A SCHEME OF HEAVEN

THE HISTORY of ASTROLOGY and the SEARCH for OUR DESTINY IN DATA

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THE ORIGINS OF ASTROLOGY IN SIX OBJECTS

α. The Pyramid of the Pharaoh Unis

Date: ca. 2350 BC

Original location: Saqqara necropolis, Egypt

Current location: Saqqara necropolis, Egypt

Significance: An early and unambiguous expression of man's regard for the stars.

When did humans first take an interest in the movements of the sky? The beginning of our species several hundred thousand years ago seems like a reasonable guess, but what actual evidence is there? Since there aren't any definitive records, we'll instead regard any physical evidence that has survived as a *terminus ante quem*, a "boundary-line before which," meaning that whatever origin date we're looking for must, logically, have happened beforehand.

Choosing the pyramids as our terminus may seem surprising, since there are a number of much older sites that are famous (or, perhaps, infamous) for their astronomical associations. Stonehenge in the U.K., for example, which dates to around 3000 BC, may have been built to align with sunrise on the summer solstice. And the even more ancient Göbekli Tepe in southern Turkey, built around 9000 BC, has also been hypothesized to have served some sort of calendrical function. But sites like these two, which consist of vaguely circular arrangements of large stone pillars, are the archaeological version of astrology's fundamental question: how do you know it's not just random?

To put it another way, the sky is a pretty target-rich environment, so any imaginary line drawn on the ground is guaranteed to point, at least approximately, to some intriguing star or celestial arc in the sky. Are you exploring an ancient structure that's oriented east–west? Well, maybe it was built that way to align with the equinoxes. And if the alignment isn't exactly east–west, then perhaps the builders had in mind the summer solstice somewhat to the north, or the winter solstice a bit to the south, or maybe even some ritually significant constellation as it would have appeared thousands of years ago.

Yet while there are plenty of things in the sky worth pointing to, the angular slop involved when sighting a line between large objects—two pillars, for example, or a row of hilltops—won't have anywhere near the precision needed to pick out a specific celestial body from its surroundings. And this makes it very hard to know if a site was built with a cosmic motivation at all.

For instance, suppose we situate ourselves at a key observation point and regard as significant just the four cardinal compass directions (north, south, east, and west), as well as sunrise and sunset at the two solstices. If we allow each of these eight directions a very reasonable 5-degree measurement window (2.5 degrees on either side), then we've already marked $8 \times 5 = 40$ degrees, out of a total 360 degrees, as cosmically significant. That's more than 10 percent of all possible compass directions. If we were to take a prehistoric temple and spin it around like a bottle, then it would have more than a 10 percent chance of settling in a direction that we'd be tempted to conclude was celestially motivated. And this is even before we've

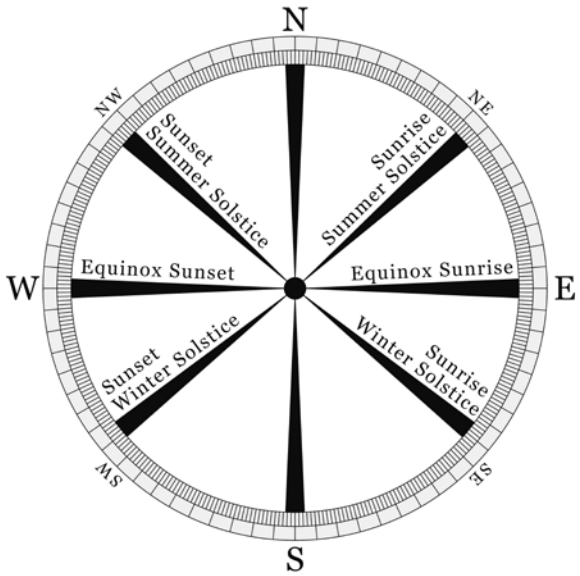

Figure 2.3: Sunrise and sunset directions for the latitude of Stonehenge. Even with very minimal assumptions, over 10 percent of the compass is quickly filled up by lines that may seem to be celestially significant.

considered the risings of the Moon and major stars. Statistically speaking, obtaining a result that can happen by dumb luck more than 10 percent of the time is simply not a significant outcome. This doesn't mean that prehistoric archaeological sites were not aligned cosmically—it's actually a perfectly plausible premise. It does mean, however, that it's difficult to argue this convincingly from their physical layout alone.

Which brings us to the pyramids. We'll skip over as no less speculative the various theories about how the pyramids' interior passageways may once have lined up with key stars, or how, taken as a group, they form a sort of primeval star chart. Actually, the pyramids' cosmic connection is much more obvious. For one thing, they're literally giant arrows pointing up at the sky. But even more definitively, we can be certain that the pyramids attest to a celestial awareness because they tell us so. A number of the earliest pyramids contain inscriptions, the so-called Pyramid Texts, consisting of spells and incantations meant to guide the deceased pharaohs on a celestial journey to the afterlife. "[P]art your place in the sky among the stars of the sky, for you are the lone star at the shoulder," exhorts one such incantation. "Now that I have swept away the night and sent off the hour-stars, the controlling powers appear and privilege me as Baboon," exclaims another.

Figure 2.4: The Pyramid of Unis, Saqqara, Egypt. WERNER FORMAN ARCHIVE / BRIDGEMAN IMAGES.

The oldest pyramid, built for the pharaoh Djoser by his advisor and architect Imhotep, dates to around 2650 BC. The oldest Pyramid Texts, inscribed in the tomb of the pharaoh Unis, date to around 2350 BC. These inscriptions

are the very oldest Egyptian literature known. Actually, they are some of the very oldest writing known, period. And the chamber containing these inscriptions is decorated with dozens and dozens of five-pointed stars, which may be the oldest unambiguous depictions of any celestial object anywhere. While doubtless not the first expressions of mankind's regard for the heavens, these monuments provide, at least for our purposes, a rock-solid starting line from which to track astrology's subsequent rise.

β. An Ancient Egyptian Coffin Lid with a Map of the Stars

Date: ca. 2000 BC

Original location: Asyut, Egypt, Tomb 20

Current location: Egyptian Museum, Cairo

Object identifier: JE 36444; SR 3/696

Significance: An early map of the heavens, and early evidence for some familiar divisions of time.

In ancient Egypt, whoever would be reborn after death, as was the Sun each morning, would need to navigate the same celestial path the Sun took through the underworld each night. It was, presumably, to assist the dead in this journey that certain Egyptian coffin lids were decorated with maps of the stars. Though they're probably knockoffs of an older, royal exemplar, these coffin lids nevertheless have the distinction of being the oldest known maps of the heavens. The stars are arranged in a table, like a spreadsheet, so they're really

Figure 2.5: An ancient Egyptian coffin lid with a map of the stars. IMAGE COURTESY OF THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO.

more like a train schedule than a conventional, pictorial star chart. Their purpose was to show which stars would be visible in the sky at various times. In so doing, these coffin lids also illustrate the development of the Egyptian calendar and provide early evidence for some of its very recognizable divisions of time: years made up of 365 days and organized into twelve months, and days made up of twenty-four hours. This latter division is of particular interest because, despite its familiarity, it also happens to be entirely arbitrary—there's no reason a day couldn't be divided into twenty-five, seventeen, or one hundred intervals called "hours." Indeed, during the French Revolution, "decimal clocks" were made which divided the day into just ten hours. So why the number twenty-four? The coffin lids provide the answer.

A typical coffin lid star map identifies thirty-six patches of stars, one for each of the thirty-six ten-day weeks of the Egyptian year. (Five special days, not belonging to any month, were tacked on to the end of the year to bring the total number of days to 365.) The stars assigned to a given week were those which, during that week, could be seen rising over the eastern horizon just before sunrise. On an average night, roughly twelve of these star patches, called decans, could be observed arcing across the sky from sunset to sunrise. This observation was later formalized into the notion of a twelve-hour night and, from there, a matching twelve-hour day.

It's important to note, however, that none of the surviving coffin lids agrees completely with the idealized Egyptian calendar. The imperfections and alterations from one coffin lid to the next evidence the frustrations in assigning nice round numbers to the cycles of astronomy. Even the seemingly small deviation of the Egyptian year of 365 days from the actual solar year of (approximately) 365.24 days was still large enough for its seasonal wanderings to have been noticeable during an individual lifespan. Regulating calendars to ensure their correspondence with the cycles of the cosmos has been one of the chief occupations of astronomers throughout history, and it's one that still requires active maintenance even today. In order to account for the uneven slowing of the Earth's rotation, for example, "leap seconds" must occasionally be added to Coordinated Universal Time, or

UTC, which is the time standard regulating the world's official clocks. As of this writing, the most recent leap second was inserted into UTC by the International Earth Rotation and Reference Systems Service (IERS) on December 31, 2016.

γ. Fragments of the MUL.APIN Astronomy Tablets

Date: 687 BC

Original location: Assur, Assyria (near modern Al-Shirqat, Iraq)

Current location: Vorderasiatisches Museum, Berlin

Object identifier: VAT 9412 + 11279

Significance: A snapshot of astronomical knowledge that includes an early version of the zodiac.

After the early artifacts of the third millennium BC, the subsequent development of the celestial sciences becomes very murky indeed. To a large degree, this is simply a fluke of archaeology. In the mid-1800s, thousands upon thousands of inscribed clay tablets were excavated from the royal library of the Assyrian Empire at Nineveh, a site that dates to around 650 BC. Meanwhile, there's no comparable trove of writings known from earlier periods. It seems reasonable that the extraordinary astronomical texts discovered in this library are the products of older traditions refined over several centuries. On the other hand, who really knows?

This is the case with the astronomical tablets called MUL.APIN, named for their opening words, which mean "The Plough Star." Some forty fragmentary copies of MUL.APIN have been recovered, one of which gives a date of inscription corresponding to 687 BC. The astronomical lore they contain, however, may be much older—perhaps by as much as a thousand years.

The MUL.APIN tablets are important because they provide an early benchmark for the state of astronomical knowledge. This knowledge included an awareness of the five planets visible to the naked eye (Mercury, Venus, Mars, Jupiter, and Saturn) and simple rules for when they could be

seen. The tablets also provide several constellation lists, together with their rising dates during the year. One of these constellation lists, the so-called constellations "in the path of the Moon," is significant because it's the earliest known forerunner of the zodiac. Since the Moon's path in the sky hews very closely to the Sun's path in the sky (the path known today as the ecliptic), this is the first indication that stargazers had begun to recognize the usefulness of this celestial circle for tracking the orbits of the Sun, Moon, and planets. Although MUL.APIN lists seventeen of these constellations, their kinship with the modern zodiac is impossible to miss.

Table 2.1: Constellations in the Path of the Moon

	Constellations in the Path of the Moon from the MUL.APIN Tablets	Corresponding Modern Constellations (zodiac constellations in ALL CAPS)
1.	Stars	Pleiades (in TAURUS)
2.	Bull of Heaven	TAURUS
3.	Loyal Shepherd of (the sky god) Anu	Orion
4.	Old Man	Perseus
5.	Shepherd's Crook	Auriga
6.	Great Twins	GEMINI
7.	Crab	CANCER
8.	Lion	LEO
9.	Furrow	VIRGO
10.	Scales	LIBRA
11.	Scorpion	SCORPIUS
12.	Pablisag (a god)	SAGITTARIUS
13.	Goat-Fish	CAPRICORNUS
14.	Great One	AQUARIUS
15.	Tails of the Swallow	PISCES (western fish)
16.	Anunitu (a goddess)	PISCES (eastern fish)
17.	Hired Man	ARIES

Exactly why the number of zodiac constellations was reduced to twelve may never be known. Mathematically, twelve has the useful property that it is evenly divisible by a large set of smaller numbers, namely, 1, 2, 3, 4, and 6. It's also worth pointing out that Jupiter, frequently the brightest object in the night sky and associated by the Babylonians with their chief god Marduk, takes very nearly twelve years to complete its orbit around the ecliptic. This may have suggested the idea of dividing the ecliptic into twelve sections such that each section housed Jupiter for roughly an entire year, even if such a system could never have been maintained consistently.

δ. A Collection of Eclipse Omens

Date: ca. 650 BC

Original location: Nineveh, Assyria (near modern Mosul, Iraq)

Current location: British Museum, London

Object identifier: K.3563

Significance: An early example of celestial divination.

Assyria, as the tablets from its archives attest, was an empire entranced by all manner of prognostication and divination. In every corner of the kingdom, seers were asked for their interpretations of omens, which they dutifully reported to the capital at Nineveh. For biblical context, Nineveh is also where Jonah was commanded to prophesy—though, to no avail, he attempted instead to flee by ship. From the rubble of Nineveh, multi-tablet tomes have been excavated detailing how to predict the future from dreams, smoke patterns, deformed births, the color of ants crossing a doorway, and, of course, everything and anything observed in the sky.

The name for the main, seventy-tablet collection of Babylonian celestial omens is *Enūma Anu Enlil*, from its opening words, "When the gods Anu and Enlil." The astronomer-priests charged with observing the sky and interpreting its signs held the title of *ṭupšar Enūma Anu Enlil*, "scribe of the omen series *Enūma Anu Enlil*." The discipline as a whole, by extension, was called

ṭupšarrūtu Enūma Anu Enlil, "the art of the scribe of *Enūma Anu Enlil*." So if you're looking for the earliest name for astrology, however imperfect the correspondence, this is probably as good as it gets.

A closely related tablet which contains an especially interesting list of celestial omens is K.3563. The tablet's origin is Babylonian, but this copy was housed, perhaps by royal request, at the Assyrian library at Nineveh. Whether it was ever consulted by the king's diviners is impossible to say. What is known is that it lay buried along with the rest of the library for nearly 2,500 years before being excavated and carted off to the British Museum in London, where it's held today. K.3563 contains a list of lunar eclipses arranged according to the months and days in which they might occur, together with the events they foretell. One example is for the lunar month of Elul (or Ulūlu), and it goes like this:

59. If on either the 13th or 14th day of Ulūlu . . . the moon is dark; the watch passes and it is dark; his features are dark like lapis lazuli; he is obscured until his midpoint; on the west (quadrant) as it is covered, the west wind blew; the sky is dark;
61. his light is covered; the son of the king will become purified (i.e., will perform *elēlu*-rituals) for (accession to) the throne but will not take the throne; an intruder will . . . princes in the west; for 8 (gloss: 16) years he will exercise kingship; . . . ; he will conquer the enemy army; there will be abundance and riches in his path; he will continually pursue his enemy, and his luck will not run out.

In other words, if you're the king and there's a lunar eclipse on the 13th or 14th of Elul while the west wind is blowing, you had better keep a very close eye out for any lucky intruders from the princes in the west.

Omen texts like tablet K.3563 reveal an impressive commitment to a close observation of the natural world, even if they display a rather bold conception of cause and effect. But how bold is too bold? Figuring out which phenomena are suitable for modeling and prediction and which aren't is a question that, in many ways, remains contentious within the sciences even today. As we'll

explore in this book, astrology, which has a long history of making predictions ranging from the perfectly reasonable to the patently absurd, offers one of the richest sources of material for probing this very question.

ε. A Cuneiform Horoscope

Date: April 29, 410 BC

Original location: Babylon (near modern Baghdad, Iraq)

Current location: Ashmolean Museum, Oxford

Object identifier: AB 251

Significance: The oldest known personal horoscope.

Figure 2.6: A cuneiform horoscope. IMAGE © ASHMOLEAN MUSEUM, UNIVERSITY OF OXFORD.

The excavation of the Assyrian library at Nineveh, and specifically the discovery of the MUL. APIN tablets and celestial omen lists, offers a snapshot of celestial knowledge as it existed around the year 650 BC. The development of this knowledge over the next several centuries is actually much better understood, again thanks entirely to fairly recent archaeological discoveries. Of particular importance is the collection of tablets from Babylon known as the "astronomical diaries." These are compilations of nightly observations of the positions of the Moon and planets, together with notes on eclipses, equinoxes, and solstices. Occasionally, the diaries record the weather (such as when it's too cloudy to make an observation), the river level of the Euphrates, grain prices, and even certain newsworthy political events.

It's generally agreed that these diaries are the long-lost records which Ptolemy referred to in his *Almagest* when he wrote that the reign of the Babylonian king Nabonasser was "the era beginning from which the ancient

observations are, on the whole, preserved down to our own time." Nabonasser's reign began in 747 BC, the oldest surviving astronomical diary dates to 652 BC, and the last surviving one dates to 61 BC. Rivaled only by the extraordinary astronomical records from ancient China, the Babylonian astronomical diaries are one of, if not the longest continuous research program ever undertaken. To properly convey the enormity of this achievement, I yield to two of its foremost historians, Hermann Hunger and David Pingree:

> That someone in the middle of the eighth century BC conceived of such a scientific program and obtained support for it is truly astonishing; that it was designed so well is incredible; and that it was faithfully carried out for at least 700 years is miraculous.

Inevitably, perhaps, the increased observational sophistication of the astronomical diaries was combined with the deep-rooted celestial omen tradition to produce an entirely new genre of text: the personal horoscope. The oldest of these goes as follows:

1 Nisannu, night of the 14th(?), . . .
2 son of Šumu-uṣur, son of Šumu-iddina, descendant of Dēkē, was born.
3 At that time, the moon was below (lit.: the lower part of) the Pincer of the Scorpion,
4 Jupiter in Pisces, Venus
5 in Taurus, Saturn in Cancer,
6 Mars in Gemini. Mercury, which had set, was not vis[ible].
7–8 [*observations of lunar visibility for the month*]
[*reverse of tablet*]
1 (Things?) will be propitious for you.
2–4 [*omitted*]

This tablet is also remarkable for being one of the very first documents to show the full evolution of the zodiac from just another constellation list to a regular system of celestial coordinates. Using the zodiac signs this way

becomes increasingly common in the astronomical diaries starting around the year 450 BC. In fact, reporting only the zodiac signs in which Saturn, Jupiter, Mars, Venus, and the Moon were located, as this horoscope does, is sufficient to narrow down its date to just a handful of possibilities, with the night of April 28/29, 410 BC, representing the most likely match. Although the name of the child born that night is missing, given how old this tablet is, and the lucky fortune it foretold, we may just as well regard it as the birth horoscope of astrology itself.

Figure 2.7: Astronomical diary chronicling the conquest of Alexander the Great. IMAGE © THE BRITISH MUSEUM.

Darius III at the Battle of Gaugamela, a battle which marked the completion of his conquest of Persia. A scheme of the heavens as they would have appeared to the stargazers in Babylon on that fateful night is plotted in color plate 4.