Astronomy's Debt to Astrology

In the center of the modern city of Mosul, in northern Iraq, lie the remains of the ancient city of Nineveh. Around 700 BCE, Nineveh was the largest city on Earth, with city walls twelve kilometers (km) long, enclosing an area of about 7.5 sq km. Nineveh was the capital of the Neo-Assyrian Empire, which at the time covered most of modern Iraq and parts of Iran, Turkey, and Syria. This empire was one in a historical line of Mesopotamian states stretching back to the earliest Sumerian kingdoms, dating to around 3500 BCE. In 1851, the British Assyriologist and archaeologist Austen Henry Layard (1817–1894) discovered a trove of about 30,000 baked clay tablets. He wrote, "The chambers I am describing appear to have been a depository for [historical records and public documents]. To the height of a foot or more from the floor they were entirely filled with them; some entire, but the greater part broken into fragments." The documents were part of the royal library of the King Ashurbanipal, who reigned from 669–631 BCE. Ashurbanipal was one of the great Assyrian rulers and a collector of documents going back to the beginning of writing.

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Neo-Assyrian star map, showing the locations of the constellations on 3-4 January, 650 BCE

Among the treasures of the Library of Ashurbanipal is the "Venus tablet of Ammisaduqa," a record of the rising and setting of the planet Venus around 1500 BCE. It is one of many documents that form the basis for Mesopotamian astrology, the study of the influence of the stars and planets on people and empires. For thousands of years, Mesopotamians had been interested in knowing the fates and futures of individuals and states, and this astrological endeavor led to development of a system of mathematics for following the orbits of the stars and planets. Of critical importance was the ability to chart the positions of celestial objects at particular points in the past and future, which allowed a horoscope to be cast for people based on their birth-times. The math involved in making these determinations supported broader astronomical pursuits, and pushed forward the fields of geometry, algebra, and trigonometry.

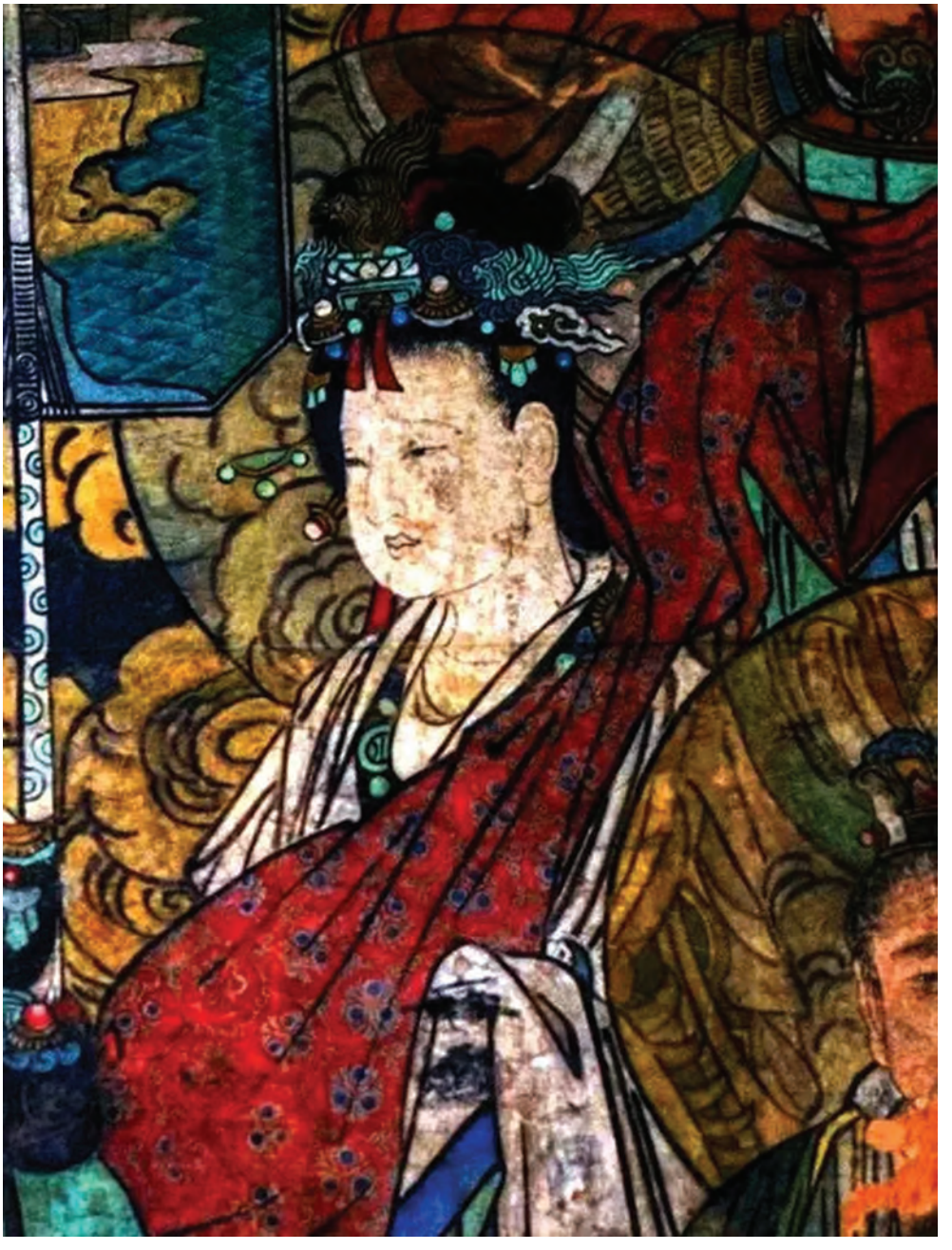
The royal courts of Mesopotamia all had astrologers on staff, and they were engaged in a competition to make better and more firmly based predictions and readings of celestial events. Astrologers had to be able to predict eclipses, the rising and setting of the planets, and keep the ritual calendars on schedule. They had to find auspicious times to do such things as planting, harvesting, marrying, crowning new kings, or going to battle. The ancient Sumerian kings set as great a store by their astrologers as they did by their generals, and the profession carried a high status.

Royal astrologers were common in rulers' courts worldwide. As powerful states emerged in China in the last two millennia BCE, their rulers also depended on state astrologers. The Chinese system of astrology developed independently from Mesopotamian practice and combines a greater interest in the lunar calendar. The Chinese way of dividing up the night sky involves twenty-eight "mansions" or major constellations that are analogous to the West's twelve zodiacal constellations. Most Chinese constellations were smaller than those in the West. For example, Orion's belt is the mansion *Shen*, only represented by three stars. *Ursa Major*, or the Big Dipper, is the constellation *Beidou* and is associated with a Taoist practice in which a priest paces out the shape of the stars in the constellation.

In the Chinese sky, the arc of the Milky Way galaxy is known as the Celestial River or the River of Heaven. The areas where there are

some long, darker patches in the Milky Way are called the Celestial Ford. One mythical story is of the star-crossed lovers—the weaver girl, granddaughter of the emperor (represented by the star Vega), and the poor cowherd (represented by the star Altair). Their love was forbidden by the emperor, and they were condemned to stay on opposite sides of the Celestial River. On the seventh night of the seventh lunar month, however, a flock of magpies would make a bridge to allow them to be together for one day.

In addition to the twelve year signs—rat, ox, tiger, rabbit, dragon, snake, horse, goat, monkey, rooster, dog, and pig—there are animals associated with months, days, and hours on a lunisolar calendar, each associated with both deities and astrological constellations. It requires great knowledge of history and tradition to make interpretations of an individual, based on their birth time, or to identify auspicious dates for weddings, funerals, or new projects.



The Planet Venus, from a 13th century Chinese mural from the Yongle Gong Taoist Temple Complex (ca. 1240 and 1358 CE)

In Mesoamerica, the Maya and later groups also used a complex calendar system for understanding personal characteristics and foretelling the future. It was based on a cycle of twenty day-names, and these repeated thirteen times within a 260-day period called a *Tzolk'in*, which make up a 7,200-day *K'atun*. In addition to this ritual calendar there was a 365-day solar calendar, and a lunar calendar as well. Every ninth night was ruled over by one of the Lords of the Night, deities with special characteristics and traits. The Lords of the Night also ruled over the nine lunar months of the lunar year. A person's horoscope had to deal with all of this, including the day-name, cycle, Tzolk'in, and K'atun, plus the lunar month and day of birth. To plan for a significant date—say the coronation of a king—required finding a date in which the characteristics of their birthdate would harmonize with the characteristics of that date.

The Greco-Roman-Egyptian scholar Ptolemy (ca. 100–ca. 170 CE) wrote the book called the *Almagest*, which was the standard astronomical textbook in the West and Islamic world from the time it was written around, 150 CE, until Copernicus (1473–1543)'s revolution of the 1500s, which moved the Sun to the center of our Solar System (*see "How the Sun was Misplaced for 1,700 Years,"* Natural History*, November 2022*). The *Almagest* was a master-

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Part of the Maya Eclipse Table in the Dresden Codex, showing eclipses that occurred between 1076 and 1148 CE

piece of astronomy and mathematics, describing the movement of the stars and planets and gave astronomers the mathematics to calculate roughly where the planets would be at any given time. This was of critical importance to astrologers, who needed to chart the positions of planets at the time of their client's birth. For an applied version of this knowledge, Ptolemy wrote a companion work on astrology called the *Tetrabiblos*.

In the *Tetrabiblos*, Ptolemy followed the argument that was the basis of Greek and Mesopotamian astrology—that events on Earth are profoundly influenced by celestial bodies. He went on to discuss the nature of the planets and their supposed influence upon events on Earth. The casting of a horoscope, according to the *Tetrabiblos*, involves calculating the positions of the Sun, Moon, planets, and stars at the time a person is born, and then interpreting these positions in light of the cultural associations and tendencies associated with each element. In the case of the Greek and Chinese astrological systems, these traits often coincide with large philosophical categories, such as masculine and feminine, yin and yang, or earth, air, water, and fire.

In the European Middle Ages, people's confidence in astrological interpretations began to wane. Part of the reason was the gradual accumulation of evidence that Ptolemy's Earth-centered model of the Solar System could not be correct. Another factor was a focus on individuals' ability to make independent decisions about their lives, unconstrained by a deterministic astrology. The Jewish philosopher Maimonides (1135–1204) had this to say about astrology:

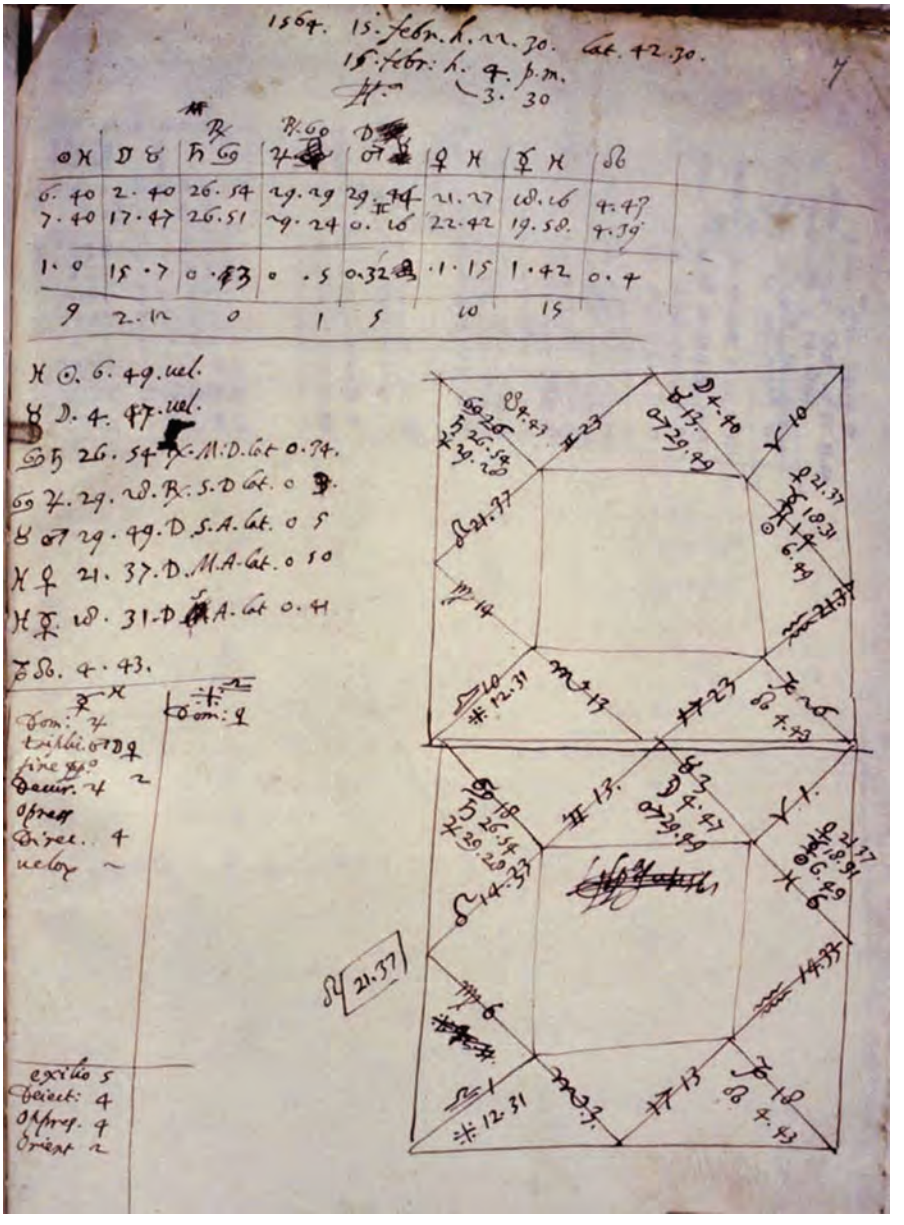
> It also is regarded as a falsehood by us because of the religious tradition, for if the matter stood thus, of what utility would the Torah and the commandment and the Talmud be to a particular individual [if he lacked] the power to do anything he set his mind to, since something else draws him on—against his will—to be this and not to be that; of what use then is the command or the Talmud? The roots of the religion of Moses our Teacher, we find, refute the position of these [astrologers]—in addition to reason's doing so with all those proofs that the philosophers maintain to refute the position of the Chaldeans. . . .

The Renaissance astronomer Galileo (1564–1642) had an ambivalent relationship with astrology. As a mathematician, he had studied the practice of astrology from the books of Ptolemy; a library in Venice has his heavily annotated copy of an introduction to Ptolemaic astrology. Like Johannes Kepler (1571–1630) and other Renaissance astronomers, he was sought after both for his skill in constructing horoscopes and in interpreting them. He cast the horoscope of his patron, Cosimo II de Medici, the Duke of Tuscany (1590–1621), and emphasized how the ruler bore the regal characteristics of Jupiter, going on about the ruler's "royal blood, nobleness in public functions, wide extent of influence over others," which Galileo traced to Jupiter in the midheaven of the Duke's horoscope. Yet Galileo was questioned by the Catholic Inquisition—long before he got in trouble with the Church for supporting Copernicus's heliocentric vision of the Solar System—for making his predictions sound too definite. The Church allowed astrology, but (as with Maimonides' critique) it was too much for them for an astrologer to say that the stars *predetermined* one's fate. Galileo even drew up horoscopes for his two daughters and himself, carefully calculating the positions of the Sun, Moon, and planets in the twelve houses of the

zodiac. On the other hand, Galileo's horoscopes sometimes seemed to be an obligation rather than something he believed. While he was a guest of the Archbishop of Siena in 1633, his host wrote to his brother that, "I have largely lost credence [in astrology] since learning that Messr. Galileo, famed as an Astrologer and still my guest after two months, derides it entirely, and makes fun of it as a profession founded on the most uncertain, if not false, foundations."

It was in the 1600s, Galileo's era, when the fields of astronomy and astrology diverged. Astronomy underwent a revolution with the understanding of the elliptical orbits of the planets around the Sun. With better telescopes it became clear that there were vast numbers of stars beyond human eyesight, and some of them in fact distant galaxies. Astrology also faced a crossroads brought on by Copernicus placing the Sun at the center of the Solar System. Since the planets were orbiting the Sun and not the Earth, the geometry of their influence must be different, and the linear distances between Earth and the other planets were seen to vary greatly as their orbits were understood. Telescopes allowed for the discovery of the outer planets, Uranus, Neptune, and Pluto, and Galileo began to work out the orbits of Jupiter's moons. The "wobble" of the Earth's axis on a 26,000 year cycle, the "precession of the equinoxes," also became better understood, but was not always taken into consideration in astrology.

Following the revolution in thought associated with heliocentrism, and other advances brought on by the scientific revolution from the seventeenth century to the present, astrology has lost relevance in the natural sciences. It doesn't mean it has been forgotten, however, nor has it lost its popular relevance in a time in which the future is uncertain. The larger historical question is this: Without astrology, would astronomy even exist? Would our ancestors have cared enough to count out the 4,333 nights of the orbit of Jupiter? Would they have invented the mathematics to correlate the solar and lunar calendars? Would the retrograde motions of Mars or Jupiter have troubled them as much as they did when their ruler was born under their sway? Galileo, Kepler, Ptolemy, and others for thousands of years made their livelihood through astrology. They all interpreted the portents of the stars for their princely patrons, as did the ancient Chinese astrologers, or Maya scribes who calculated out the Venus table in the Dresden Codex. We may clearly understand that Ptolemy's magnificent *Almagest* was the greater contribution to humans' understanding the cosmos, but his astrology book, the *Tetrabiblos*, probably sold a lot more copies.



Galileo's hand-calculated horoscope. It is shown twice here because he calculated it under both the Julian and Gregorian calendars.

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