1586.535v.

15.

Johann Schöner. *Tabulae astronomicae.* Petreius, Nuremberg, 1536.

"Let others admire wooden doves and such automata," wrote the Lutheran theologian Philipp Melanchthon in the preface to this work. "Much more worthy of admiration are these tables, which show the positions of stars for many centuries." This is one of several astronomical works that the Nuremberg scholar Johann Schöner prepared for the printer Johannes Petreius.

Gift of Robert Wheeler Willson, 1927. *GC5.Sch634.536t.

16.

Giovanni Battista Amico. *De motibus corporum coelestium.* Venice, 1536.

Using the ancient idea of homocentric spheres, Amico sought to eliminate Ptolemaic equants and eccentrics that were seen by many as philosophically objectionable in an Aristotelian cosmology. His scheme of nested concentric circles failed to give satisfactory numerical answers. Harvard's copy of this rare tract was once owned by the bibliographer Pietro Riccardi, and subsequently by the astronomer and historian of astronomy J. L. E. Dreyer (Plate V).

Daniel Treadwell Bequest, 1931. Typ 525.36.139.

17.

Sebastian Münster. *Organum uranicum.* Basel, 1536.

Books with moving parts were introduced at the very inception of astronomical printing; they were first used by Regiomontanus himself in his 1474 *Kalendar*. In Johann Schöner's *Aequatorium astronomicum* (1521) the volvelles became an actual paper instrument. (Schöner's equatorium is so extremely rare that there is apparently no copy in America.) Münster's "celestial instrument" is one of several works that reflect the growing sophistication of astronomical printing in the early sixteenth century (Plate VI). Münster was both a designer of mathematical devices and a distinguished Hebraist.

Gift of David P. Wheatland, 1972. *fGC5.M8895.536o.

18.

Oronce Fine. *In proprium planetarum aequatorium.* Paris, 1538.

Fine's equatorium, like Münster's paper instruments, was designed for pre-

dicting the places of planets. The author was the outstanding French astronomer of the early 1500s. In the Harvard copy the pieces of the paper equatorium are uncut; these plates, dated 1526, are so rare that Fine's bibliographer, Emmanuel Poulle, knows of only one other set, at the Bibliothèque Sainte-Geneviève in Paris.

Degrand Fund, 1953. *FC5.F494.538i.

19.

Georg Joachim Rheticus. *Narratio prima.* Gdansk, 1540.

It is possible that Rheticus, a young Wittenberg mathematics professor, first heard about the unpublished heliocentric theory from Johann Schöner in Nuremberg. At any rate, soon after the 25-year-old Rheticus began his visit to the 67-year-old Copernicus, he dedicated this "first narrative" to Schöner. Our copy is bound with a collection of five other sixteenth-century works (Plate I), and on one of the pages a manuscript horoscope of Johann Schöner appears. The *Narratio prima* is so rare that, for example, no copies are recorded in the British Isles, and only one in all of France.

Gift of Harrison D. Horblit in memory of Mark M. Horblit, II, 1949. *GC5.C7906.540a.

20.

Leonhard Fuchs. *De historia stirpium.* Basel, 1542.

A medical professor at Tübingen, Fuchs described 400 German and 100 foreign plants and illustrated them from nature in 512 superb woodcuts. Handsome portraits of the two artists and the engraver appropriately conclude this magnificent volume. The work is one of the chief productions in the 1542/43 "annus mirabilis" of publishing.

Gift of William King Richardson, 1950. Typ 565.42.409F(A).

21.

Georg Peurbach. *Theoricae novae planetarum.* Wittenberg, 1542.

Erasmus Reinhold, professor of astronomy at Wittenberg, heard of Copernicus' work from his colleague Rheticus. Thus, in his commentary in this edition of Peurbach, he praises an unnamed astronomer from Prussia, "whose genius all posterity will rightly admire." Like many sixteenth-century astronomy texts, this edition includes illustrations with movable volvelles (Plate VII).

Gift of Robert Wheeler Willson, 1927. *GC.P4625.474tm.

22.

Nicolaus Copernicus. *De lateribus et angulis triangulorum.* Wittenberg, 1542.

The technical nature of *De revolutionibus* placed it beyond the capabilities of the printers in the university town of Wittenberg; nevertheless, Rheticus succeeded in issuing there the two mathematical chapters as a textbook. This is Copernicus' first printed scientific work (Plate IX). Like most of the ephemeral textbooks from this period, *De lateribus* is quite scarce. Other collections in America with copies include Williams College, Cornell University,

the Dibner Library at the Smithsonian in Washington, the Library of Congress, Duke University Medical School, Indiana University, R. B. Honeyman, and Roman Vishniac.

Gift of Harrison D. Horblit and the Friends of the Harvard College Library, 1974. *GC5.C7906.542d.

23, 24.

Nicolaus Copernicus. *De revolutionibus orbium coelestium libri VI.* Petreius, Nuremberg, 1543.

"In the center of all rests the sun. For who would place this lamp of a most beautiful temple in a better place?" asks Copernicus on the most famous page of his definitive work. Typographically, *De revolutionibus* is rather dull and compares unfavorably to the great illustrated masterpieces of Fuchs and Vesalius, but Copernicus' epoch-making work captures first place by the profound novelty of its views. Perhaps the most formidable astronomical treatise of the century, it earned admiration even from those who rejected its cosmology. Probably the edition comprised about 500 copies, of which nearly 250 have been traced today.

Gift of David P. Wheatland, 1972. *GC5.C7906.543d.
Gift of William King Richardson, 1950. WKR 13.3.5.

25.

Andreas Vesalius. *De humani corporis fabrica.* Basel, June 1543.

Vesalius' treatise, written in Padua and published when he was 29, marked the birth of modern anatomy. His *Fabrica* completely superseded Galen as Fuchs superseded Dioscorides and as Copernicus superseded Ptolemy. The splendid plates set new standards for book illustration, and were used and copied in other medical works for over two centuries.

Gift of Philip Hofer in memory of Sumner Mead Roberts, 1942.
Typ 565.43.868F.

26.

Francesco Maurolico. *Cosmographia.* Venice, 1543.

The Sicilian Maurolico was one of the outstanding mathematics teachers of the Renaissance. Written in the form of three dialogues, his *Cosmographia* was the first printed astronomical textbook on an advanced level.

Duplicate Fund, 1972. *IC5.M4474.543c.

27.

Johann Schöner (editor). *Scripta clarissimi mathematici Joannis Regiomontani.* Nuremberg, 1544.

For reasons unknown, by 1544 Schöner had left the editorial fold of Johannes Petreius, and he had these tracts published by Johannes Montanus and Ulrich Neuber. At first glance a rather miscellaneous assortment, this collection includes fundamental work documenting the first half-century of system-

atic observing in the European astronomical Renaissance. Copernicus must have had access to a manuscript copy of some of these data, for he used several observations of Mercury from this source in his *De revolutionibus*. This copy includes manuscript annotations in the hand of Michael Maestlin, the teacher of Kepler.

Gift of Robert Wheeler Willson, 1927. *GC.R2636.5445(A).

28.

Girolamo Cardano. *Ars magna*. Petreius, Nuremberg, 1545.

Petreius' offer to print any manuscript of Cardano (who was having trouble finding a publisher) brought fame to both parties. This algebraic treatise gives for the first time the solution of the cubic equation, the outstanding printed mathematical contribution of the century. In a special letter on the verso of the title page Cardano praises Andreas Osiander as a learned man "who understands not only Hebrew, Greek, and Latin but even mathematics," and he thanks him for seeing the book through the press. Osiander, the pastor of the St. Lorenz Kirche in Nuremberg and sometime assistant of Petreius, performed the same service for the *De revolutionibus*, but apparently on his own initiative also added an anonymous preface to Copernicus' work saying that the heliocentric system was only a hypothetical model.

Exhibition copy: lent by David P. Wheatland.

Harvard copy: Bowditch Fund, 1904. *IC5.C1782.545a.

29.

Walter Ryff. *Der furnembsten, notwendigsten, der gantzen Architectur*. Petreius, Nuremberg, 1547.

Late in his publishing career, when German-language texts dominated his output, Petreius produced Ryff's well-illustrated synopsis of Vitruvius.

Gift of Philip Hofer, 1941. Typ 520.47.761F.

30.

Robert Recorde. *The Castle of Knowledge*. London, 1556.

This vernacular treatise on the celestial sphere, including navigational instruments and tables, is cast in the form of a dialogue between a master and his student. In one famous exchange the master evades the question of the Copernican system by answering, "You are too young to be a good judge in so great a matter."

Gift of Philip Hofer, 1941. Typ 505.56.734.

31.

Georgius Agricola. *De re metallica libri XII*. Basel, 1556.

This spectacularly illustrated guide to mining and metallurgy was delayed six years by the preparation of the numerous woodcuts. Like the many other natural history works of Agricola, a scholar and physician, this first modern book on technology was based on direct observation.

Gift of Joseph T. Tower, Jr., 1931. *fGC5.Ag832.556d.

32.

Konrad Gesner. *Thierbuch. Vogelbuch. Fischbuch.* Zurich, 1557–1563.

Gesner's massive *Historiae animalium* is considered the starting point of modern zoology. Published in Zurich between 1551 and 1587, it consists of five large folio volumes containing 3,500 pages and over 1,000 illustrations. Although Harvard has the original Latin edition, this first vernacular abridgment was chosen for display.

Gift of Daniel B. Fearing, 1915. F 5405.58.6F*.

33.

William Cuningham. *The Cosmographical Glasse.* John Daye, London, 1559.

Although better printed and illustrated than Recorde's *Castle of Knowledge*, the contents of Cuningham's rival work are decidedly inferior. A comprehensive work on practical mathematics, his compilation from continental authors failed to point out even obvious errors. Recorde's volume retained its popularity, but the *Cosmographical Glasse* gradually lost favor and was forgotten. Although not an important book, its beauty and scarcity earned it a place in the exhibition.

Gift of Philip Hofer, 1975. *H505–3F.

34.

Jean Taisnier. *Opusculum perpetua memoria dignissimum, de natura magneti.* Cologne, 1562.

The increased use of the compass in navigation in the sixteenth century inspired a new interest in magnetism. Taisnier's speculations on the magnet gave Johannes Kepler his initial ideas of the nature of celestial forces. This copy is one of Harvard's early acquisitions.

Gift of Thomas Hollis, 1764–74. *FC5.M9425.559v.

35.

Nicolaus Copernicus. *De revolutionibus orbium coelestium libri VI.* Heinrich Petri, Basel, 1566.

Heinrich Petri of Basel was probably a relative of Johannes Petreius; in any event, he took over many of the same authors and titles after the Nuremberg press closed in 1550. Probably the Basel edition was printed soon after the 1543 printing had sold out; the two editions must have been almost identical in size because the same number of each printing survive. The second edition follows the first almost page by page, but also includes Rheticus' *Narratio prima.*

Exhibition copy: gift of David P. Wheatland, 1972.

Harvard copy: early acquisition, date unknown. *GC5.C7906.543db.

36.

Euclid. *The Elements of Geometry.* John Daye, London, 1570.

John Dee's eloquent preface to this work, the first Euclid in English, was designed "to stir the imagination mathematical." The preface established Dee's

intellectual leadership among English mathematicians for three generations or more. This book is notable for the small paste-on constructions that permit solid geometry to be displayed in three dimensions.

Exhibition copy: lent by the American Association of Variable Star Observers.

Harvard copy: gift of Morton Pepper in memory of his wife, C. Doris Hellman, 1975. fSTC 10560.

37.

Erasmus Reinhold. *Prutenicae tabulae coelestium motuum.* Wittenberg, 1585.

These handy tables for the prediction of planetary positions helped spread Copernicus' reputation even though they contained no hint of the heliocentric cosmology. Prepared by the astronomy professor at Wittenberg, and colleague of Rheticus, the Prutenic Tables were reprinted several times after the original 1551 edition.

Gift of C. T. Metzdorf, 1877. *GC5.Sch634.536tca.

38.

Giordano Bruno. *La cena de le ceneri.* [London], 1584.

The "Ash Wednesday Supper," one of six Italian dialogues written by Bruno in London, is an elaborate metaphor based in part on the Copernican system. In veiled terms he proposes a religiously liberal alliance between England and France. En route he gives a qualified acceptance of the Copernican system and postulates an infinity of worlds (see Plate X). The only other copy of this book listed by the National Union Catalogue is at the University of Southern California.

Gift of Harrison D. Horblit in memory of Mark M. Horblit, II, 1950. STC 3935.

39.

Giordano Bruno. *De l'infinito universo et mondi.* [London], 1584.

In this Italian dialogue on the plurality of worlds, one of his greatest metaphysical works, Bruno employs pre-Socratic teachings in an attack on Aristotle. Despite a false Venetian imprint, the work was published in London during his brief stay there. The only other copy of this book listed in the National Union Catalogue is at the Yale Historical Medical Library.

Gift of Henry S. Grew, 1950. STC 3938.

40.

Simon Stevin. *De Beghinselen der Weeghconst, De Weeghdaet, De Beghinselen des Waterwichts.* Leiden, 1586.

The leading sixteenth-century work on mechanics, Stevin's triplet of Dutch treatises contains the first theoretical treatment of statics since Archimedes. This copy was bound for presentation to the city of Nuremberg.

Gift of David P. Wheatland, 1972. *NC6.St485.B586b.

41.

Tycho Brahe. *De mundi aetherei recentioribus phaenomenis.* Uraniborg, 1588.

The foremost observational astronomer of the sixteenth century rejected the Copernican system in favor of his own geocentric scheme in which the sun revolved about the earth, carrying the other planets around it. This major treatise on the Comet of 1577 displays for the first time Tycho's geocentric system. One of the rarer items in the exhibition, the volume was printed at Tycho's own press at Uraniborg.

Gift of Mrs. E. D. Brandegee, 1908. *QDC5.B7308.588da.

42.

Giovanni Antonio Magini. *Novae coelestium orbium theoricae congruentes cum observationibus N. Copernici.* Venice, 1589.

In 1588 Magini won a coveted professorship at Bologna over competitors including Galileo. Although he adopted Copernicus' observations in this treatise, the work is thoroughly geocentric. Such an attitude typified much of the reception of Copernicus' work in the sixteenth century.

Keller Fund, 1972. *IC5.M2724.589n.

43.

Leonard Digges. *A Prognostication Everlasting.* Thomas Digges. *A Perfit Description of the Coelestiall Orbes.* London, 1596.

Thomas Digges's "perfect description" was an English translation of the cosmological parts of *De revolutionibus*, the only part of Copernicus' treatise published in the vernacular before the nineteenth century. The work contains a famous diagram of the Copernican system that shows the fixed stars spread out toward infinity and no longer constrained to a thin shell (see Plate XII). The 1576 edition of Digges's diagram was the second pictorial publication of the heliocentric theory after Copernicus; the first was Valentine Naibod's *Primarum de coelo et terra institutionum quotidianarumque mundi revolutionum* (Venice, 1573).

Gift of William A. White, 1939. STC 6869.

44.

Johannes Kepler. *Mysterium cosmographicum.* Tübingen, 1597.

Kepler's initial opus was the first treatise enthusiastically endorsing the heliocentric view after that of Copernicus himself. He conjectured that the spacing of the planets was determined by a nesting of spheres and regular solids, a notion that required a sun-centered universe. Kepler's success in finding the mathematical planetary relations paved the way for Newton's work.

Gift of Curt A. Reisinger, 1953. *GC6.K4436.596p.

CONTRIBUTORS TO THIS ISSUE

Dr. Ralph Colp, Jr., Attending Psychiatrist, Columbia University Health Service, and Instructor in Clinical Psychiatry at Columbia, is the author of numerous articles and of *To Be an Invalid: The Illness of Charles Darwin*, which was published by the University of Chicago Press in 1977.

Carney E. S. Gavin is Curator of Near Eastern Art and Archaeology in the Semitic Museum at Harvard, Coordinator of Project Whence in the Semitic Museum, Assistant Chaplain of the Harvard Radcliffe Catholic Student Center, and Assistant Pastor of St. Columbkille's Parish in Brighton, Massachusetts. He was ordained a priest in 1965 and earned his doctorate at Harvard in 1973 with a dissertation entitled "The Glyptic Art of Syria-Palestine." He has also been a student at Boston College, Oxford, and Innsbruck, and has participated in field excavations in Austria, Cyprus, Germany, Great Britain, Jordan, and Tunisia.

Owen Gingerich, Professor of Astronomy and of the History of Science at Harvard, contributed "Rara Astronomica" to the April 1971 Harvard Library Bulletin; volumes he has edited include *Frontiers in Astronomy* (1970) and *The Nature of Scientific Discovery* (1975).

Howard Mumford Jones, Abbott Lawrence Lowell Professor of the Humanities, *Emeritus*, at Harvard, has written many books in addition to those mentioned in the chapter of his autobiography that appears in this issue; he has also taught at many universities besides Harvard — at Chicago, Hebrew University in Jerusalem, Michigan, Montana, North Carolina, and Texas.

Leo M. Kaiser, Professor of Classical Studies at Loyola University of Chicago, has contributed editions of Harvard Latin orations to three previous issues of the Harvard Library Bulletin, January 1973, July 1974, and October 1976, as well as to several other periodicals.

Charles Edwards O'Neill, S.J., earned his doctorate at the Pontificia Università Gregoriana in Rome; he is now Director of the Institutum Historicum S.I. (Jesuit Historical Institute) in Rome (on leave from his position as Professor of History at Loyola University, New Orleans). In addition to many contributions to journals, he has written *Church and State in French Colonial Louisiana: Policy and Politics to 1732*, published by the Yale University Press in 1966.