Rara astronomica

Rara Astronomica

Owen Gingerich

HOUGHTON Library, the rare book library of Harvard University, contains many marvelous treasures, not the least of which is the collection in the history of science. Harvard's superb holdings in astronomy were demonstrated by the exhibition "Rara Astronomica," on display in Houghton from January to April 1970. Fifty-six printed items, ranging from a Chinese woodblock book of 1461 to Laplace's *Systême du Monde* of 1796, were complemented by eight manuscripts, four instruments, and a medal. A catalogue of these items will be presented here, but I shall begin by explaining how these books came to Harvard, and how they were chosen for the exhibition.

In a college library old enough to have been contemporary with Galileo and Newton, one might expect to find early purchases or donations of their works. Actually, the earliest acquisitions exhibited, Kepler's *Mysterium Cosmographicum* (1621) and his teacher Maestlin's *Epitome Astronomiae* (1624), came to Harvard as recently as 1830 and 1831 respectively. If one observes when the items shown in the exhibition came to Harvard, the striking fact emerges that almost half of them have been obtained since Houghton Library was opened in 1942.

Nevertheless, Harvard did acquire astronomy books in the seventeenth and eighteenth centuries. The *Catalogus Librorum Bibliothecae Collegii Harvardini* of 1723 lists about fifty astronomy titles, among them Tycho's *Astronomiae Instauratae Progymnasmata* (1610), Kepler's *Tabulae Rudolphinae* (1627), Riccioli's *Almagestum Novum* (1651), Huygens' *Systema Saturnium* (1659), Tycho's *Historia Coelestis* (1666), and Hevelius' *Selenographia* (1678). Alas! These perished in the Great Fire of 1764, and the copies exhibited were later replacements. Yet even if these six had survived, they would have constituted only a minor portion of the display. In 1735 there were only three sixteenth-century astronomical works in the Harvard library, and not a single scientific incunable.[1] The "Rara Astronomica" showed twenty-seven books, tracts, or manuscripts dating before 1600, the great majority having come to Harvard in the twentieth century.

The printed library catalogue of 1790 lists fewer than sixty astronomy titles, including the only four astronomy books known to have escaped the flames in 1764: Hevelius' *Cometographia* (1668) and the Lubienietz *Theatrum Cometicum* (1666), both charged out to the astronomer John Winthrop; and Gregory's *Astronomiae, Physicae et Geometriae Elementa* (1702) and Streete's *Astronomia Carolina* (1710, 2nd ed.), charged out to a recent graduate, Christopher Bridge Marsh.[2] No copy of Newton's *Principia* was listed in the 1723 catalogue or its supplements, but after the fire, in 1768, Thomas Hollis sent a copy of the third edition. It was apparently not until 1969 — just in time for "Rara Astronomica" — that Harvard finally acquired a first edition *Principia*.

In the nineteenth century, the College's holdings in astronomy and mathematics were notably expanded when George Phillips Bond, the second director of the observatory, bought virtually the entire library of the mathematician Karl Gustav Jacob Jacobi (1804–1851). Bond learned of this collection while abroad in 1851, and with money from the Haven Fund bought the 900 of the 998 items still unsold from an A. Asher catalogue.[3] That Bond was an astute and informed bookbuyer is shown by a manuscript note in his copy of the sale catalogue, where he has remarked on a Paris price of 252 gold francs for a German serial offered from the Jacobi library at 80 gold francs: "The prices asked for Books of this kind in Paris are much higher than in London at the 2nd hand Book Stores. In London they do not seem to know their value."

Among the valued works acquired by Bond from the Jacobi sale,

[1] Based on an examination of *Catalogus Librorum Bibliothecae Collegii Harvardini Quod est Cantabrigiae in Nova Anglia*, Boston, 1723; *Continuatio Supplementi*, Boston, 1725; *Continuatio Catalogi Librorum Bibliothecae Collegii Harvardini Ab Anno 1725 Ad Annum 1735*, Boston, 1735.

[2] Lists of books saved from the fire are found in the Harvard University Archives, UA III 50.27.64.

[3] *Viri Doctissimi Clarissimi Nuper Defuncti Caroli Gustavi Jacobi Jacobii Professoris, P. O. Omnium Academiarum Sodalis Catalogus Librorum qui Pretiis Appositis Venduntur ab A. Asher & Co.*, Berlin, Paris, London, 1851. Bond's copy is in the Harvard University Archives. See also Dorrit Hoffleit, "The Library of the Harvard College Observatory," HARVARD LIBRARY BULLETIN, V (1951), 102–111. The Observatory "Treasure Room" collection mentioned in her article is now in Houghton Library.

three were shown in the "Rara Astronomica": Stoeffler's *Calendarium Romanum Magnum* (1518), Kepler's *De Stella Nova* (1606), and Lambert's *Cosmologische Briefe* (1761). Altogether Bond bought six Kepler items, helping Harvard on its way to establishing the largest collection of Kepler in the western hemisphere.

Nevertheless, the backbone of Harvard's collection of rare astronomical books was formed only in 1927, by the gift of 127 volumes from the library of Robert Wheeler Willson. Born in 1853, Willson was one of the youngest members of the Harvard class of 1873. He was early fascinated by astronomy, and upon graduation accepted a year's appointment as assistant to Benjamin A. Gould at the Argentine National Observatory. Perhaps Willson acquired part of his taste for old books from Gould, who formed the rich collection of rare astronomical treatises now at the Dudley Observatory in Albany, New York.

After his South American sojourn, Willson held appointments as tutor in physics at Harvard and as assistant astronomer at Yale. Then he went to Würzberg, where he received a Ph.D. *magna cum laude* in 1886. He returned to a series of posts at Harvard, culminating in a full professorship in astronomy in 1903. Professor Willson was a pioneer in developing apparatus and methods for the teaching of astronomy but, unhappily, his efforts were always quite separate from those at Harvard College Observatory, where Professor E. C. Pickering maintained an impenetrable aloofness from the problems of astronomy education in the College.

Apart from the books themselves, there is little record of Willson's book-collecting habits. The official Harvard minute on the life and services of Robert Wheeler Willson passes over this aspect in a single sentence; a slightly expanded version reads

> Professor Willson was much interested in the early history of Astronomy and its allied subjects, read Latin with comparative ease, and found pleasant relaxation in the collecting of rare volumes, early printings, and autographed copies of the masterpieces of science. He prized especially highly a presentation copy of Galileo's *Dialogues*, published in 1632, inscribed presumably in the handwriting of its author.[4]

Unfortunately, no list was kept of the 127 books given in 1927 by Willson's widow, but his bookplate clearly identifies the volumes. The books themselves stand in mute testimony to a remarkably knowl-

[4] H. T. Stetson, "Robert Wheeler Willson," *Popular Astronomy*, XXXI (1923), 308–313.

edgeable and thorough collector. Willson bought not only the well-known classics, such as those by Galileo and Kepler, but also the lesser and often rarer works required for a research collection. Examples of the latter are the earliest works on sunspots, published anonymously by Christopher Scheiner (the exhibition showed only the *De Maculis Solaribus* of 1612 but the collection also includes the slightly earlier, rarer, but less showy *Tres Epistolæ de Maculis Solaribus*).

Willson copies were shown in nine of the ten major display cases of the "Rara Astronomica"; they ranged from a 1478 *Sphere of Sacrobosco* to Thomas Wright's *Original Theory or New Hypothesis of the Universe* (1750). The six titles exhibited that had gone up in smoke in 1764 were all from the Willson library. Altogether, seventeen Willson books made up a quarter of the exhibition. Another quarter came from two other benefactors, Philip Hofer and David Wheatland.

Philip Hofer began collecting fine printing even before he entered Harvard with the class of 1921. By the late 1920's he had determined to build a comprehensive collection that would illustrate the arts of the book from earliest times to the present. In 1938, after serving in the New York Public and the J. P. Morgan Libraries, he returned to Harvard to establish the Department of Printing and Graphic Arts, built around his own magnificent collection of more than ten thousand books and manuscripts. William A. Jackson has described Mr. Hofer's collection in *The Book Collector*.[6]

Among the natural sciences, astronomy ranks with botany, zoology, and medicine as an inviting subject for artists and illustrators. Constellation figures were printed as early as 1482 in the Hyginus *Poeticon Astronomicon*, and the particularly fine Hofer copy was once owned by a noted Renaissance humanist (Plate I). Depicting the constellations reached an apex in Bayer's *Uranometria* of 1603, and the Hofer copy is in a splendid Anthon Fugger binding. One of the best and most innovative fifteenth-century printers, Erhard Ratdolt, specialized in mathematics and astronomy; his 1485 *Sphere of Sacrobosco*, the first book to contain printed multi-colored diagrams, was another of the eleven Hofer items shown. The *pièce de résistance* of the entire display, the Petrus Apianus *Astronomicum Caesareum* (1540), which has

[6] William A. Jackson, "Contemporary Collectors XXIV: Philip Hofer," *The Book Collector*, IX (1960), 151–164, 292–300.

perfect sets of the elaborate movable volvelles, was also Mr. Hofer's gift.

Six items in the exhibition, ranging from a precious fourteenth-century manuscript of Chaucer's *Treatise on the Astrolabe* to a pair of eighteenth-century English broadsides on eclipses (Plate XI), were given by David P. Wheatland, '22. Mr. Wheatland's interest in collecting was kindled by Professor George Parker Winship's course in the history of the printed book. With prize money won, as he puts it, "for showing the most enthusiasm in the course," he bought his first rare science book, Boyle's *New Experiments Physico-Mechanicall* (1660). Thinking that early books on electricity might fill a shelf, he set out to form a collection that has grown to thousands of volumes.

During many years of service in the Harvard Physics Laboratories, Mr. Wheatland kept an eagle eye out for historic scientific equipment at the University; in 1950 he became founder and curator of Harvard's Collection of Historical Scientific Instruments. Not only has he conserved Harvard's antique scientific apparatus dating back to Revolutionary War times, but previously he began forming his own collection of instruments. Mr. Wheatland's interest in electricity books led him to early apparatus, especially to magnetic devices and compasses; the compasses in turn led to sundials, and these led him to form a major collection on dialing. This group of over six hundred items was given to Houghton Library in 1968 and 1969. It included one of the rarest printed items in the show, the German *Kalendar* of 1474, unique in America.

While collecting books on electricity, Mr. Wheatland also acquired classics of science by such authors as Copernicus, Kepler, Napier, and Newton, and he has presented a number of these to Houghton Library. His gift of the first edition of Newton's *Principia* (1687) a few weeks before the opening of "Rara Astronomica" filled at a propitious moment the most conspicuous gap in Harvard's history of science collections.

Another notable donor to Harvard's history of science resources is Harrison D. Horblit, '33, who has given a remarkable series of rarities in memory of Mark M. Horblit, II. Two especially precious representatives were shown, the extraordinarily scarce Rheticus *Narratio Prima* (1540) (Plate II) and the *Disputationes contra Cremonensia* printed by Regiomontanus in 1474.

A host of other benefactors is acknowledged in the catalogue.

Among the few endowed funds regularly available for science books is the Peter Paul Francis Degrand (1787–1855) Fund "for French works and periodicals on the exact sciences and on chemistry, astronomy and other sciences applied to the arts and to navigation." Descartes' *Principia Philosophiae* (1644) was one of several Degrand books displayed.

The selection of some sixty books and manuscripts to represent both the great moments of astronomy and the science treasures of the Houghton Library was a challenge simultaneously rewarding and frustrating. There was no dearth of material. With only one exception, the eleven astronomical works listed in Horblit's *One Hundred Books Famous in Science* (1964) were available. It was not these volumes that posed any difficulty but, rather, the choice of additional material to supplement and support these landmarks.

The publications of Galileo, Kepler, and other giants of astronomy were easily located and examined — but it would have taken more insight than any of us possessed before the show to know that the beautiful plates in Horrebow's *Basis Astronomiae* (1735), Marinoni's *De Astronomica Specula* (1745) or Bianchini's *Hesperi et Phosphori Nova Phaenomena* (1728) might have gone well beside Tycho's *Astronomiae Instauratae Mechanica* (1598). Similarly, it was not until after the exhibition closed that we discovered the stunning engraved *Sphaera Stellifera* of Willem Blaeu, nine possibly unique proof gores for a celestial globe.

One frustration in arranging the exhibition was coping with more first-class items than we could possibly show. Volumes by Johannes Hevelius, replete with his own splendid engravings, would have filled more than two cases; we compromised by selecting only the *Uranographia* (1687) and the *Selenographia* (1647), sadly leaving behind in the stacks all the rest, including the handsomely illustrated *Machinae Coelestis* (1673). Or consider the publications of Johannes Kepler: Harvard has twenty-six Keplers printed before 1635, more than any other library in the country. They include two items unique in America. Five books, plus a loose leaf from a sixth, survived the competition for exhibition space.

Throughout the exhibit it was necessary to balance sizes, textures, and visual appeal within the limitations imposed by the cases. Copernicus' *De Revolutionibus* (1543), for example, is intellectually exciting but visually dull, and Tycho's *De Mundi Aetherei* (1588), though much rarer, is scarcely more stimulating to the eye. Our solution? We placed them alongside the flamboyant frontispiece of Riccioli's *Almagestum Novum* (1651), which depicts these two great world systems hung in a balance (Plate X). We thereby produced a display that cannot be duplicated by any other library in this hemisphere (and we clinched that by adding the Rheticus *Narratio Prima*, one of only four copies we know about in America).

Locating manuscript material required far more imagination than the printed books. No subject classifications are available, so the exhibits had to be sought by author. Who would have guessed that Houghton houses a royal presentation manuscript by Oronce Finé, the leading French astronomer of the sixteenth century? Or one of a half-dozen Galileo letters in the United States? Knowledgeable and helpful librarians were indispensable, and lucky hunches at the card catalogue turned up more material. This included two documents of William Herschel representing a collection that promises to be the best outside England.

Another tricky category contains the broadsides — rare ephemera often of great interest. If printed anonymously, they are devilishly difficult to locate, but the name of Halley did lead us to a splendid cache of fifteen English broadsides on the total eclipses of 1715 and 1724 (Plate XI), once owned by the noted English collector Narcissus Luttrell. Our search also uncovered a Tycho Brahe broadside, *Calendarium Naturale Magicum Perpetuum* (1582), so exquisitely rare that it was even overlooked in Dreyer's *Tychonis Brahe Opera Omnia*. Perhaps in the future some clever exhibitor will find a way to cope with its 120 x 58-centimeter size.

Happily, many people pointed out things we might have missed. Nathan Sivin searched the Harvard-Yenching Library for an appropriate oriental work, finding the Pao Yun-lung woodblock book of 1461. Roderick and Margaret Webster alerted me to the Houghton astrolable (Plate V), and inadvertently set me onto the 1482 Hyginus. William H. Bond, Librarian of Houghton, brought forth the Finé manuscript at just the right moment (Plate VI).

"Rara Astronomica" could not have been staged without the unceasing efforts and critical eye of Roger Stoddard, Associate Librarian of Houghton, who served as joint organizer from its inception to its realization. The staff of Houghton Library was unfailingly cooperative at every stage. The registrar's office and the conservation department of the Fogg Art Museum gave further help. My assistant, Miss Barbara Welther, deserves special thanks for work which included typing the sixty-nine captions for the exhibit.

CATALOGUE

Books, Tracts, and Broadsides
(approximately in chronological order)

1.

Pao Yun-lung. *T'ien yuan fa wei.* China, 1461.

This is the second woodblock edition of a Neo-Confucian handbook of cosmology, "Principles of the Cosmos: Elucidation of Subtleties," first printed in 1297. Pao Yun-lung (1226–1296) was an expert in the "Book of Changes," and applied certain elements of its structure to the arrangement of this book. The work includes rudimentary star charts of the "lunar mansions" as well as a diagram of the "nine roads" of the moon.

Harvard-Yenching Library, 1932.

2.

Johannes Regiomontanus. *Disputationes contra Cremonensia Deliramenta.* Nuremberg, 1474.

The advent of printing provided a powerful force for the reform of astronomy, and no fifteenth-century figure exploited its possibilities more effectively than Johannes Regiomontanus, the first scientific publisher. As a student of the Viennese astronomer Peurbach, he studied Ptolemy's *Almagest*, a work then only imperfectly understood. This dialogue between "Viennensis" and "Cracoviensis," written and printed by Regiomontanus, is a severe critique of the commentary on Ptolemy attributed to Gerhard of Cremona, illustrating the new sophistication of Peurbach's school.

Gift of Harrison D. Horblit in memory of Mark M. Horblit, II, 1948.

3.

Johannes Regiomontanus. *Kalendar.* Nuremberg, 1474.

Regiomontanus printed his first almanac both in German and Latin. Like other such ephemera, the German calendar is quite rare, and our copy is unique in America. The calendar is one of nine titles printed by Regiomontanus during his comparatively short stay in Nuremberg. A facsimile, with commentary by Ernst Zinner, was issued in Leipzig in 1937 as a *Veröffentlichungen der Gesellschaft für Typenkunde des XV Jahrhunderts.*

Gift of David P. Wheatland, 1969.

4.

Johannes de Sacrobosco. *Sphaera Mundi.* Venice, 1478.

Sacrobosco's Sphere went through numerous editions in the fifteenth and early sixteenth centuries, making it the most widely printed astronomy textbook of all time. In this, the first illustrated edition, it is joined with the *Theorica Planetarum* attributed to Gerhard of Cremona, but later editions generally included treatises of Peurbach and Regiomontanus instead.

Gift of Robert Wheeler Willson, 1927.

5.

Caius Julius Hyginus. *Poeticon Astronomicon.* Ratdolt, Venice, 1482.

This elementary treatise on astronomy and stellar myths draws chiefly on Eratosthenes; popular in the Renaissance, it is probably falsely attributed to Hyginus. This copy was originally owned by Hieronymus Monetarius, a Nuremberg physician and humanist. It was printed by Erhard Ratdolt, an innovative German printer working in Venice, who specialized in scientific works; this 1482 edition contains some of the earliest printed constellation figures. (Plate I).

Gift of Philip Hofer, 1942.

6.

Johannes Regiomontanus. *Calendarium.* Ratdolt, Venice, 1482.

The format of this fifteenth-century calendar follows those printed by Regiomontanus himself and established even earlier in manuscript versions. Positions for the sun, moon, and ascendants for any day in 1475 through 1532 can be determined from this "universal" annual calendar. Included also are diagrams of forty-eight eclipses for 1483 to 1530, not very accurately predicted.

Gift of Philip Hofer, 1941.

7.

Johannes Regiomontanus. *Ephemerides 1484–1506.* Ratdolt, Venice, 1484.

Between 1476 and 1484 Erhard Ratdolt repeatedly reissued this pioneering set of daily planetary positions calculated by Regiomontanus. The leading fifteenth-century ephemeris, it was used by Magellan on his round-the-world voyage. This is one of seven copies of these editions recorded in the Americas.

Gift of Robert Wheeler Willson, 1927.

8.

Johannes de Sacrobosco. *Sphaera Opuscula.* Ratdolt, Venice, 1485.

In 1485 Ratdolt printed the first multi-color illustrations in Puerbach's *Theoricae Novae Planetarum*, which was included in this edition. (See Walter Gräff's "Älteste Deutsche Farbenholzschnitte," *Zeitschrift für Bücherfreunde*, Neue Folge, I: x, 335–340, Jan. 1910.) Joined with this is also the *Disputationes contra Cremonensia* of Regiomontanus.

Gift of Philip Hofer, 1942.

9.

Johannes Regiomontanus. *Epytoma in almagestū ptolemei.* Venice, 1496.

The monumental "Mathematical Composition" of Ptolemy made its first and only printed appearance in the fifteenth century in this posthumously published abridgement by Regiomontanus and Peurbach. A far more substantive work than the often reprinted Sphere of Sacrobosco, Ptolemy's *Almagest* expounded the epicyclic theory of the sun, moon, and planets that still served as the basis for predicting planetary positions.

Gift of Philip Hofer, 1941.

10.

Claudius Ptolemy. *Almagestum.* Venice, 1515.

Although several editions of Ptolemy's *Geography* had appeared in the fifteenth century, the first complete *Almagest* was not printed until 1515. A corrupt translation from the Arabic by Gerhard of Cremona, this beautifully printed Latin version nevertheless made available Ptolemy's tables of chords, of stars, and of planetary motions as well as the epicyclic theory and the observations on which it rested. A more satisfactory translation from the Greek by Georg von Trapezunt was printed in Venice in 1528, and the Greek text itself was published in Basel in 1538; Harvard has both those editions.

Gift of Robert Wheeler Willson, 1927.

11.

Johannes Stoeffler. *Elucidatio Fabricae Ususque Astrolabii.* Oppenheim, 1513.

Handsomely illustrated and with detailed instructions both for the construction and use of an astrolabe, this early work set the standards and provided material for a host of imitators. Besides this first edition, Harvard has the printings of 1524 (Oppenheim), 1570 (Paris), and 1585 (Paris). Stoeffler, professor of mathematics at Tübingen, also achieved fame for calculating fifty years of ephemerides; he was the teacher of Sebastian Münster, Johann Schöner, and Georg Rheticus.

Gift of Philip Hofer, 1939.

12.

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. This copy, once in the library of the mathematician Jacobi, was purchased for Harvard by George Phillips Bond, second director of the observatory.

Haven Fund, 1851.

13.

Alessandro Piccolomini. *De le Stelle Fisse.* Venice, 1540.

Piccolomini, a resident of Siena and an archbishop, was an early popularizer of science. Most memorable of his efforts is this set of forty-eight xylographic star charts. This is the first of a dozen editions printed from the same woodblocks during the sixteenth century.

Gift of Robert Wheeler Willson, 1927.

14.

Petrus Apianus. *Astronomicum Caesareum.* Ingolstadt, 1540.

Dedicated to Charles V, this magnificently illustrated volume depicts the epicyclic theory of the solar system, eclipses, and planetary conjunctions. Twenty-one plates contain moving colored disks, or volvelles, some with as many as eight layers. At the end are found the first diagrams demonstrating that comets' tails point away from the sun. Harvard owns two of the ten copies we know about in the United States.

Gift of Philip Hofer, 1941.

15.

Georg Joachim Rheticus. *Narratio Prima.* Danzig, 1540.

In 1540 the 25-year-old Rheticus visited the 67-year-old Copernicus to learn about the unpublished heliocentric theory; this "First Narrative" resulted. Our copy is bound with a collection of five other sixteenth-century works; included is a manuscript horoscope of Johann Schöner, to whom the *Narratio Prima* is addressed (Plate II). It is tempting to speculate that most of this collection may once have belonged to Schöner himself, although the 1589 date stamped on the binding comes after his death. Another copy in a very similar blind-tooled white pigskin binding with clasps, with nine other tracts different from those in our volume, is owned by the Burndy Library in Norwalk, Connecticut. This has been described by Bern Dibner in a facsimile published by Otto Zeller, Osnabrück, 1965. The provenance of the Yale copy is unknown. A fourth copy in the United States was once owned by William Marshall Bullitt of Louisville, Kentucky, but where his collection of mathematical books went after his death in 1957 is unknown to us.

Gift of Harrison Horblit in memory of Mark M. Horblit, II, 1949.

16.

Nicolaus Copernicus. *De Revolutionibus Orbium Coelestium Libri VI.* 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. The cornerstone of modern astronomy, "On the Revolutions of the Heavenly Spheres" effectively challenged ancient authority and ultimately destroyed the homocentric view of the universe. Although almanac makers quickly adopted the Copernican tables, the system did not gain widespread support until it was publicized by Galileo and Kepler in the following century.

Gift of William King Richardson, 1950.

17.

Johannes Regiomontanus. Scripta Clarissima Mathematici. Nuremberg, 1544.

At first glance merely a collection of miscellaneous tracts by Regiomontanus, Peurbach, and Schöner, this fundamental work documents the first half-century of systematic observing in the European astronomical renaissance. (Plate III) Copernicus must have had access to a manuscript copy of these data, for he used the observations in his *De Revolutionibus*. A second, very heavily annotated copy of this work also came to Harvard from the Willson Library.

Gift of Robert Wheeler Willson, 1927.

18.

Georg Busch. *Von dem Cometen/Welcher in diesem 1572. Jar/in dem Monat Novembris erschinen.* [Augsburg, 1573.] [6]

The remarkable event described in this tract, although called a "comet" (in common with other transitory phenomena then believed to be atmospheric), was actually a distant, brilliant supernova. Its outburst fired the imagination of sixteenth-century astronomers, and its analysis by Tycho Brahe provided a strong influence for astronomical reform.

Observatory Purchase, 1861.

19, 20, 21.

Andreas Nolthius. *Observatio, und Beschreibung des Cometen/welcher im Novembri und Decembri/des 77. und noch im Januario/dieses 78. Jharsz erschienen.* [Erfurt, 1578].[7]

Paul Fabricius. *Judicium de Cometa, qui anno Domini M.D. LXXVII. A 10. Die Novemb: usque ad 22. Diem Decemb: Viennae conspectus est.* Vienna, [1578].

Mario Vergeri. *Nuovo Guidicio sopra la Meravigliosa Cometa veduta in Mantova alli 13. di Novembre MDLXXVII.* Mantua, 1578.

The writer of each of these rare tracts describes the great comet that appeared in November 1577. The tract of Nolthius is particularly notable because Tycho Brahe mentions those observations in his *De Mundi Aetherei Recentioribus Phaenomenis*. The Harvard collection includes a dozen other sixteenth- and seventeenth-century comet tracts, including another on the comet of 1577, by Cornelius Gemma. See the forthcoming revised edition of Doris Hellman's *The Great Comet of 1577*.

Observatory Purchase, 1861.

22.

Tycho Brahe. *De Mundi Aetherei Recentioribus Phaenomenis.* Uraniborg, 1588.

This major treatise on comets displays for the first time Tycho's geocentric system in which the sun revolves about the earth, carrying the other planets around it. The illustrious Danish astronomer shows that if crystalline spheres had really existed, they would have been smashed by the Comet of 1577. This

[6] Diagonal slashes transcribed from title page.

[7] Diagonal slashes transcribed from title page.

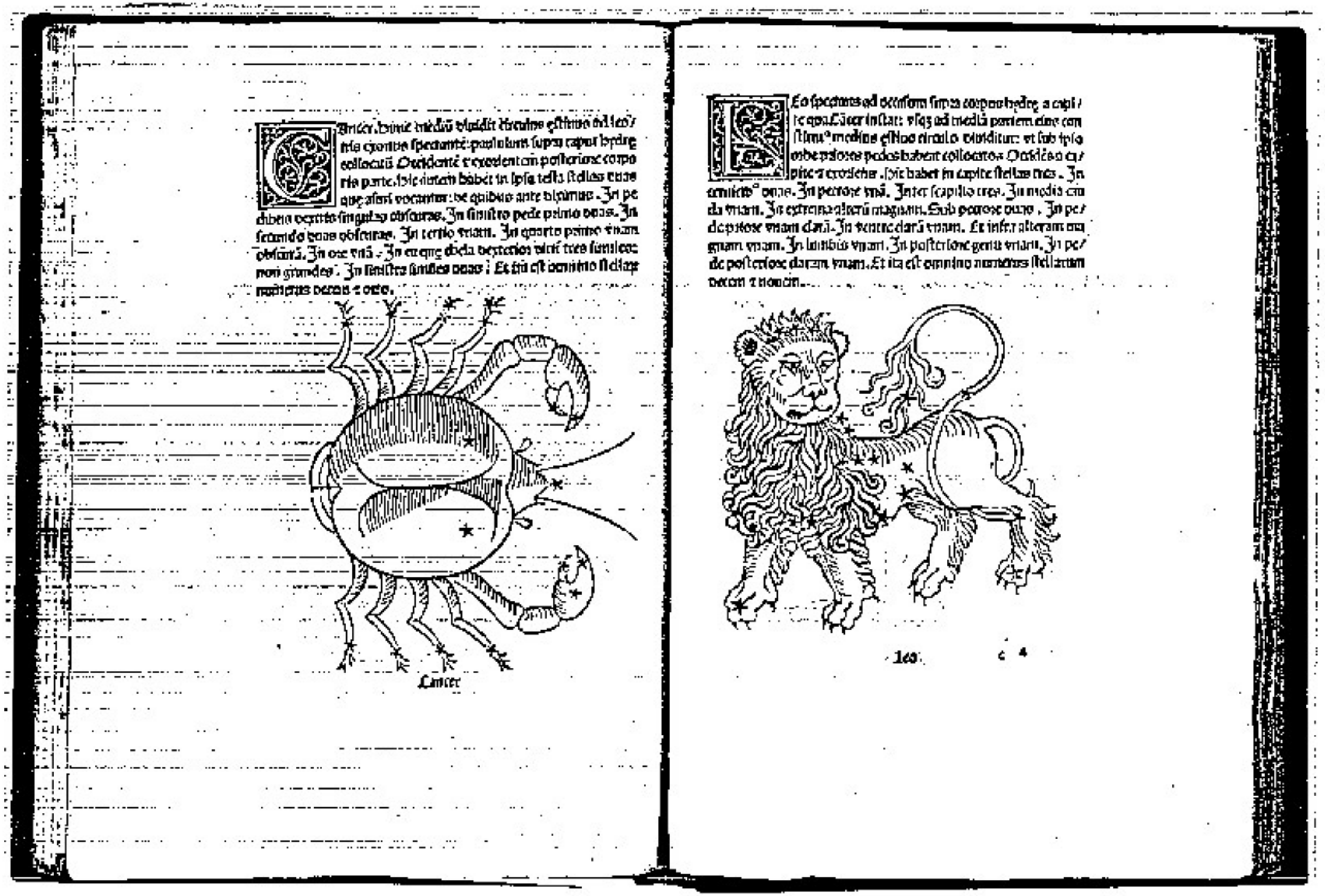
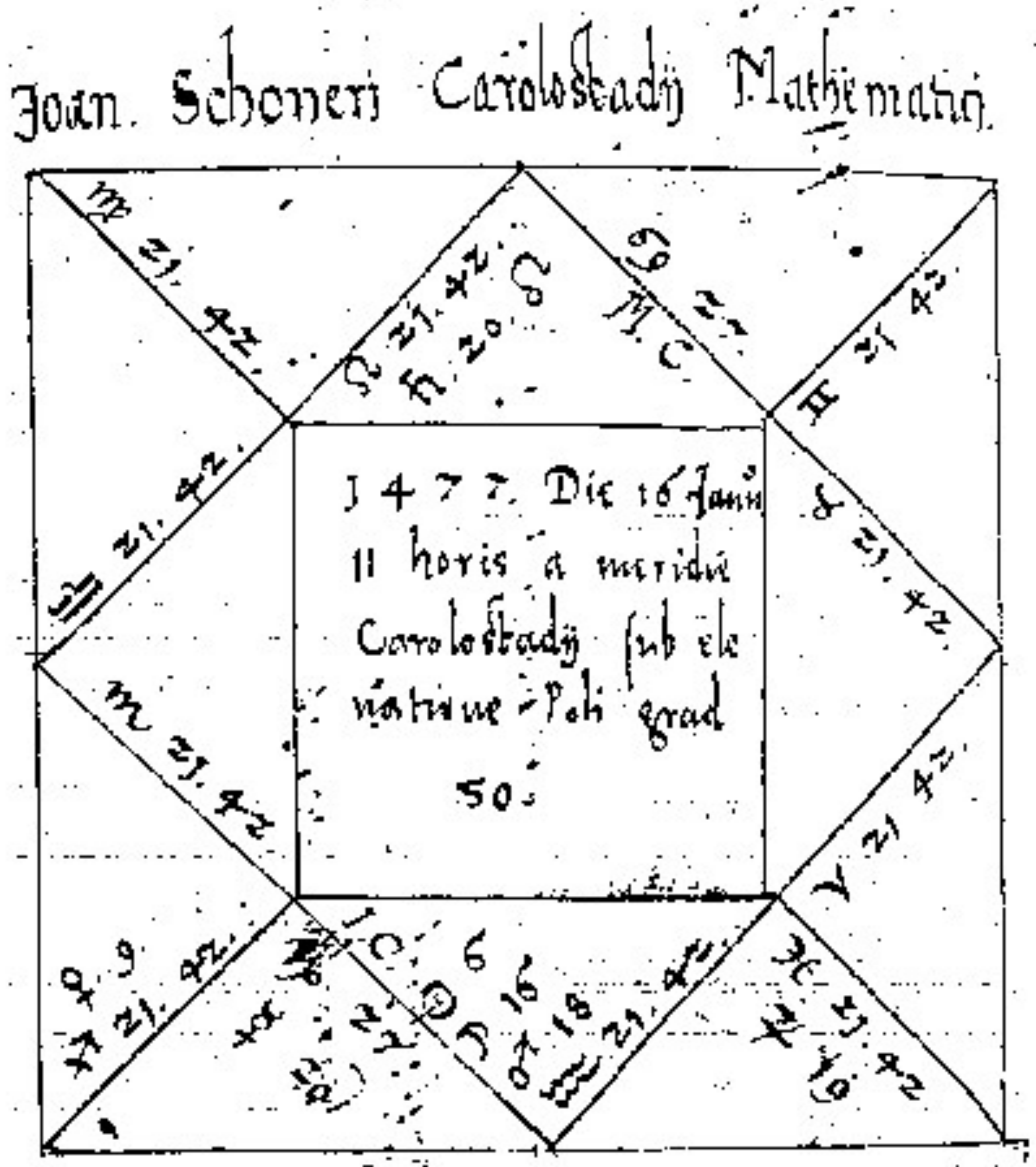


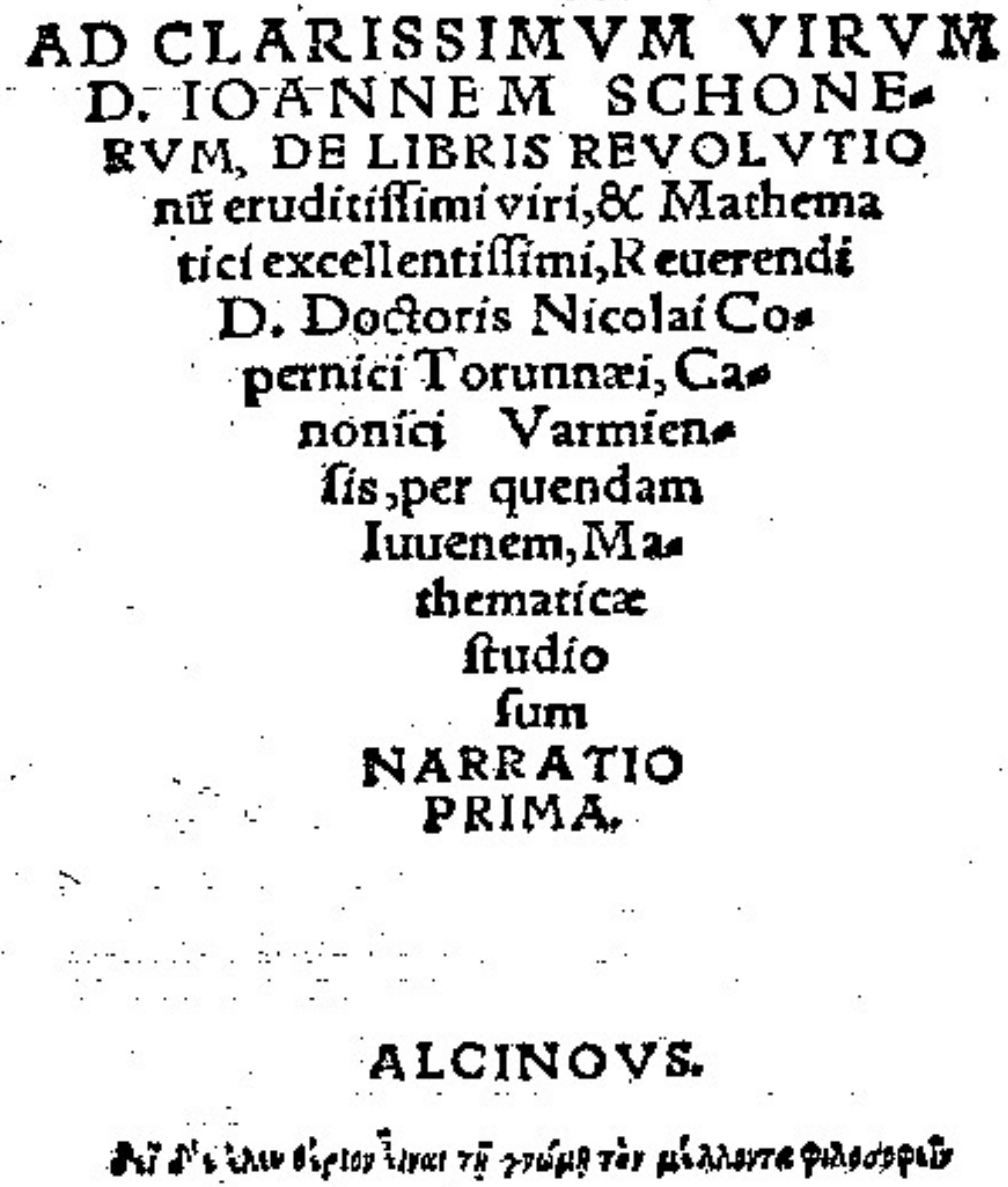
PLATE I

HYGINUS: POETICON ASTRONOMICON, VENICE, 1482

(No. 5)

Photography for Plates I–III and VI–XII
by Frank White, Biological Laboratories, Harvard University




AD CLARISSIMVM VIRVM D. IOANNEM SCHONERVM, DE LIBRIS REVOLVTIONū eruditissimi viri, & Mathematici excellentissimi, Reuerendi D. Doctoris Nicolai Copernici Torunnæi, Canonici Varmiensis, per quendam Iuuenem, Mathematicæ studiosum

NARRATIO PRIMA.

ALCINOVS.

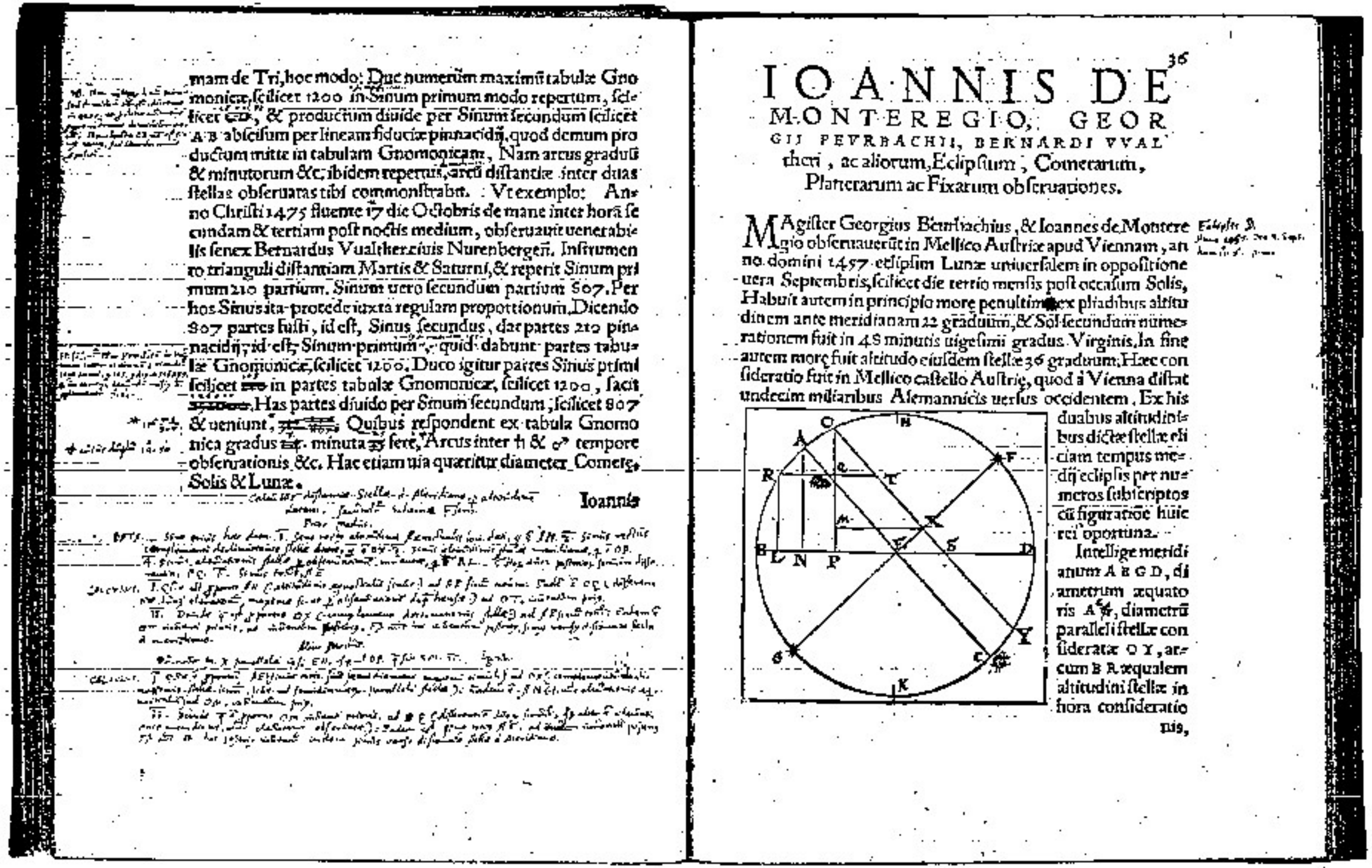
Δεῖ δ' ἐλευθέριον εἶναι τῇ γνώμῃ τὸν μέλλοντα φιλοσοφεῖν

Plate II

RHETICUS: NARRATIO PRIMA, DANZIG, 1540

TITLE (RIGHT) AND MANUSCRIPT HOROSCOPE OF JOHANN SCHÖNER IN THE SAME VOLUME (LEFT)

(No. 15)



mam de Tri, hoc modo: Duc numerum maximum tabulæ Gnomonicæ, scilicet 1200 in Sinum primum modo repertum, scilicet [illegible], & productum diuide per Sinum secundum scilicet A B abscisum per lineam fiduciæ pinnacidij, quod demum productum mitte in tabulam Gnomonicam, Nam arcus graduū & minutorum &c. ibidem repertus, arcū distantiæ inter duas stellas obseruatas tibi commonstrabit. Vt exemplo: Anno Christi 1475 fluente 17 die Octobris de mane inter horā secundam & tertiam post noctis medium, obseruauit uenerabilis senex Bernardus Vualther ciuis Nurenbergeñ. Instrumento trianguli distantiam Martis & Saturni, & reperit Sinum primum 210 partium. Sinum uero secundum partium 807. Per hos Sinus ita procede iuxta regulam proportionum, Dicendo 807 partes fusti, id est, Sinus secundus, dat partes 210 pinnacidij, id est, Sinum primum, quid dabunt partes tabulæ Gnomonicæ, scilicet 1200. Duco igitur partes Sinus primi scilicet [illegible] in partes tabulæ Gnomonicæ, scilicet 1200, facit [illegible]. Has partes diuido per Sinum secundum, scilicet 807 & ueniunt [illegible]. Quibus respondent ex tabula Gnomonica gradus [illegible] minuta [illegible] fere, Arcus inter ♄ & ♂ tempore obseruationis &c. Hac etiam uia quæritur diameter Cometæ, Solis & Lunæ.

Ioannis

36

IOANNIS DE MONTEREGIO, GEORGII PEVRBACHII, BERNARDI VVALTHERI, ac aliorum, Eclipsium, Cometarum, Planetarum ac Fixarum obseruationes.

MAgister Georgius Beurbachius, & Ioannes de Monteregio obseruauerūt in Mellico Austriæ apud Viennam, anno domini 1457 eclipsim Lunæ uniuersalem in oppositione uera Septembris, scilicet die tertio mensis post occasum Solis, Habuit autem in principio moræ penultima ex pliadibus altitudinem ante meridianam 22 graduum, & Sol secundum numerationem fuit in 48 minutis uigesimi gradus Virginis, In fine autem moræ fuit altitudo eiusdem stellæ 36 graduum; Hæc consideratio fuit in Mellico castello Austriæ, quod à Vienna distat undecim miliaribus Alemannicis uersus occidentem. Ex his duabus altitudinibus dictæ stellæ elicīam tempus medij eclipsis per numeros subscriptos cū figuratiōe huic rei oportuna.

Intellige meridianum A B G D, diametrum æquatoris A [illegible], diametrū paralleli stellæ consideratæ O Y, arcum B R æqualem altitudini stellæ in hora consideratio nis,

PLATE III

REGIOMONTANUS: SCRIPTA CLARISSIMA MATHEMATICI, NUREMBERG, 1544

(No. 17)

PLATE IV

SHAIKH MUHAMMAD 'IRÂQÎ: PERSIAN ASTROLABE, CA. 1600
(No. 66)

Courtesy of the Fogg Art Museum

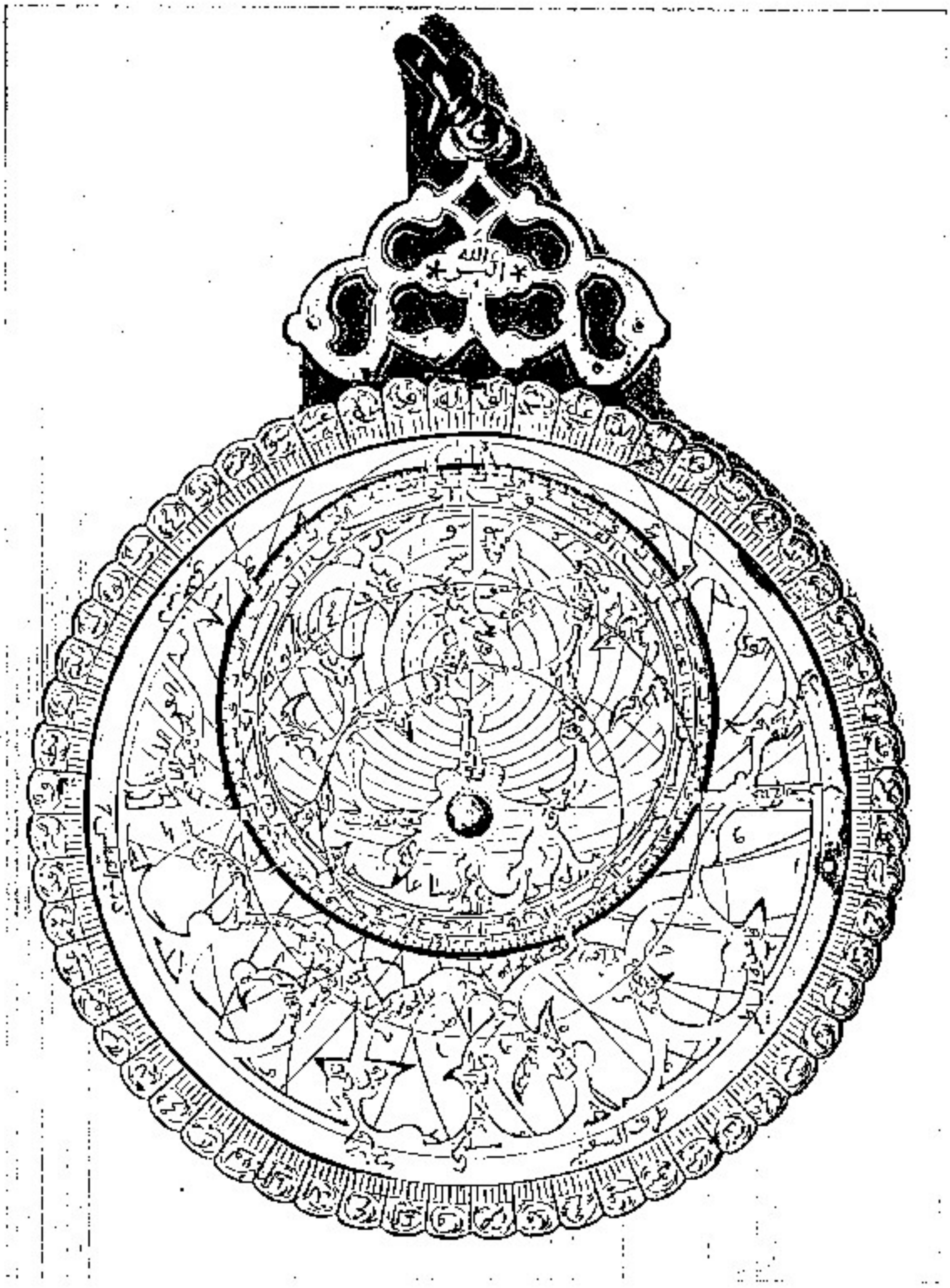
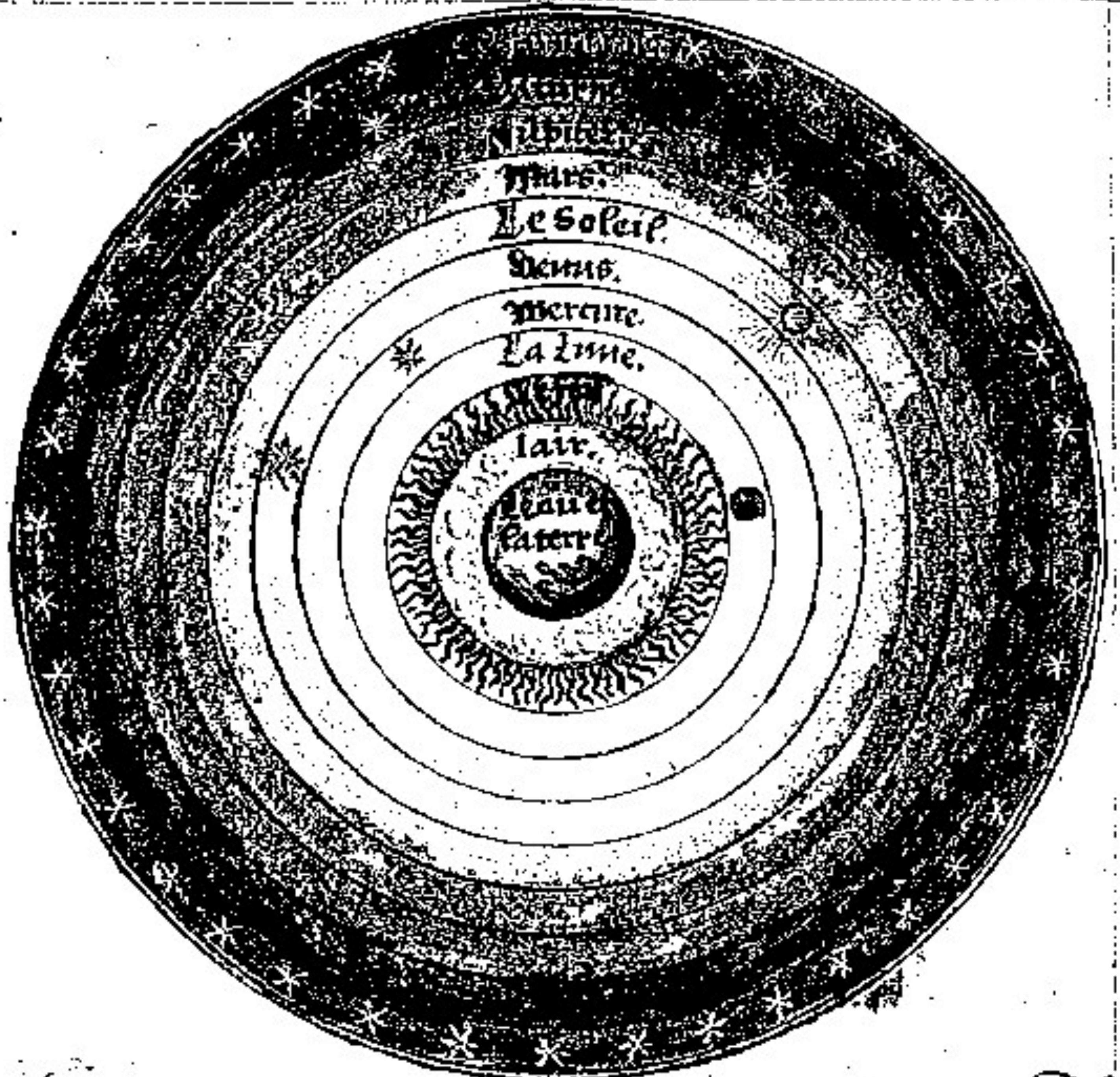


PLATE V

HÂMID IBN MUHAMMAD MUQÎM: INDIAN ASTROLABE, 1628–29
(No. 67)

Le j. liure.



Et conuient noter, que lesdictz planetes sont communement exprimés par leurs propres figures et caracteres: Et sont de telle nature et qualité, et comparés aux sept metaulx, ainsi comme sensuyt.

♄	Saturne,	froid/et sec,	maling		du plomb.
♃	Jupiter,	chauld/et humide,	bening		de lestain.
♂	Mars,	chauld/et sec,	maling	Tenant	de lacier.
☉	Le Soleil,	Chauld/et sec,	Bening	de la	de Lor.
♀	Venus,	froide/et humide,	benigne	confe.	du cuyure.
☿	Mercure,	de la nature de ceulx adioinct.			de largent vif.
☾	La Lune,	froide/et humide,	benigne		de largent.

PLATE VI

FINÉ: LE SPHERE DU MONDE, HOLOGRAPH MANUSCRIPT, PARIS, 1549
(No. 59)

Oxon: June 3. 1705

Sr I hoped to have heard some news from you since
you left us, but cannot find you correspond with
any one of my acquaintance. I think the business
of the house is fixt, and the Workmen have orders
to gett all things ready, but as yett nothing is touched.
Your friend Dr Charlette is left provicechancellour for
a month and resolves to push on that affair vigorously
last week I reced the Morton Hounworth Money and paid
the Vicechancellour twelve pounds and gott his hand
to the Computus Cistae Mathematicae. Four pounds I
have of yours in my hands I will pay you at my
return which will be this week, the day not yet
determined. As to Pirsson rent I have not yet wrote
about it, being desirous that you and I should write
joyntly, in relation to the Lease the young Mr Blincoe
seems desirous of. We can easily gett the money
remitted by Mr Reynolds means. I have finished my
paper of Comets, but am forced to exceed the bounds
of a sheet; finding it not possible to contract all I
ought to say into that Compass. I hope Madam
Gregory and family are in good health pray give
my service to her.

I am
Your most faithfull servt
Edm: Halley

PLATE VII

HALLEY TO [DAVID GREGORY?], AUTOGRAPH LETTER, OXFORD, 3 JUNE 1705
(No. 62)

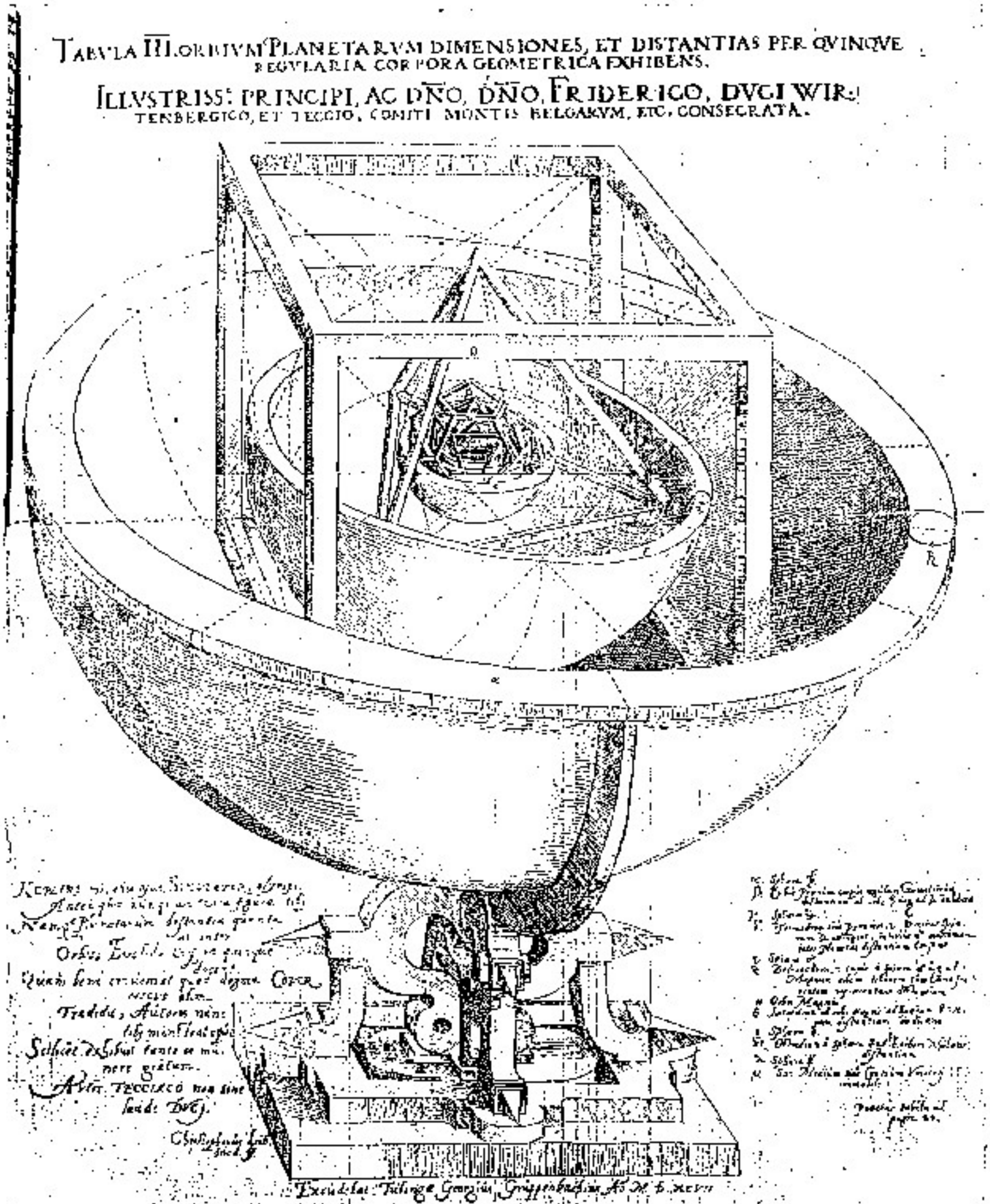


Plate VIII

KEPLER: MYSTERIUM COSMOGRAPHICUM, TÜBINGEN, 1597
(No. 26)

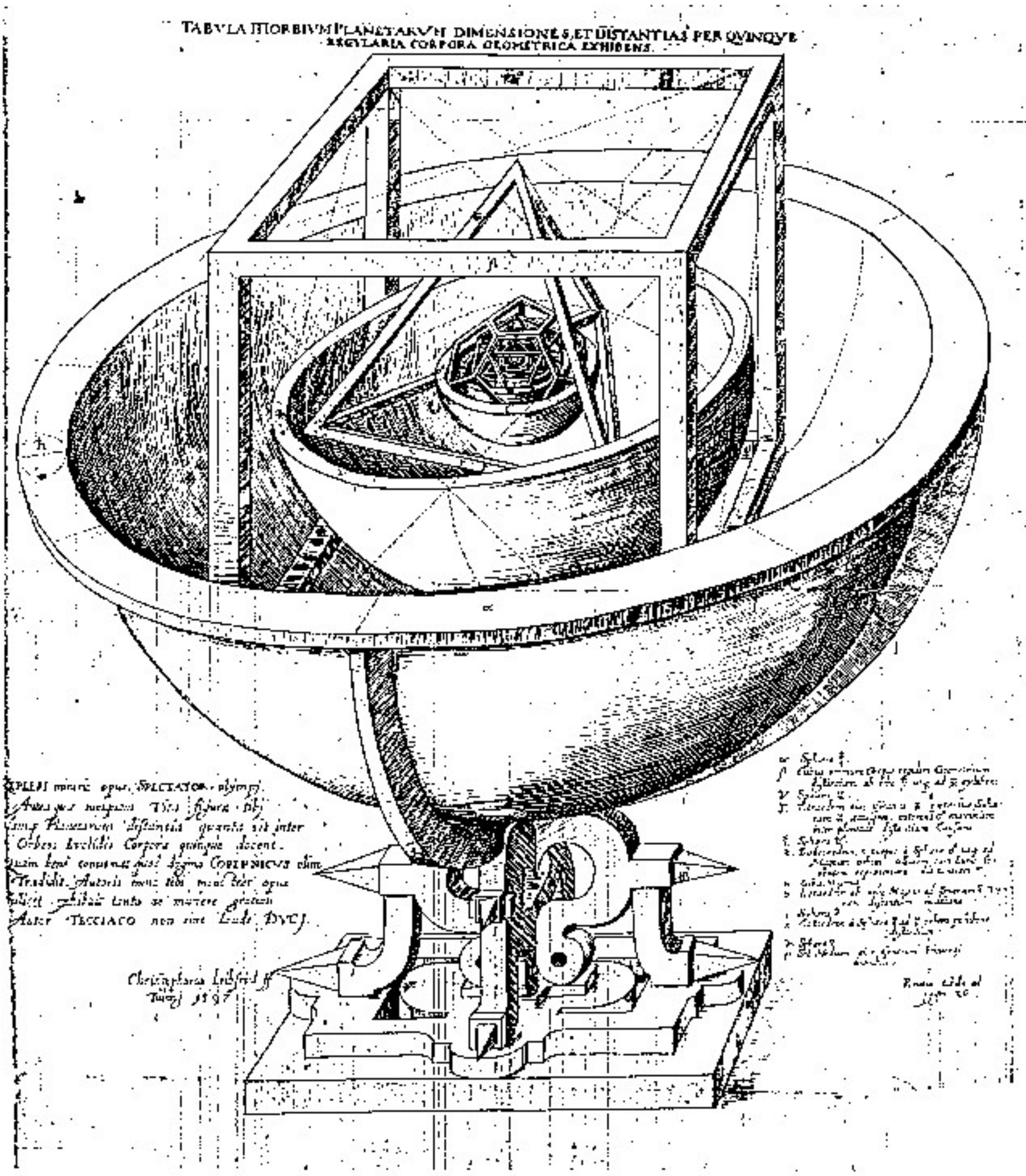


PLATE IX

KEPLER: MYSTERIUM COSMOGRAPHICUM, FRANKFURT, 1621
(No. 27)

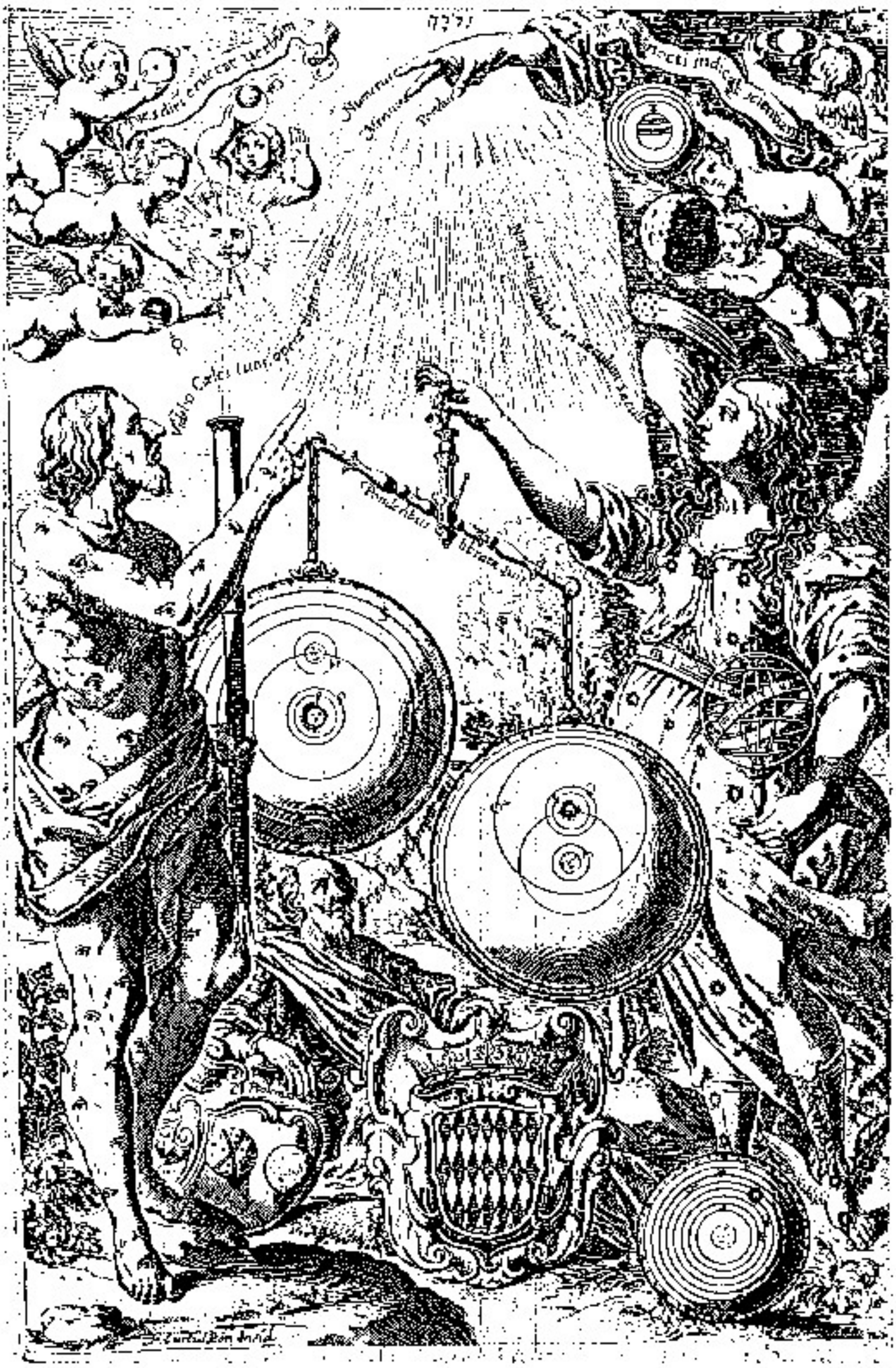


PLATE X

RICCIOLI: ALMAGESTUM NOVUM, BOLOGNA, 1651

(No. 40)

PLATE XI

HALLEY: BROADSIDE, [LONDON, 1715]
(No. 50)

CONSTELLATIO VII. 143

Z CONSTELL. VIII.

PLATE XII

SCHILLER: COELUM STELLATUM CHRISTIANUM, AUGSBURG, 1627
(No. 36)

volume was printed at Tycho's own press at Uraniborg, and was intended as the second volume of his *Astronomiae Instauratae Progymnasmata*, but was finished long before the first.

Gift of Mrs. E. D. Brandegee, 1908.

23.

Tycho Brahe. *Astronomiae Instauratae Mechanica.* Wandesburg, 1598.

"Machines for the reform of astronomy" is an apt translation of Tycho's description of his ingenious scientific instruments. Wrought on a lavish scale of wood, brass, and steel, these massive measuring machines enabled Tycho to pinpoint celestial objects with a precision never before obtained. Tycho boasts in this book that his Uraniborg observatory had cost King Frederick II "more than a ton of gold . . . so great was my desire to study the stars." After the King's death, Tycho left Denmark for the Imperial Court in Prague, and en route he issued a small first edition of this work at Wandesburg. Christopher Steidelmayr records on the title page that this copy was given to him in Prague in 1602 in accordance with the author's wishes.

Gift of Philip Hofer, 1945.

24.

Tycho Brahe. *Astronomiae Instauratae Progymnasmata.* Frankfurt, 1610.

Tycho began printing his principal work at his Uraniborg observatory on the island of Hveen, but the "Exercises in the Reform of Astronomy" was finally published posthumously at Prague in 1602 with an appendix by Kepler. Most of the sheets were then bought by a Frankfurt publisher, who printed anew only the first sixteen pages in this 1610 issue.

Gift of Robert Wheeler Willson, 1927.

25.

Johann Bayer. *Uranometria.* Augsburg, 1603.

Bayer's monumental *Uranometria*, a work of breathtaking beauty, is the first substantial atlas of the heavens. Its Greek-letter designations for the stars have now become standard. Although based on Tycho's star catalogue, the *Uranometria* added fourteen new southern constellations according to information from Dutch navigators. Anthon Fugger's name is stamped on the vellum binding of this copy. The Harvard collection also includes copies published in Ulm in 1607, 1639, and 1661.

Gift of Philip Hofer, 1942.

26, 27.

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

Johannes Kepler. *Mysterium Cosmographicum.* Frankfurt, 1621.

Kepler's first book introduced the cosmological idea that motivated his entire astronomical career: the spacing of the planets is determined by a nesting of spheres and regular solids. Kepler's neo-Platonic fascination with the perfect solids as the key to the solar system's structure continued to the end of his life. The exhibition included the figure of nested spheres and solids from both editions to show that the plate in the second edition is the mirror image of the first (Plates VIII and IX).

Gift of Curt A. Reisinger, 1953; Harvard College Library, 1830.

28.

Johannes Kepler. *De Stella Nova.* Frankfurt, 1606.

Kepler was intrigued by the relation between the brilliant new star of 1604 and the conjunction of Saturn, Jupiter, and Mars. His calculations revealed a similar event in 6 B.C., which, in his view, could have ignited the Christmas star. Harvard also owns a German tract of 1604, Kepler's first account of the nova, which is unique in America.

Haven Fund, 1851.

29.

Johannes Kepler. *Astronomia Nova.* Prague, 1609.

When Kepler came to Prague to work with Tycho Brahe, he bet a colleague he would solve the orbit of Mars within a week. The task took five years, and in his analysis he finally rejected circular orbits in favor of the ellipse. This, the most important volume in Kepler's prolific output, truly founded the "new astronomy." It records the discovery of his law of areas as well as the law of ellipses.

Gift of Robert Wheeler Willson, 1927.

30.

Galileo Galilei. *Sidereus Nuncius.* Venice, 1610.

In the same year that Kepler was publishing his great *Astronomia Nova*, Galileo was preparing his "The Starry Messenger." Though only a thin pamphlet of 28 leaves, it reports the important first telescopic discoveries, including the satellites of Jupiter and the starry nature of the Milky Way. Although these discoveries did not prove the correctness of the Copernican system, in Galileo's hands they demonstrated the inadequacy of ancient beliefs and kindled the smoldering Copernican dispute.

Gift of Robert Wheeler Willson, 1927.

31.

[Christopher Scheiner.] *De Maculis Solarib[us] et Stellis Circa Jovem Errantibus.* Augsburg, 1612.

Both Johann Fabricius and Father Scheiner (under the pseudonym "Apelles") published observations of sunspots before Galileo. This work, from the second round of the ensuing debate, answers a letter of Galileo. Scheiner's extension of the discussion to the satellites of Jupiter enabled Galileo to mention and endorse the Copernican system in his response (see 32 below).

Gift of Robert Wheeler Willson, 1927.

32.

Galileo Galilei. *Istoria e Dimostrazioni Intorno alle Macchie Solari.* Rome, 1613.

Galileo in this work argues that, contrary to the opinion of Apelles, the sunspots must actually be on the surface of the sun, and for the first time he unequivocally endorses the Copernican system in print. Galileo's "Sunspots" contains 38 engravings of the sun's appearance from June to August of 1612.

Gift of Mr. and Mrs. Ward M. Canaday, 1954.

33.

Johannes Kepler. *Harmonices Mundi.* Linz, 1619.

Kepler's continuing cosmological search for the underlying causes of the distances and periods of planets led him to apply musical theory to the planetary patterns. In the course of examining the silent harmonies of the planets, he discovered his third law: the squares of the periods of the planets round the sun are proportional to the cubes of the distances.

Gift of Robert Wheeler Willson, 1927.

34.

Michael Maestlin. *Epitome Astronomiae.* Tübingen, 1624.

Although Maestlin's astronomy textbook promoted the Ptolemaic system, at the University of Tübingen he taught the Copernican system to pupils such as Kepler. This is the seventh and last edition of a work originally published in 1582, but copies of any edition are exceedingly rare in America.

Gift of the Rev. F. W. Greenwood, 1831.

35.

Johannes Kepler. *Tabulae Rudolphinae.* Ulm, 1627.

Kepler's discovery of the laws of planetary motion, based on Tycho's observations, provided the foundation for these perpetual tables from which the planet's position could be calculated for any moment. This is the first scientific book to exploit the newly discovered logarithms. The four copies of the "Rudolphine Tables" in the Harvard collection exhibit all the variations that arose when Tycho's heirs forced Kepler to reprint the initial signatures because they felt that his long dedication to the Emperor overbalanced theirs. The copy displayed was once owned by Philip Eckebrecht, who engraved the world map for the book.

Gift of Robert Wheeler Willson, 1927.

36.

Julius Schiller. *Coelum Stellatum Christianum.* Augsburg, 1627.

In Schiller's extraordinary celestial atlas, the zodiac became the twelve apostles, Lyra became the manger of Christ, Andromeda the sepulchre, Canis Major appeared as David, Hercules as the Magi (Plate XII), and so on. Announced on the title as a revision of Bayer, and engraved on the same generous proportions, the Schiller opus has now become a splendid curiosity.

Dexter Fund, 1941.

37.

Galileo Galilei. *Dialogo . . . sopra i Due Massimi Sistemi del Mondo, Tolemaico, e Copernicano.* Florence, 1632.

Galileo chose for this important work the form of a "dialogue on the two great world systems" between three friends. It is hard to understand how Galileo convinced the censors that his treatment was inconclusive — the *Dialogo,* far more than any other work, convinced men of the truth of the Copernican system. A manuscript line of presentation from the author, presumably in Galileo's own hand, is at the bottom of the title page of this copy.

Gift of Robert Wheeler Willson, 1927.

38.

René Descartes. *Principia Philosophiae.* Amsterdam, 1644.

In this, his third great work, Descartes ends the old Aristotelian distinction between the aetherial starry spheres and the sublunar space. His law of inertia correctly anticipates Newton's and his celebrated theory of vortices reigned supreme for several decades. Even the title of Newton's masterpiece, *Philosophiae Naturalis Principia Mathematica,* was undoubtedly influenced by his desire, conscious or unconscious, to replace Descartes' *Principia Philosophiae.*

Degrand Fund, 1922.

39.

Johannes Hevelius. *Selenographia sive Lunae Descriptio.* Danzig, 1647.

In this, the first selenographical atlas, Hevelius adopted names of terrestrial features for the moon; today only a few traces of his nomenclature remain, and the major craters follow the scheme of Grimaldi and Riccioli. Hevelius inscribed this copy to Georg von Strackwitz in 1652.

Gift of Robert Wheeler Willson, 1927.

40.

Giovanni Battista Riccioli. *Almagestum Novum.* Bologna, 1651.

In the flamboyant frontispiece of the "New Almagest" (Plate X), the eye-covered Earth with his telescope looks up to the newly discovered marvels of the heavens as Urania tests the Copernican and Tychonic systems in her balance. Riccioli, a Jesuit, favored a form of geocentric Tychonic system when weighing the evidence in this erudite compendium. On the detailed moon map included in this treatise Tycho's name is assigned to the most conspicuous crater. This chart, prepared by Riccioli's collaborator Grimaldi, has established the names of most of the principal craters on the moon's visible face.

Gift of Robert Wheeler Willson, 1927.

41.

Pierre Borel. *De Vero Telescopii Inventore.* The Hague, 1655.

After pointing out that Galileo was not the inventor of the telescope, Borel attributes the instrument to Zacharias Janssen. Included in this book is a tract in which Huygens prints a veiled announcement in an anagram of his discovery of Saturn's ring.

Degrand Fund, 1933.

42.

Christiaan Huygens. *Systema Saturnium.* The Hague, 1659.

Huygens first circulated his recognition of Saturn's rings in an anagram (see 41 above), whose meaning is revealed in this work: Saturn "is encircled by a thin, plane ring, nowhere attached, inclined to the ecliptic." Huygens also here announced his discovery of Titan, the first known satellite of Saturn.

Gift of Robert Wheeler Willson, 1927.

43.

Jean Dominique Cassini. *Découvertes de Deux Nouvelles Planètes Autour de Saturne.* Paris, 1673.

Cassini came to Paris from Bologna in 1668 to take charge of the new observatory, and there he discovered the four satellites of Saturn. The two described here, Iapetus and Rhea, were found in 1671 and 1672.

Degrand Fund, 1924.

44.

[Albert Curtz]. *Historia Coelestis.* Augsburg, 1666.

Kepler, who took over Tycho's observations at the premature death of his mentor, withheld publication as a ransom against his own back salary from the Imperial Diet. Thirty-six years after Kepler's death they were finally printed under the editorship of "Lucius Barrettus," an anagram for Albertus Curtius. Unfortunately, Curtz had only a faulty copy of the data, and the result, while showing the scope of Tycho's work, has been likened by J. L. E. Dreyer to an Augean stable.

Gift of Robert Wheeler Willson, 1927.

45.

Otto von Guericke. *Experimenta Nova . . . de Vacuo Spatio.* Amsterdam, 1672.

Justly renowned for its description of the dramatic experiment with the evacuated Magdeburg hemispheres, von Guericke's treatise is set within a cosmological framework and a discussion of the vacuum in interstellar space.

Dexter Fund, 1941.

46.

Johannes Hevelius. *Firmamentum Sobiescianum, sive Uranographia.* Danzig, 1687.

Among the new constellations created by Hevelius in this monumental celestial atlas is Scutum Sobiescian, the shield with which John Sobieski defended Europe against the Turks in 1673. Other innovations include Lacerta, Vulpecula, Lynx, Canes Venatici, and Sextans Uraniae — the latter one of his own splendidly decorated instruments. This copy contains only the charts and the engraved frontispiece dated 1687; Harvard also owns the 1690 issue that includes a printed title and text and which (as is customary) follows the Hevelius *Prodromus Astronomiae.*

Dexter Fund, 1941.

47.

Isaac Newton. *Philosophiae Naturalis Principia Mathematica.* London, 1687.

Published in a first edition of only 300 copies, Newton's epoch-making synthesis has become the most sought-after volume in the history of science. Newton sets forth the laws of motion and of universal gravitation, and then applies these principles to an array of astronomical phenomena including precession, comets, the tides, and lunar theory. In this copy the title page is in the earliest state, with a three-line imprint.

Gift of David P. Wheatland, 1969.

48.

Edmond Halley. *Astronomiae Cometicae Synopsis.* Oxford, 1705.

In these pages Halley published the first comet orbit ever calculated. He proposed that the bright comets seen by Apianus in 1531, by Kepler in 1607, and by himself in 1681 were one and the same. His prediction of a future return was strikingly verified on Christmas day in 1758, and the comet has since received his name. (See also item number 62.)

Gift of William Inglis Morse, 1948.

49.

John Flamsteed. *Historiae Coelestis.* London, 1712.

Newton's impatience to procure the lunar observations from Flamsteed, the methodical Astronomer Royal, finally prompted Edmond Halley to publish this material that the reluctant Flamsteed had deposited with the trustees of the Greenwich Observatory. Flamsteed felt his observations had been shamefully abbreviated in this edition, and when political fortunes changed, he captured and burned the offending pages. Only the sixty copies already distributed escaped, including this example in a Queen Anne binding. Harvard also owns Flamsteed's approved and vastly enlarged 1725 edition.

Gift of William King Richardson, 1950.

50, 51.

Edmond Halley. *A Description of the Passage of the Shadow of the Moon over England.* [London, 10 April 1715].

[Edmond Halley]. *A Description of the Passage of the Shadow of the Moon over England as it was Observed.* [London, 1 September 1715].

An interesting comparison between the predicted and the observed path of an eclipse is afforded in this pair of broadsides from 1715. The second one includes the predicted path of the 1724 eclipse. Both are part of a collection of fifteen English broadsides dealing with the two eclipses, once owned by Narcissus Luttrell, the famed English collector of ephemera, who carefully annotated all his broadsides with the date of purchase and the price. (Plate XI)

Gift of David P. Wheatland, 1953.

52.

William Whiston. *Scheme for the Solar System Epitomis'd*. London, ca. 1770.

This broadside shows one of the earliest diagrams with comet orbits. Whiston includes a pious English translation of part of the General Scholium to Book III of Newton's *Principia*, first published in the second edition, 1713. The broadside was first printed in 1715, but our copy is probably a restrike from the 1770's; it bears the line "Republished by Fras. West (successor to Mr. Adams) Optician to His Majesty 83 Fleet St. London."

Gift of William Inglis Morse, 1948.

53.

Thomas Wright. *An Original Theory or New Hypothesis of the Universe*. London, 1750.

In this work with heavy theological overtones, Wright for the first time attributes the appearance of the Milky Way to the arrangement of stars in an extensive, thin stratum.

Gift of Robert Wheeler Willson, 1927.

54.

[Immanuel Kant]. *Allgemeine Naturgeschichte und Theorie des Himmels*. Königsburg, 1755.

In this rare and anonymously published work, the young Kant, yet to become famous as a philosopher, likens the Milky Way to a rotating disk of stars analogous to the planetary system, and he envisions an infinity of other Milky Ways. These considerations of space and time led Kant into the deep pursuit of philosophy.

George Schünemann Jackson Fund, 1932.

55.

Johann Heinrich Lambert. *Cosmologische Briefe*. Augsburg, 1761.

Lambert proposed for the structure of the Milky Way a system of "assemblages of assemblages" each with its own center of rotation. This copy came to Harvard when George Phillips Bond purchased Jacobi's library.

Haven Fund, 1851.

56.

Pierre-Simon Laplace. *Exposition du Système du Monde*. Paris, 1796.

Arago called this "the Mechanique Celeste disembarrassed of its analytical paraphernalia." Lucid and masterly in style, it won Laplace a place in the French Academy. The famous nebular hypothesis for the origin of the solar system appears in note vii of this edition.

Degrand Fund, 1940.

Manuscripts

57.

Geoffrey Chaucer. *A Treatise on the Astrolabe.* English manuscript, ca. 1400.

Sometimes called "Bread and Milk for children," Chaucer's treatise was composed in 1391 for "Little Lewis," aged ten. It is primarily a Middle English translation from Messahalla's work on the astrolabe. This diminutive manuscript is considered to be a link between the two main groups of early Chaucer *Astrolabe* texts.

Gift of David P. Wheatland, 1953.

58.

Alfonso X. *Miscellanea Astronomica.* Vienna, ca. 1425.

Commissioned by Alfonso the Great in 1253, these planetary tables calculated from the Ptolemaic system achieved widespread use in the Middle Ages and provided the basis for the leading almanacs until the time of Copernicus. This volume of Austrian manuscripts includes not only the Alfonsine planetary information, but also trigonometric tables, a list of stars with constellation drawings, Latin instructions on spherical astronomy, and a treatise on the astrolabe.

Gift of Philip Hofer, 1946.

59.

Oronce Finé. *Le Sphere du Monde.* Holograph manuscript. Paris, 1549.

This splendid illuminated manuscript is Finé's own translation of his Latin treatise of spherical astronomy, *De Mundi Sphaera sive Cosmographia,* Paris, 1542, evidently prepared for Henri II of France (Plate VI). Houghton Library also owns several handsomely illustrated printed works from Finé, who was the leading French astronomer of his century.

Gift of Christian A. Zabriskie and Philip Hofer, 1951.

60.

Galileo Galilei. Autograph letter. Padua, Jan. 5, 1601.

In one of a handful of Galileo letters in the Western hemisphere, the Italian astronomer thanks an unknown patron for "the very beautiful poem and most pleasing letter."

Gift of Alfred C. Berol, 1967.

61.

Isaac Newton to Charles Townshend. Autograph letter. London, August 25, 1724.

One of Newton's duties as Master of the Mint was to bring coin clippers and counterfeiters to justice. Perhaps more memorable is his introduction of the milling on the edges of coins as a countermeasure against clipping and forgery. The text of the letter follows:

My Lord
I know nothing of Edmund Metcalfe convicted at Derby Assizes of counterfeiting the coyne; but since he is very evidently convicted, I am humbly of opinion that its better to let him suffer, then to venture his going on to counterfeit the coin & teach others to do so untill he can be convicted again. ffor these people very seldome leave off. And its difficult to detect them. I say this with most humble submission to his Maj^{es} pleasure & remain
Mint Office
Aug. 25. 1724. My Lord

Your Lord^{ps} most humble &
obedient Servant
Is. Newton

L^{d} Townshend

The Locker-Lampson–Warburg–Grimson Album, Gift of Bettina W. Grimson, 1960.

62.

Edmond Halley to [David Gregory?]. Autograph letter. Oxford, June 3, 1705.

"I have printed my paper of comets, but am forced to exceed the bounds of the sheet, finding it not possible to contract all I ought to say into that compass," writes Halley to a fellow astronomer (Plate VII). The comet paper itself is number 48.

Perkins Fund, 1962.

63.

William Herschel. Holograph manuscript. Slough, 1797.

On 13 March 1781 a new planet swam into Herschel's view, named by him "Georgium Sidus" in honor of George III. This interesting scrap, illustrating the motion of the new planet, was presented to E. C. Pickering, Director of the Observatory, by Herschel's great grandson in July 1918. After the dangers of wartime shipping were over, he also gave Harvard a major group of Herschel's manuscripts.

Gift of J. C. W. Herschel, 1918.

64.

William Herschel to Edward Pigott. Autograph letter. Datchet, March 3, 1783.

In this letter the great English observer discusses the proper versus apparent motions of stars caused by the motion of the sun, a topic on which he had just completed an important paper. Herschel also mentions that the speculum mirror for his telescope had cracked in the 11 January cold, but had now been replaced, enabling him to observe "Georgium Sidus" (Uranus), the planet he had discovered almost exactly two years earlier. Houghton also houses a collection of Herschel's printed papers presented by him to Pigott.

Gift of David P. Wheatland, 1960.

Instruments

65.

Chinese Jade Pi. Han Dynasty.

The Chinese pi is a stone disk with serrated edges that may match the pattern of certain northern stars. According to Henri Michel, these disks are the oldest extant astronomical instruments, and were used between two and three thousand years ago to locate the north celestial pole. The jade pi exhibited is one of several in the Fogg Art Museum (Acquisition 1943.50.532). See H. Michel, "Le plus ancien instrument d'astronomie: Le Pi," in *Ciel et Terre*, **75**, Mai-Juin 1959.

Fogg Art Museum, Gift of Grenville L. Winthrop, 1943.

66.

Shaikh Muḥammad 'Irâqî. Persian Astrolabe. Ca. 1600.

Like many highly ornate Persian astrolabes with their handsome calligraphy, this one is not particularly impressive as an astronomical instrument. The three coordinate plates provide for the latitudes 30°, 30°, 30°, 32°, 32° and 34°; this redundancy plus the lack of trigonometric graphs suggests that the astrolabe was made primarily for decoration. The maker's name, inscribed in a cartouche on the back, is otherwise unknown. The dimensions are 8.4 by 10.9 centimeters. (Plate IV)

Fogg Art Museum. Alpheus Hyatt Fund, 1958.

67.

Ḥâmid ibn Muḥammad Muqîm. Astrolabe. Lahore, 1038 A.H. = 1628–29 A.D.

This astrolabe is one of four known from this craftsman, whose family had made instruments in Lahore through three generations. It is signed on the back, within the shadow box, "Work of the least of the servants Ḥâmid ibn Muḥammad Muqîm ibn 'Îsà ibn Allah-Dâd, royal astrolabist of Lahore," and is dated in a heart-shaped cartouche below the shadow box. The movable brass chart, or rete, gives Arabic names for 40 stars (Plate V). The four coordinate plates provide for use at the following latitudes: 0°, 18°; 21°, 24°; 27°, 29°; 32°, 35°. Only the third plate includes azimuths. Two circular tables underneath the plates give latitudes and longitudes of 40 towns. The dimensions are 12.6 by 16.5 centimeters.

Gift of Philip Hofer, 1955.

68.

Diyâ' ad-dîn Muḥammad ibn Qâ'im Muḥammad. Astrolabe. Lahore, 1073 A.H. = 1662–63 A.D.

A prolific maker of astrolabes and globes, Diyâ' ad-dîn was a first cousin to Ḥâmid (see preceding item). The astrolabe is dated and signed within the shadow box, "Work of the least of the servants Diyâ' ad-dîn Muḥammad ibn Qâ'im Muḥammad ibn 'Îsà ibn Allah-Dâd, royal astrolabist of Lahore." The rete gives Arabic names for 43 stars. The four coordinate plates provide for use at the following latitudes: 0°, 18°; 22°, 25°; 27°, 29°; 32°, 34°. Two circular tables underneath the plates give latitudes and longitudes of 52 towns. The dimensions are 10.6 by 14.0 centimeters.

Lent by Owen Gingerich.

69.

Gold Medal of the Royal Astronomical Society. Awarded to George Phillips Bond. 1865.

George Bond's principal observations were carried out with Harvard's 15-inch telescope, which, until it was surpassed in 1862, ranked with the Pulkovo instrument as the largest refractor in the world. His comprehensive and handsomely illustrated monograph on Donati's Comet of 1858, in *Annals of the Harvard College Observatory* (1862) won widespread acclaim and in 1865 brought him the gold medal of the Royal Astronomical Society, the first ever awarded to an American. The obverse of the medal shows a bust of Newton, the reverse, Herschel's 40-foot telescope.

Harvard College Observatory, 1865.

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