Ancient Astronomers

Our century owes a great debt to the curiosity of early Mesopotamian priestly observers of the skies, because this activity is the embryo of mathematics and the scientific quest. These early "tupšar" or temple astronomers were drawn to the mysteries of a night sky unsullied by today's ubiquitous light pollution. They watched patterns of stars rise in the East, culminate and set in the West during the course of a night until the rising sun washed out the sky. As the seasons changed in succession over the course of each year, different sets of constellations would be visible in the cycle.

Furthermore, five of the observed stars were seen to move against the backdrop of the others, roughly along the same path used by the moon and the sun, but less uniformly so, sometimes appearing to make small loops or even move backwards along the path for several nights before continuing eastward on that pathway called the Ecliptic.

What a compelling mystery all of this was! Little wonder that the most active players in the nightly theater of the skies were imagined to be divine entities or tokens of divinity imparting a message for spectators to read and comprehend. Above all, human beings are pattern-seeking animals compelled to devote great efforts to discover patterns in the world around them and also speculate on the meaning of those changing patterns, certain that special advantages must accrue from successfully interpreting messages from the Gods.

Among the most ancient of the tablets of astronomical diaries that have come down to us are those concerning the planet Venus originally compiled during the reign of the king Ammisaduqa (c.1646-1626 BCE). Although several of the familiar zodiacal constellations comprising the Ecliptic circle are recorded on boundary markers from this time, the system of twelve equal month signs, each of thirty degrees' extent, seems not to be attested until about the fifth century BCE. Detailed star catalogues developed by the eighth century BCE and gradually became more sophisticated as we move down the ages among Sumerian, Babylonian, Assyrian, Persian, then Hellenistic civilizations.

Lunar and planetary positions were first observed in relation to the kakkab minati, so-called "normal stars" prominent in a band ranging between ten degrees north of the Ecliptic to seven and one-half degrees south of it. Among the brightest of these are Aldebaran, in the middle of Taurus, Regulus, near the beginning of Leo, Spica, near the end of Virgo, and Antares, the heart of Scorpio. We still commonly use the Babylonian sexagesimal system of degrees, minutes, and seconds of angular measurement as well as in units of time. The Babylonian "uš" referred both to a degree of arc measurement, as well as the time unit for the sky to apparently rotate through that angle, one-fifteenth of our hour. Basically the ancient astronomers wished to observe long enough to discover the intervals between recurrences of planetary phenomena, including position against background stars, occultation of such stars, and both lunar and solar eclipses, in order to be able to predict them accurately. There was also the magical belief that events 'down below' would recur in synchrony with apparitions in the heavens ... an intuitive faith in some sort of cosmic order and desire to discover as much of it as possible.

By the beginning of the reign of Nabûnasir (747 BCE), astronomical recordkeeping had become sufficiently comprehensive to improve the calendar. Nineteen solar years were found to equal two hundred thirty-five lunar months. The discrepancy is but two hours, so that the first day of the month of Nisanu could be easily kept in step with the vernal equinox. This cycle is historically known to us as the Metonic Cycle, because the astronomer, Meton of Athens introduced in a Greek calendar beginning on June 27, 432 BCE, the summer solstice of that year. The Metonic Cycle is still the basis of the lunisolar Jewish calendar, in which a thirteenth month, Adar, is inserted during seven out of each nineteen years.

Naburiannu is the earliest of the Babylonian astronomers known from extant records. About 500 BCE he completed the tables known as System A, describing the moon's motion against the background of the stars of the Ecliptic, now beginning to be seen roughly in the form of the twelve signs of the Zodiac familiar to us today. Incidentally, within System A, it was reckoned that the vernal equinox occurred when the sun reached the tenth degree of Aries, not the beginning. Aries at this time was still represented as the hired hand, "Luhunga".

Over a century later, the Babylonian scholar Kidinnu refined estimates of the lengths of the solar year and the lunar synodic month within the context of so-called System B. The sun's apparent position at the vernal equinox was by now pegged at the eighth degree of Aries ... it's not certain when observers recognized that this point is effectively moving backwards against the stars. That's an effect now known to be cause by the precession of the spinning earth on its axis. By our time, in the northern hemisphere, spring begins when the sun is still near the beginning of Pisces, crossing into Aries around April fourteenth. Kidinnu seems to be responsible for introducing a Babylonian calendar based on a more accurate seventy-six year cycle, known generally as the Calippic cycle after Aristotle's student, Calippus of Cyzicus, imported this to Greek calendars beginning June 28, 330 BCE, less than a year after Alexander's armies captured Babylon.

Alexander had ordered that available Babylonian astronomical diaries and related documents be copied for his scholarly contacts in the Greek world, and through this effort, Hipparchus was able to draw upon records going back to 747 BCE. This provided him with the data needed to compile a catalog of over eight hundred stars in about 130 BCE, and Hipparchus is usually considered the father of Astronomy as a science and the first to note the precession of the Ecliptic, which he estimated as about one degree per century. Precession is now known to be about one degree per 71.6 years. The catalog of Hipparchus was a major forerunner of the Syntaxis of Claudius Ptolemy, dated 137 CE, and better known by its Arabic title, Almagest, for it came back into European knowledge through the Arabic translation in the medieval period.

Unfortunately there is record of the execution of a Babylonian named Kidinnu, in the aftermath of the conquest of Babylon. That person is assumed to be the scholar described here. Mesopotamia ultimately became a battleground between the Roman and Parthian empires; Babylon had considerably declined as a city and center of knowledge, though Baghdad on the Tigris attained high stature for a time particularly under the Abassid Caliphs Harun Ar-Rašid (786-803 CE) and Al-Ma'mun (813-833 CE) who sponsored the Bayt ul-Hikmah there as a great institution of learning, translating ancient knowledge and enlarging upon it.

In Roman times, famed naturalist Pliny the Elder credited Kidinnu (Cidenas) with the finding that the planet Mercury, whether appearing before sunrise or after sunset, is never viewed more than twenty-two degrees away from the sun. That fact will later bring some thinkers to the realization of the Heliocentric position championed by Copernicus in the mid fifteenth century. In fact, Aristarchus of Samos (310 - 230 BCE) was the first to clearly argue that the sun, rather than the earth, must be the center of our family of planets.

The famous Syracusan scholar Archimedes preserved memory of this great insight by a passing reference in his own work, The Sand Reckoner:

"Aristarchos has brought out a book consisting of certain hypotheses, wherein it appears, as a consequence of the assumptions made, that the universe is many times greater ...

His hypotheses are that the fixed stars and the Sun remain unmoved, that the Earth revolves about the Sun on the circumference of a circle, the Sun lying in the middle of the orbit, and that the sphere of the fixed stars, situated about the same center as the Sun, is so great that the circle in which he supposes the Earth to revolve bears such a proportion to the distance of the fixed stars as the center of the sphere bears to its surface."

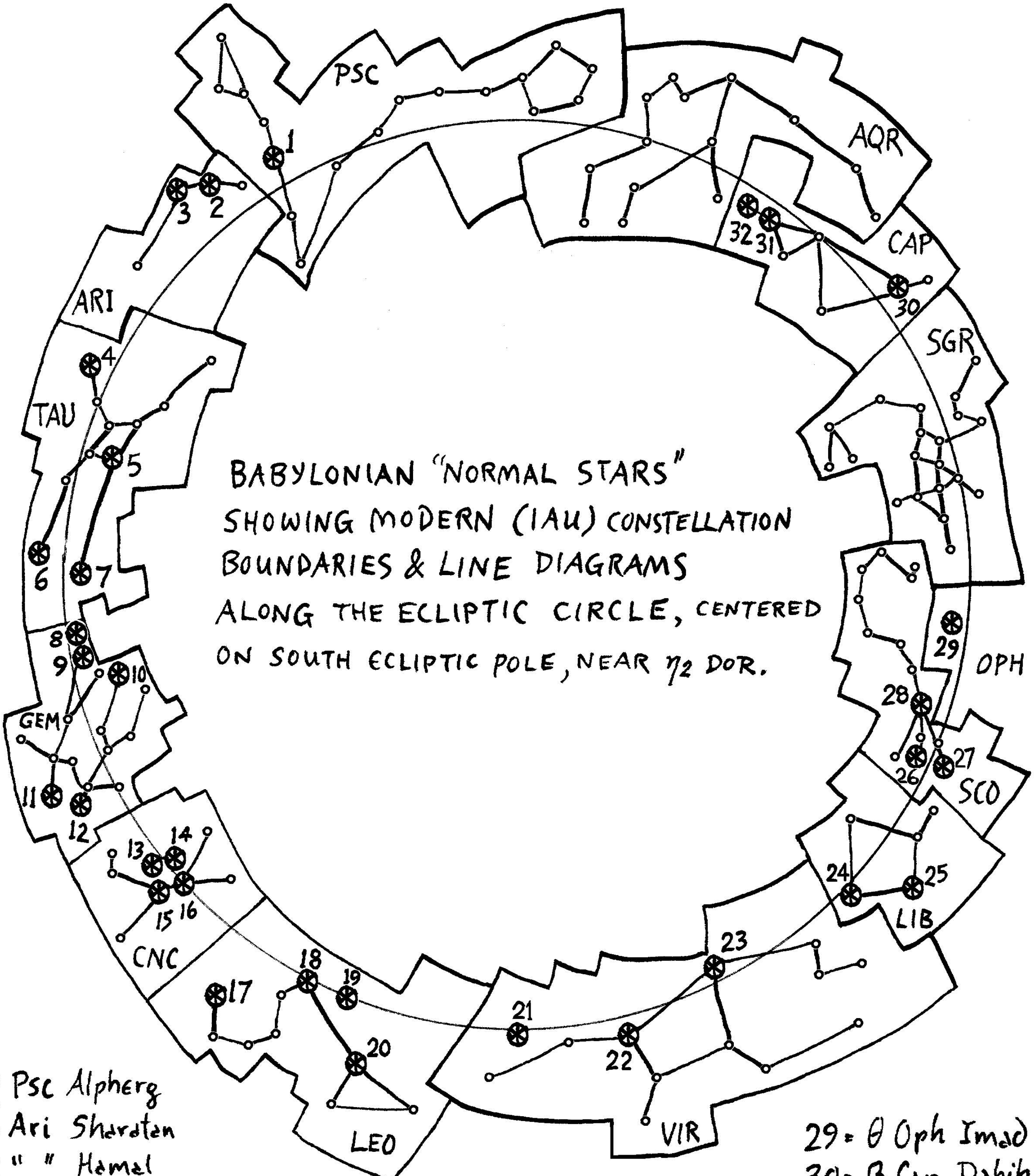
Unfortunately, the views of Aristarchus were rejected by most contemporaries and for many centuries thereafter, the geocentric model expounded strongly by Claudius Ptolemy held sway.

Aristotle himself recorded other remarkable insights of the pre-Socratic philosophers Anaxagoras and Democritus that the Milky Way might be composed of very distant stars, so distant that the parallax would be beyond the power of our eyes to resolve. He dismissed that though, claiming the phenomenon to be a "fiery exhalation" of nearby stars, essentially in the upper atmosphere. Many could not grasp the possibility of such enormous distances. It was left for Alhazen (965 - 1037 CE) to refute Aristotle though actual attempt to observe parallax. He could not, and concluded that such stars are indeed very distant and well outside the atmosphere.

Eratosthenes of Cyrene (276 - 195 BCE), associated with the great Alexandrian Library, was another prominent mathematician and astronomer of antiquity. He actually made a measure with 99% accuracy of the circumference of the earth by the ingenious use of trigonometry to compare noon shadows created by the sun on the summer solstice at both

Alexandria and Aswan, finding the distance between the two locations to be one-fiftieth of the circumference.

Knowledge has over time been hard-won by the successive efforts of people endowed with curiosity, talent for accurate observation, and gifts of both logic and insight. In ancient Mesopotamia and the Mediterranean world, many important discoveries were made in an age that was essentially pre-scientific because science as a self-correcting methodology simply had not yet evolved in the collective mind. Mesopotamian observers and thinkers contributed much for successive cultures to consider and build upon, and those accomplishments were an important source for the cultural and scientific world of the present.



1 = η Psc Alpherg
2 = β Ari Sharatan
3 = α " " Hamal
4 = η Tau Alcyone
5 = α " " Aldebaran
6 = β " " Elnath
7 = ζ " " Hecka
8 = η Gem Propus
9 = μ " " Calx
10 = γ " " Alhena
11 = α " " Castor
12 = β " " Pollux

13 = η Cnc
14 = θ " "
15 = γ " " Asellus Bor.
16 = δ " " Asellus Aust.
17 = ε Leo Reselasad Aust.
18 = α " " Regulus
19 = ρ " " Shir
20 = θ " " Chertan

21 = β Vir Zavijava
22 = γ " " Porrima
23 = α " " Spica
24 = α Lib Zubenelgenubi
25 = β " " Zubenelschemali
26 = δ Sco Dschubba
27 = β " " Acrab
28 = α " " Antares

29 = θ Oph Imad
30 = β Cap Dabih
31 = γ " " Nashira
32 = δ " " Deneb Algedi