

Origins of the ancient constellations: I. The Mesopotamian traditions

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In the sky-map of ancient Babylon, constellations had two different rôles, and thus developed into two overlapping traditions. One set of constellations represented the gods and their symbols; the other set represented rustic activities and provided a farming calendar. Many constellations were shared by the two traditions, but in some regions of sky there were alternative divine and rustic figures. These figures developed in stages from ~3200 BC to ~500 BC. Of the divine set, the most important (although the last to be finalised) were the twelve zodiacal signs, plus several associated animals (the serpent, crow, eagle, and fish), which were all transmitted to the classical Greek sky-map that we still use today. Conversely, the rustic constellations of workers and tools and animals were not transmitted to the West. However, a few of them may have survived in Bedouin Arab sky-maps of the first millennium AD.

Introduction

Although our constellations were inherited from classical Greece, they were probably much older. A common view is that they came originally from Mesopotamia – the land of Sumer and Babylon. But many statements about such an origin in popular books are derived ultimately from old and erroneous sources.^{1,2} So this article will review what is now known of Mesopotamian sky-maps, and to what extent they were passed on to the western world. A second article will explain how the Greeks combined various traditions to form the classical sky-map.

Although the surviving records from Mesopotamia are incomplete and often difficult to translate with certainty, they are quite adequate to show how the general picture of the heavens developed, and we actually have multiple copies of the main Babylonian ‘textbooks’ from several historical stages.³⁻⁸ A complete catalogue of recorded star names was given by Gössmann.³ Mesopotamian astronomy as a whole is described in the book by van der Waerden,⁶ and (more briefly) in Refs. 9–11. Mesopotamian religion and its symbols are summarised in Ref. 12.

Reviewing this wealth of recent scholarship, I infer that there were two overlapping traditions of constellations in

Mesopotamia, which developed contemporaneously but had different purposes. The ‘divine’ tradition identified heraldic animals and divine figures in the constellations, for religious purposes, especially in the zodiac; these were the figures illustrated as pictographs in Mesopotamian art. The ‘farming calendar’ tradition identified rustic workers and animals in the sky, to provide an annual calendar for farmers. Although many constellations belonged to both traditions, only the zodiacal and associated constellations from the ‘divine’ tradition were transmitted to the West.

The historical development will be traced through six phases.

1. The early pictograph phase, ~3200–2100 BC;
2. The boundary-stone pictograph phase, ~1350–1000 BC. These two phases show the icons of the gods which were also applied to constellations in the divine tradition (Table 1).
3. The *Three Stars Each* phase, ≥ 1100 BC (Table 2);
4. The *MUL.APIN* phase, 1100–700 BC. These two phases provided successive ‘textbooks’ of the constellations, which are the first written records to include the farming-calendar tradition. The *MUL.APIN* lists (Table 3), which are more complete and accurate, also give the

The four cardinal points, 90 degrees apart, are where the ecliptic crosses the celestial equator and where it reaches furthest north and south. As defined by the position of the Sun, they are the equinoxes and solstices. The position of the spring equinox is named the First Point of Aries; the latitudes of the summer and winter solstices define the Tropic of Cancer and the Tropic of Capricorn.

Heliacal rising is when a constellation first becomes visible rising in the dawn. This can be coincident with the date when the Sun is in the constellation, if the principal stars happen to lie north-preceding the centre of the constellation, as in the case of Taurus (the Pleiades) and Aries. Or it can be up to a month later, depending on the pattern and brightness of the stars, and the tilt of the ecliptic at that season.

Precession is the gradual circling of the Earth’s axis around the pole of the ecliptic. It alters the zodiac’s relation to the seasons at a rate of one constellation every 2160 years (1° every 72 years). The cardinal points have shifted from one constellation to the next in approx. 6540 BC, 4380 BC, 2220 BC, 60 BC, and AD 2100 – but these are only average dates, as the constellations had different and variable sizes, and were only assigned equal 30-degree intervals in the fifth century BC for astrological purposes. If a constellation marked a particular month in (say) 1000 BC by the solar position, on average it would have marked it by heliacal rising about a thousand years earlier.

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divine associations of those constellations which were shared between the two traditions, thus allowing us also to interpret the icons of the divine tradition.

5. The astrometric diaries phase, ~750–60 BC. Astronomy and astrology matured together; the first precise and regular records of planetary motions were used in constructing horoscopes. Also from this period we have the first surviving pictures of Mesopotamian constellations, the Seleucid and Dendera Zodiacs (below).
6. Transmission of the zodiacal constellations to the Greeks, and of a few farming-calendar constellations to the Arabs.

The Seleucid and Dendera Zodiacs are illustrations of the pictograph tradition from the 5th phase, showing the zodiac plus the four ‘para-zodiacal’ animals (crow, serpent, eagle, and southern fish). The Seleucid Zodiac was a set of 12 clay tablets showing the zodiacal signs for astrology, and examples of three of them survive from the last few centuries BC: Taurus with the Pleiades, Leo with Corvus standing on Hydra, and Virgo with her ear of corn.^{6,13} The Dendera Zodiac is the only complete map that we have of an ancient sky, from Egypt in the first century BC; it shows the classical zodiac surrounded by the Egyptian constellations for the rest of the sky (Figure 6). But the zodiacal constellations are not shown in their Graeco-Roman forms; the shapes of the figures on the Seleucid and Dendera Zodiacs are almost identical to each other and to the boundary-stone pictographs from the second millennium BC (compare Figures 5 and 6). So the Dendera Zodiac seems to be a complete copy of the Mesopotamian zodiac.

First phase: early pictographs, ~3200-2100 BC^{12, 15–18}

The great Mesopotamian civilisations date back to the Sumerians, who invented both cities and writing around 3000 BC. But even before then, from the late 4th millennium BC (~3200 BC), Mesopotamia produced a rich artistic tradition. The artworks include pottery, and carvings, and especially seals (carved cylinders to be rolled across a wet clay tablet to impress the owner’s emblems). They show many naturalistic animals, which are often being killed by each other or by gods, kings, or heroes.^{15–17} Some common artistic motifs, such as the lion-attacking-bull or the two-ibexes-with-tree, may have had religious or mythical meaning.

Prominent in these artworks are bulls and lions, and sometimes scorpions. These same animals were pictured in the sky as the earliest zodiacal constellations – Taurus, Leo, and Scorpius. We do not know when these constellations

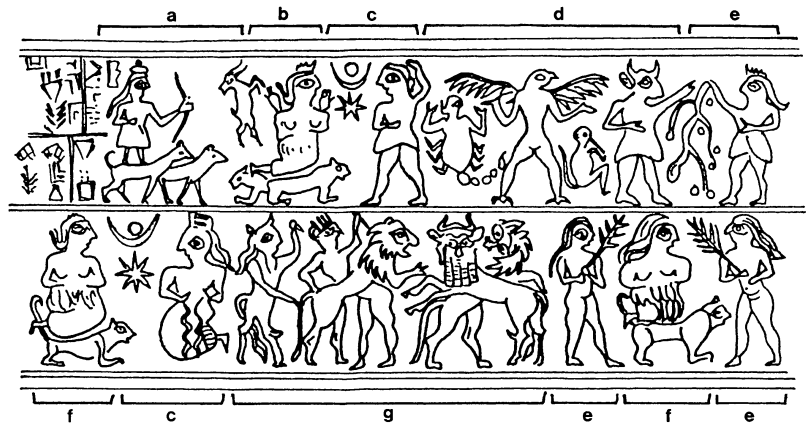


Figure 1. A cylinder-seal impression from the Elamite capital of Susa, ~2500 BC. **Key:** (a) Hunting god standing on two dogs, aiming a bow at a goat; (b) Goddess on two lions, with weapons or wings at her shoulders (similar to later figures of Ishtar); (c) Sun, Moon, and Venus, and a worshipper; (d) Chimeric figures, viz. scorpion-man, bird-demon, monkey with flute, bull-human; (e) Figure holding a branch; (f) Goddess kneeling on a lion; (g) A variation on a classic combat scene: bull-man and hero stabbing one of two lions, which in turn are attacking a human-headed bull. *Original clay impressions in the Louvre; this drawing by D. Collon [Refs. 15, 16], reproduced by permission.*

were actually defined, but it was most probably around the same time, ~3200 BC. Although the main importance of bulls and lions was as real animals and as power symbols, some of these figures were decorated with stars and so may have represented the constellations.¹⁸ Moreover, it was just around this time that these constellations plus Aquarius marked the cardinal points of the ecliptic [see box on page 9]; and they were among the few zodiacal constellations which were invariant in all later Mesopotamian star-lists. Their history is discussed further below, under ‘Zodiac I’.

Although the four cardinal points are commonly thought of in relation to the Sun, defining the solstices and equinoxes, it requires a rudimentary cosmology to realise that the Sun is ‘in’ a constellation during the day. The early Mesopotamians probably did not have this; they described the sun-god as entering a chamber of the ‘interior of heaven’ during the night,¹² and cutting his way out through a gate on the horizon in the morning (see Figure 2). However, for a people who were clearly interested in the Moon and other planets, these would be sufficient to make the cardinal points evident and important.

Later artworks showed many animals and gods, some of which were clearly identified with heavenly bodies. They often included the symbolic triad of Sun, Moon, and Venus. Two beautiful examples from what is now Iran may show an early stage in this tradition. One is a cylindrical stone jar of ~2600 BC;¹⁷ the other is a seal of ~2500 BC (Figure 1). Each shows a splendidly vivacious bestiary and pantheon, including the Sun-Moon-Venus symbols and a lion-versus-bull combat scene with an eagle or a man-bull joining in. Between them they also include a goddess standing on lions (prototype of Ishtar/Leo and Virgo?), a hunting god with bow standing on dogs (unidentified; perhaps prototype of Pabilsag/Sagittarius?), a figure holding two streams of water, standing on oxen (prototype of Ea/Aquarius?), and a figure holding two snakes, standing on panthers (probably not Ophiuchus; prototype of Ningizzida/Hydra?). These scenes may show the beginnings of the zodiacal

iconography which, as we shall see, developed standard symbols for the gods which were shown in the sky as well as in art.

It is intriguing that many of these possibly proto-zodiacal artworks came from Elam, Sumer's rival to the east, later part of Persia. The earliest bulls and lions proposed by Hartner¹⁸ as astronomical were Elamite, as were the two bestiaries cited above. Moreover, as we shall see below, the original *Three Stars Each* lists probably had the Pleiades, Leo, Scorpius, and Aquarius listed as 'Stars of Elam', whereas the 'Stars of Akkad' and 'Stars of Amurru' included only a few other zodiacal constellations (Gemini, Libra, and ?Cancer) which may in any case have belonged to the farming-calendar tradition at that stage. It might be worth investigating whether the zodiac actually originated from Elam rather than Sumer.

Sumer was conquered by Sargon of Akkad, who established the first of a series of increasingly great and terrible empires which ruled Mesopotamia: Akkadians (from 2334 BC), Sumerians again (from 2150 BC), 'Old' Babylonians (from 1830 BC), Kassites (from 1530 BC), 'Middle' Babylonians (from 1125 BC), Assyrians (from 729 BC), 'New' Babylonians or Chaldeans (from 612 BC), and Persians (from 539 BC). However, the culture of religion, art, and astronomy was a continuous one in spite of these upheavals.

'The Sumerian deities were mostly associated with fertility and animal husbandry, but the Akkadian deities were predominantly astral, representing Sun, moon and stars. In order to unite the country ... [these] deities were combined and a standard iconography devised so that they could easily be identified visually. The fine seal of Adda illustrates the process.' – D. Collon [Ref.17]. (See our Figure 2.)

Thus from ~2300 BC onwards, many seals showed divine figures including those which became the zodiac, as well as bulls, lions, birds, and other animals. The 'zodiacal' figures do not tend to be grouped together and there may be no astronomical intent; rather, in all the pictograph tradition, we see symbols of gods which were also displayed in the stars. The seal of Adda (Figure 2) groups together the greatest number of gods in their archetypal images, which were also the forms most clearly related to the stars – though all its figures are seen in similar forms on other seals.

Ea, the beneficent god of earth and life, who dwelt in the abyssal waters, was shown with two streams running from his hands or shoulders; he became Aquarius, and his symbols also formed the constellations of Capricornus (Ea's goat-fish, first seen on a seal of Ur just before 2000 BC), the Field (our Square of Pegasus), Piscis Austrinus, and perhaps Pisces (see final section) and Aries (Ea's ram's-head staff).

Ishtar, queen of heaven and whore of Babylon, goddess of love and fertility and war, was shown with weapons and lions and harvest produce; later her only astral symbol was the planet Venus, but she may have been the origin of the constellations of the Bow (our Canis Major), and Leo, and Virgo.

An unidentified **hunting god** carries a bow, and could perhaps be Pabilsag, our Sagittarius.

The sun-god, **Shamash**, is shown as a bearded man with rays flaring from his shoulders, cutting his way through the eastern horizon with his characteristic serrated knife.

On seals of this period, the Sun-Moon-Venus triplet was only occasional. It became frequent on seals from ~2100 BC onwards,¹⁷ but from that time onwards the gods were shown paying more attention to the kings than to the heavens.

The Sumerians may have created the other constellations later recorded in Babylon; although there are no surviving written records of most of these before about 1100 BC, the Babylonians used Sumerian names for many of them. However, this may just have been because the Babylonians used the Sumerian language and script for many of their cultural writings. Sumer was to Babylon as Greece was to Rome – respected as the source of civilisation even after being absorbed into the empire – so some names might have been invented in the Sumerian language at later times. The cuneiform symbols could be read either as Sumerian words (which are transliterated in capital letters in our tables, as is conventional), or as syllables in the Babylonian (Akkadian) language (written in lower-case), so the decipherment is a complicated matter. Many of the constellation names cited herein were written in Sumerian.

Second phase: boundary-stone pictographs, ~1350–1000 BC^{19–22}

An entirely new pictograph tradition began in Babylonia during the Kassite dynasty: the boundary stones ('kudurru'). They were royal charters, which called on the gods to witness and protect the ownership of land. King²⁰ suggested that the lengthy and detailed divine curses written on the stones were needed to protect land privatised by Kassite kings for their favourite officials. The boundary stones are of interest here because they were decorated with symbols of the gods, most of which corresponded to planets or constellations. The extant ones range in date from ~1350

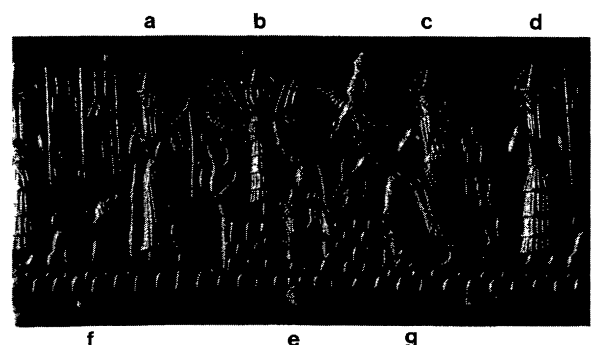


Figure 2. Wax impression of the 'Seal of Adda', ~2300 BC. Original in the British Museum, no. WA 89115. **Key** [Refs. 15, 16]: (a) An unidentified hunting god with a bow. (b) The goddess Ishtar with weapons at her shoulders, holding a bunch of dates. (c) The god Ea, with two streams filled with fish running from his shoulders, holding an eagle. (d) The two-faced attendant of Ea. (e) The sun-god, Shamash, with rays flaring from his shoulders, cutting his way through the mountains of the horizon with his serrated knife. (f) Lion. (g) Bull. *Reproduced by permission of the British Museum.*

BC to ~1000 BC, apart from some later ones produced down to the end of Assyrian rule. There were only minor changes in style during this period, all the common symbols being already present in the 14th century BC. Some were vertical slabs with the symbols in rows which corresponded roughly to a cosmic order, whereas others were more ovoid stones with the symbols arranged artistically around the upper 'dome', and some early ones were more columnar with elaborate scenes around four sides. Examples of the first two forms are illustrated in Figures 3 and 4, with a key to the symbols in Table 1.

The following survey will show that, in the second millennium BC, there were clear records of the divine icons which also became the zodiacal constellations of Taurus, Leo, Scorpius, Sagittarius, Capricornus, Aquarius, and probably Virgo and Aries, while there may also have been forerunners of Pisces and Gemini. The zodiac was never shown explicitly, and there is no proof that the icons represented constellations at that time. Several of these constellations would not become part of the astronomers' sky-map until much later. However, it seems very likely that they represented divine constellations, given the cosmographical ordering of the more important deities which we will

find on many of the boundary-stones. Many of the para- or non-zodiacal constellations were also known as divine symbols, and several of these were also represented on boundary-stones.

Over 100 boundary-stones are known,²¹ but most are fragmentary. From the major reviews of Refs. 19–21, I have tabulated the symbols on the 24 stones that appear reasonably complete,²² grouped into three stylistic periods. The frequencies of the common symbols are listed in Table 1. The special features of the pre- and post-canonical groups will be described below. Here we summarise the iconography of the canonical group.

1–3. **Shamash, Sin, and Ishtar** are no longer shown as figures; they are always shown as the Sun-Moon-Venus triad on top of the stone.

4–7. Next, there are usually three or four shrines (absent from Figure 3). The first three represent three great gods and three divisions of the heavens: **Anu**, the ancient god of the heavens; **Enlil**, son of Anu, god of the air and the forces of nature, and lord of the gods; and **Ea**, the beneficent god of earth and life, who dwelt in the abyssal waters. The Babylonians divided the sky into three parts named after them. The northern sky was the Way of Enlil; the equator and most of the zodiac occupied the Way of Anu; and the southern sky was the Way of Ea. Even if other shrines are absent, Ea is always represented somewhere, either by a goat-fish (Capricornus) with a ram's-head standard, or by a turtle. Possibly the shrine of Anu represented 'the seat of Anu', cited in *MUL.APIN* as the divine form of Cancer – a blank patch of sky for the abstract sky-god, balancing the goat-fish Capricornus of the earth-and-water god, as these two now marked the summer and winter solstices. The fourth shrine, less often shown, is for **Ninharsaga (Ninmah)**; she was the mother of the gods and midwife of mankind, but is not known to have had astral significance apart from one southerly constellation (see *MUL.APIN*, Table 3).

8–13. Next, there is an array of four to six standards and/or shrines, which, I propose, represent the remaining four planets. These planets were later clearly identified with the gods Marduk, Nabu, Nergal, and Ninurta.⁶ On the boundary stones they are as follows:

8. One of these symbols is always **Marduk** (Jupiter), chief god of Babylon; he has a vertical spade, like a spear, and usually also a shrine with a dragon.

9. Another is almost always **Nabu** (Mercury), god of scribes and wisdom: almost always a shrine with a wedge (writing implement), or occasionally bricks, or just a vertical wedge.

10. Another is usually **Nergal** (Mars), god of the underworld and of plagues; his standard has a panther-head. It is usually called a lion-head, but looks as much like a panther-head, and *MUL.APIN* identifies Nergal with the constellation of the Panther or Panther-griffin, whose name means 'Demon with the gaping mouth.' (However the standard does not show the constellation, which had legs but perhaps not the head; it could be a griffin with an eagle's head.)

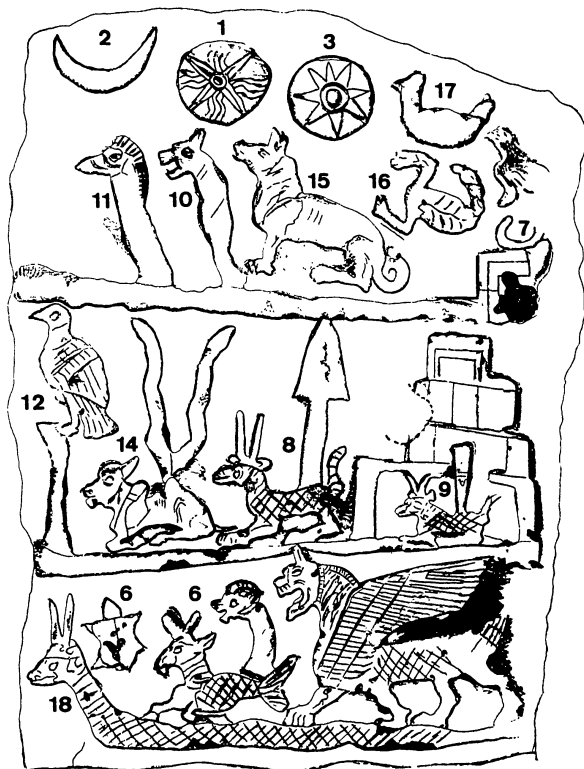


Figure 3. Symbols on a late Kassite boundary stone from the reign of Marduk-apal-iddina I: specimen S62/H7/London-99 [Ref. 22], in the British Museum (IV.R.38/43); see Ref. 20 for detailed description. See Table 1 for key. The composition is typical of the vertical slab boundary stones, with the symbols shown roughly in the order of the astronomical bodies. The execution is as rough as it appears on this drawing, and may be unfinished; possibly the stone was found unsuitable for fine working. Unique features of this stone are: (i) the ziggurat, above the dragon of Nabu; (ii) the winged lion, striding on the back of the serpent – the same posture later shown for Leo and Hydra in the Seleucid and Dendera zodiacs. Adapted from Hinke [Ref. 19] and reproduced by permission of the Syndics of Cambridge University Library.

Table 1. Symbols on Babylonian boundary stones

Key	Symbol	God	Astral identity	Frequency:		
				Period: Pre. (Total): (7)	Canon. Post. (14)	(3)
<i>Disks at top:</i>						
1	4-pointed star	Shamash	Sun	7	14	3
2	Crescent	Sin	Moon	7	14	3
3	8-pointed star	Ishtar	Venus	7	14	3
<i>Shrines ± symbols:</i>						
4	Shrine & head-dress	Anu	<i>Equatorial sky</i>	2	13	3
5	Shrine & head-dress	Enlil	<i>Northern sky</i>	2	13	3
6	Goat-fish) Ram's-head) Turtle)	Ea	<i>Southern sky;</i> Capricornus, Aquarius, etc.	7	13-14	3
7	Omega?Yoke?	Ninharsaga	(Part of Argo)	0	11-12	3
<i>Standards or shrines ± heraldic animals:</i>						
8	Spade ± Dragon	Marduk	Jupiter	7	14	3
9	Wedge or Bricks & Dragon	Nabu	Mercury	3	12	3
10	Panther-head	Nergal	Mars; (Cyg-Cep-Lac.)	5-6	10-12†	2
11	Vulture-head	Zababa	Saturn? Saturn?	3-4	10-12†	2
12	Perched bird	Shuqamuna & Shu- malia? Ninurta?	Saturn?	5-6	12	0
13	Double lion head with club	Ninurta? Nergal?	Mercury?	4	6-9	1
14	Lightning ± Bull	Adad (Ramman)	LIGHTNING; Taurus	6	13*	3
<i>Stand-alone figures:</i>						
15	Dog (sitting) ± Goddess	Gula	(Herc. & Lyra); Leo?	5-6	13*	2*
16	Scorpion	Ishhara	Scorpius	6*	13*	2*
17	Lamp	Nusku	LAMP-LIGHT	7	13*	3
18	Serpent (Ningizzida	Hydra	6*	14	2*
19	Walking bird (Nirah Papsukal	Milky Way? Orion	4	8	2

Notes

This table lists all the symbols frequently found on boundary stones; Figures 3 and 4 show examples. The last column lists the frequency of appearance in the 24 best-preserved examples (Ref. 22). These are divided into three periods (Ref. 21):

'Pre-canonical' (Seidl's 1st and 2nd groups, with stone S63): middle Kassite, ~1350–1170 BC.

'Canonical' (Seidl's 3rd to 7th groups): late Kassite and Middle Babylonian, 1188–1044 BC.

'Post-canonical' (Seidl's 9th and 10th groups): one minimal tablet from ~850 BC, and two Assyrian stones in old style, 760–648 BC.

Where a range of frequencies is given, the higher number includes cases where the symbol has probably been erased or where it is replaced by a related symbol (see text)†.

*These otherwise ubiquitous symbols are only absent from the following stones: S25 and S31/S33 (possibly erased); S40 and S63 (unfinished); S96 (minimal tablet).

† The panther-head is replaced on S67 by a horse-head under a rainbow, possibly the constellations of the Horse and Andromeda Nebula as listed in *MULAPIN*, which were adjacent to the Panther-griffin. Conversely the vulture-head is replaced on S71 by what may be a rainbow.

On some more elaborate stones (S32, S40 (Figure 4), and probably S33), these standards are accompanied by a winged lion with the panther-head and a bird looking backwards with the vulture-head. On S63, the bird looking backwards replaces the vulture-head.

11. Alongside the panther-head almost always stands the vulture-head standard of **Zababa**, god of war, who in some places was a husband of Ishtar. The vulture (or eagle) head is crested, so the species may be a Stone eagle or Egyptian vulture. Zababa was portrayed in a constellation adjacent to the Eagle (Aquila). It would make sense on the boundary stones if he represented Saturn, but this is problematic.

12, 13. The fourth planet is supposed to be **Ninurta** (Saturn), but there is much confusion about the identities, symbols, and planets of this god. *MULAPIN* says that Mercury was called Ninurta. Ninurta was god of war and of farming, and was often identified with Ningirsu, and sometimes with Zababa; however they are associated with three different constellations in *MULAPIN*, and there are three different standards available on the

[On the cover]

Figure 4. Symbols on a late Kassite boundary stone: specimen S40/H21 [Ref. 22]. This is a polar-projection map of the 4-sided panel around the top; see Table 1 for key. The symbols have been drawn apart to avoid distortion. Although it is unfinished with no inscription, this is one of the finest boundary stones artistically, with an unusually free style, and the serpent coiled on top is fearsome. As on one other stone, the standards of Nergal and Zababa are accompanied respectively by a winged dragon or panther, and by a standing bird; however the Nergal group seems to be duplicated instead of a double lion head standard. Below this panel, the original has a unique second row, not shown here, which portrays a lively procession of people with fruit, musical instruments, and animals. Below that are the lamp, scorpion-man, and walking bird (here sketched in from other stones), and a second, even larger serpent coiled around the bottom. The scorpion and lightning are missing, probably because the stone was unfinished. The Kassite dynasty ended in 1125 BC when the Elamites sacked Babylon and carried the boundary stones off to Susa; this one was among the ones discovered there and taken to the Louvre. *Adapted from Hinke [Ref. 19] and reproduced by permission of the Syndics of Cambridge University Library; q.v. for photos of the original.*

boundary stones. As well as Zababa's vulture-head, there is usually a perched bird, which is labelled for the little-known Kassite gods Shuqamuna and Shumalia, but could also represent Ninurta (Saturn) in most cases, but not all. There is also, less frequently, a double-lion-head-with-club, which may be Ninurta's.

So these six standards include the four remaining planets; but which is which? On some stones there is a distinct set of four standards, but the set is not fixed. On stones S68 and S96, it consists of standards nos. 8, 9, 10, 11, but on S29 and S48 it is nos. 8, 10, 11, 13. The most consistent set of identifications would therefore be: 8 = spade = Marduk = Jupiter; 10 = panther-head = Nergal = Mars; 11 = vulture-head = Zababa = Saturn; 9 = wedge etc. = Nabu = Mercury, or 13 = double-lion-head = Ninurta = Mercury. However, some stones have five equally prominent standards; and on S49 the set is 8, 10, 11, 12. Finally, on a pair of late stones (S79 and S80), Nergal and Zababa are absent, and we have nos. 8, 9, 12, 13, where no.13 is split apart into the double-lion-head and the club as separate objects, so only these objects and the perched bird are available for Mars and Saturn. One is driven to conclude that no set of assignments can identify all four planets on all the stones, probably because the Babylonians had a prolific symbolic culture and did not regard consistency as an important virtue.

14. One other symbol accompanies the planetary gods – the lightning-fork of **Adad**, god of storms, sometimes perched on his bull.

15–18. The rest of the stone always includes four other symbols. The lamp of **Nusku** must represent lamp-light. The scorpion of **Ishhara** would seem to be zodiacal. The goddess **Gula** and/or her dog are sometimes the largest icon, probably because boundary stones were dedicated to her as consort of Ninurta; she was goddess of healing, and was also shown with her dog in constellations (see below). And the serpent often ties together the whole composition. Sometimes it is coiled on top like a real and malevolent guardian (Figure 4, on the cover). Sometimes it climbs up the side, like the Milky Way, which was seen as a serpent conquered by the gods – perhaps the snake-god **Nirah**. And sometimes it winds around the bottom, and in Figure 3 it has exactly the same form with a lion as the constellations Leo and Hydra in later zodiacs; in

MUL.APIN, Hydra was identified both with Nirah and with Ningizzida, a god of the underworld (see below).

19. One other, less frequent symbol is the walking bird of **Papsukal**, messenger of the gods (our Orion).

Note that the zodiac is not shown as such. The first four constellations may perhaps be represented: Taurus by the bull of Adad, Scorpion by the scorpion, Aquarius by the shrine of Ea, and Leo possibly by Gula's dog (since the name UR.GU.LA for Leo means 'Great Dog' – though the dog was actually represented in our Hercules). But they do not appear as a set and were probably not intended as one.

Next we turn to infrequent or non-canonical symbols. One set of these occurs only on early stones – the pre-canonical and early canonical ones.²² Many of these stones have more diverse patterns than later ones (especially S12) and they sometimes include fantastic human-animal chimaeras, and complete humanoid deities. Some of the two-legged chimaeras have no known astronomical equivalents and seem to belong to the earlier world of fabulous bestiarities. They are:

20–23. A lion-demon wielding a dagger (on S5, S63, and many early fragments in Seidl); a man-bull or man-horse holding a staff (on S5, S12, S63); a scorpion-man-bird (on S25, S40, S67); and a winged sprite with a double helix for legs (on S12).

But other symbols are almost identical with those seen later on the Seleucid and Dendera Zodiacs (Figure 6). They are:

24. A centaur with a bow – actually an even more wondrous chimaera, with two heads, two wings, and two tails – just like Sagittarius on the Dendera Zodiac (Figure 5). (On S12, S14, S63.)

25. A winged lion or lion-dragon, sitting or standing (S14, S25, S63, S62). On S62 (Figure 3), it strides on the serpent just like Leo on Hydra. (Recumbent lion-dragons also appear as extras on several later stones, supporting canonical symbols: S32, S33, S40, S107.)

26. Adad in person, grasping the lightning and standing on a prancing bull, is shown on two or three fragments. The bull has a posture like the Dendera Taurus (Figure 6) except that the head is not turned back.

27. Ea in person, pouring two streams of water as on the earlier seals, is shown on two fragments (Figure 5); he is Aquarius.

Other early icons are:

28. Six of our pre-canonical group (and none later) show a fox or jackal, often accompanying the goat-fish or turtle, and so probably another symbol of Ea.

29. An ear of corn, which is labelled as the fertility goddess **Shala**, who was later identified with Virgo. On S32 and S33 it is supported by a recumbent sheep or ram; on S12, the goddess herself appears holding the ear of corn, much like Virgo on the Seleucid Zodiac; and on S9 the ram appears alone, like Aries, which was later identified with another fertility deity, **Dumuzi** (see below).

30. An icon of unknown significance, a bundle or perhaps a sheaf of corn (S5, S32, S33?, S63, S71).

31. A plough – perhaps the constellation of mul-APIN itself? (S14, S32, S33).

Origins of the ancient constellations

To sum up these early symbols, eight of the classical zodiacal figures seem to be shown on boundary-stones, but most of them, being merely animal demons or fertility deities, were dropped from the canon as it developed in favour of the greater gods.

Conversely a couple of well-known stars were added on later stones, at a time when astral identities were beyond doubt:

32. The arrow, Sirius, is shown in late canonical stones (S74, S78, S79, S80). (This arrow, aimed at Orion, was strung in a bow formed by the 'rear' of Canis Major with some stars of Puppis. It may have been part of a large human archer figure.⁸)
33. The seven stars, the Pleiades, appear in the Assyrian period (S103, and other Assyrian carvings).

There is one written text from this period, which confirms that the constellations we have mentioned were indeed identified with gods. This is the 'Prayer to the Gods of the Night'.⁷ It is Old Babylonian (~1830–1530 BC). It invokes 17 'stars' to bless a divination from entrails. The list is as follows, giving the names with the style and translation that is later used in *MUL.APIN*.

Ahati [unidentified]; Gaga [unidentified]; ⁴Dumuzi [Aries]; ⁴Ningizzida [Hydra]; E-pa-e [Square of Pegasus? Jupiter?]; mul.Mul [Pleiades]; Is-li-e [the Bull's Jaw = Hyades]; Sipa.zi.an.na [Orion]; Kak.si.sa [Sirius]; Ban [the Bow ≈ Canis Major]; Gir.tab [Scorpius]; A-mushen [Aquila]; Ku₆ [Piscis Austrinus]; Shim.mah [the Swallow]; Ud.ka.duha [the Panther]; Mash [Gemini?]; Mar.tu [unidentified; means the country of Amurru].

This list is not congruent with any later star-list, but almost all the entries in it are the constellations that we have already encountered on the seals and boundary stones. (See Ref. 6 for the full text but of a different version.)

There was a much larger literature on celestial omens, which comprised the other supernatural function of the stars. But most of the omens referred to sightings of the planets rather than the fixed stars, and the earliest ones that do refer to constellations are undated; they may be no older

than the *MUL.APIN* lists (see below). (Horoscopic astrology was not invented till much later; see Paper II.)

One other Old Babylonian text deserves mention: the great epic of creation.²³ It has often been wrongly cited as being portrayed in some of our constellations, but in fact it describes the cosmography that we will see in the following phases. When the ocean was without form and void, it was ruled by the vast dragon Tiamat, who summoned up a host of fearsome monsters to defend her chaos against the gods:

She set up the Viper, the Dragon, the Sphinx, the Great Lion, the Mad Dog, and the Scorpion-Man, mighty lion-demons, the Dragon-Fly, the Centaur – bearing weapons that spare not, fearless in battle. [Ref.23].

These include the fabulous chimaeras that we have just seen on early seals and boundary-stones, most of which did not make it into the sky. Conversely several authors over the past century have proposed any one of our serpentine constellations as a sign of Tiamat, with any of the hero figures as Marduk, the god who defeated her: Serpens and Ophiuchus, Draco and Hercules, Cetus and Perseus. (Likewise, just about every male figure has also been identified as the hero Gilgamesh from a different myth,²⁴ with equally little justification.) It is now clear that there is no basis for these identifications and these constellations were unknown in Mesopotamia. Indeed, Marduk was Jupiter.

Marduk tore the monster's body into two parts. One part he made into the heavens, where he fashioned the constellations; the other part he made into the earth, where he was worshipped as chief god of Babylon. In the heavens, he set up the Ways of Anu, Enlil, and Ea:

He constructed stations for the great gods, fixing their astral likenesses as constellations. He determined the year by designating the zones: he set up three stars for each of the twelve months. After defining the days of the year by heavenly figures, he founded the station of Jupiter [the ecliptic] to determine their bands....

Alongside it he set up the stations of Enlil and Ea.

[adapted from Ref.23].

Here we see chaos replaced by the celestial grid that was to determine the star-lists in the next two phases.

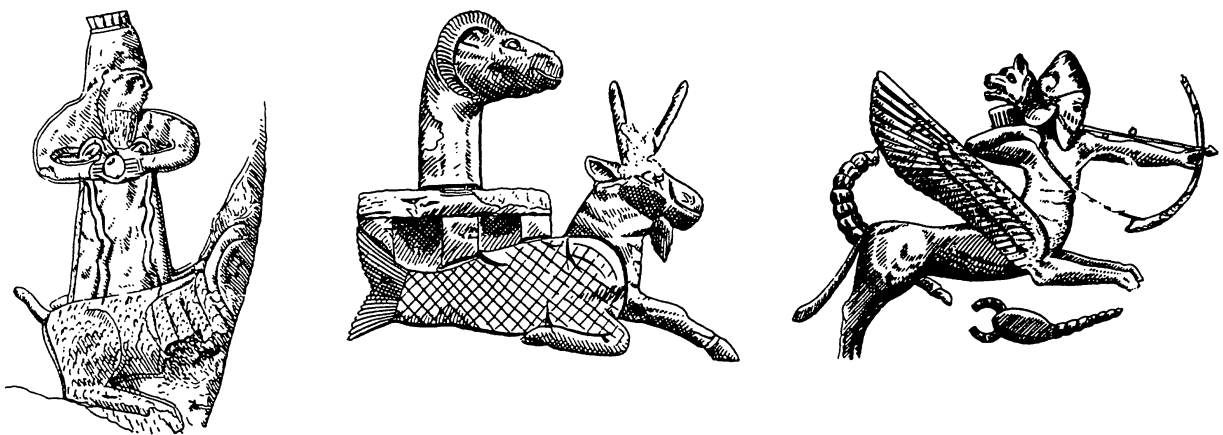


Figure 5. Three symbols from boundary stones which show zodiacal figures almost exactly as on the Dendera Zodiac (Figure 6). The water-pourer is from a fragmentary stone in the Louvre. The goatfish is common on boundary stones and elsewhere; a contemporaneous stone basin from Elam, in the Louvre, is decorated around the outside with 16 identical goat-fish though lacking the ram's-head of Ea. The centaur is from stone S12/London-101 (and is also shown on S63); it has two tails (one being that of a scorpion) and two heads (one being the same as the panther-head of Nergal). From Refs. 6 and 19.

Table 2. Mesopotamian constellations and stars: the *Three Stars Each* and annual calendar lists

Month	A			B		
	<i>Stars of Akkad</i>	<i>Translation</i>	<i>Modern stars</i>	<i>Stars of Amurru</i>	<i>Translation</i>	<i>Modern stars</i>
I	mulAPIN	Plough	Tri + γ And	1-IKU	Field	Square of Peg (30)
II	Anunitum	Lady o'H	N.Psc + β And (32)	SHU.GI	Old man or Charioteer	Perseus (34)
III	SIBA.ZI.AN.NA (= Shitaddalu)	Shepherd o'H	Orion (5)	MUSH (= Shiru)	Serpent	Hydra + β Cnc (10)
IV	UD.AL.TAR (= SHUL.PA.E)	--	JUPITER	KAK.SI.DI (= GAG.SI.SA)	Arrow	Sirius (9)
V	MAR.GID.DA	Wagon	Plough (UMA)	MASH.TAB.BA. GAL.GAL	Great twins	α + β Gem (6)
VI	SHU.PA (= Shudum)	? (Yoke)	Arcturus (+ Boötes?) (16)	BIR (= Kalitum)	Kidney	?Canopus or Argo (Carina)
VII	Zibanitum (= ZIB.BA.AN.NA)	Scales o'H	Libra (18)	NIN.MAH	Exalted lady	Argo (Puppis)
VIII	UR.IDIM	Mad dog	Lupus (19)	LUGAL (= Sharru)	King	Regulus (13)
IX	UZA (= UZ)	Goat	Lyra (23)	Salbatanu	--	MARS
X	A-mushen (= Nashru)	Eagle	Aquila (26)	AL.LUL (= Alluuttum)	Crab	?Eq1, or Cnc (see month IV)
XI	DA.MU (= Shah)	[Pig of] god Damu	?Delphinus or head of Draco	SHIM.MAH	Great swallow	W.Psc + head of Peg (28)
XII	Nibirum (= ^d Marduk)	--	JUPITER	KA5.A	Fox	Alkor

Notes

Lists A and B are the 'stars of Akkad' and 'stars of Amurru'; *list C* is a reconstruction of the 'stars of Elam'. These lists comprise the *Three Stars Each* lists; they are essentially permutations of the 36 stars in the circular 'astrolabes' and may have predated them.^{4,6} *List C* includes the two constellations that remain in the extant 'stars of Elam' (GIR.TAB and GU.LA), plus all other 'stars' that appear in the 'astrolabes' but not in the two preceding lists, which therefore probably belonged to the 'stars of Elam'.

These lists are from Ref. 6, plus some alternative translations or identifications from Refs. 3,7,8. Synonyms in brackets are not necessarily found in the *Three Stars Each* lists. All these 'stars' except Bir/Kalitum also appear in *MUL.APIN* list I (under the same or different names; Table 3). Differences from Table 3, in transcription or translation, illustrate the uncertainties which remain in interpreting these ancient texts (also see Ref. 27).

Third phase: The *Three Stars Each* tablets, >1100 BC^{4,6,7}

In the tripartite division of the Babylonian sky, the northern sky was the Way of Enlil, the equator and half the zodiac occupied the Way of Anu, and the southern sky was the Way of Ea. The boundaries were at 17°N and S such that the Sun spent exactly three consecutive months in each 'Way'.

The earliest recorded Babylonian star system is the 'Three stars each' or '36 stars' system, which represents the legend just quoted. It was written out on circular tablets which are inaccurately called 'astrolabes', as well as on straightforward lists. The earliest surviving examples are from ~1100 BC.

These lists include the earliest records of several farming-calendar constellations, and they clearly state that their heliacal risings were used in a calendrical system. Such a natural calendar was needed in ancient Babylonia because the civil year was determined by lunar months. The new

List D contains all the other constellations whose heliacal risings are given in Lists II and IV of *MUL.APIN*; the order in which they appear in those calendrical lists is indicated by a number in brackets. List D also includes all the remaining zodiacal constellations from list VI of *MUL.APIN* (see text).

Overall, this Table includes most or all of the entries in *MUL.APIN* for constellations (as opposed to single stars or small groups), except for the circumpolar ones (see Table 3). See text for the few other constellation names in Babylonian records.

Note: Star-names read in Sumerian are conventionally transliterated in capital letters; those in Akkadian, in lower-case. They begin with the universal prefix mul-, meaning star, which I have usually omitted; and some of them end with the suffix AN.NA, meaning 'of Anu' and thus 'of the heavens', here abbreviated as o'H. I have omitted accents, and simplified the names in the main text for greater readability.

year was fixed by the sighting of the new moon near the spring equinox, so the year contained either 12 or 13 months, and it wandered forwards and backwards relative to the solar year. Helical rising was also important for the calendar of Egypt, where that of Sirius marked the start of the new year, and foretold the flooding of the Nile, as early as ~3000 BC; a first-dynasty inscription describes Sirius as 'Herald of the New Year and of the Flood'.⁶ Hartner¹⁸ noted that around 3000 BC in Mesopotamia, the start of spring ploughing in February coincided with the heliacal rising of mul-APIN ('the Plough', our Triangulum) and the heliacal setting of mul-Mul ('the star of stars', the Pleiades).

The *Three Stars Each* tablets indeed list three 'stars' for each month – divided between the three Ways – but the divisions are often astronomically incorrect. Almost all the 'stars' have been identified, mostly with constellations that will be described later, but some are single stars and others are planets. The earliest such text lists the 3×12 stars by month, and has notes on their relative positions, rising and

Table 2 (continued)

Month	C			D		
	Stars of Elam, etc.	Translation	Modern stars	Others in MUL.APIN	Translation	Modern stars
I	DILI.PAT	--	VENUS	Lu.HUN.GA (= Agru)	Hired farm labourer	Aries (1)
II	mulMUL Is-li-e	Star of stars Bull's jaw	Pleiades (3) Hyades inc. Aldeb. (4)	GAM GUD.AN.NA	Scimitar/Crook Bull o'H	Capella or Auriga (2) Taurus
III	URA (= UR.GU.LA)	Lion, or Great dog	Leo (11)	MASH.TAB.BA. TUR.TUR	Lesser twins	S. part of Gem (7)
IV	MASH.TAB.BA	Twins	Procyon + β CMi	AL.LUL	Crab	Procyon and/or (8) Cancer
V	BAN (= Pan)	Bow	Rear of CMa + part of Puppis (12)	NUN-ki	City of Eridu	Canopus (14)
VI	UGA-[mushen]	Raven	Corvus (15)	AB.SIN	Furrow	Spica (17)
VII	EN.TE.NA. MASH.LUM	Cold swamp-pig?	Centaurus (inc. Crux?) (20)	UR.KU	Dog	Hercules (21)
VIII	GIR.TAB	Scorpion	Scorpius (22) [without Libra]	GAB.GIR.TAB	Breast of Sco.	Antares (24)
IX	UD.KA.DUH.A	Panther-griffin	Cygnus + parts of Cep & Lac (25)	Pa-bil-sag	Archer?	Sgr (27)
X	GU.LA	Great one	Aquarius (29)	SUHUR.MASH	Fish-goat	Capricornus
XI	NU.MUSH.DA	Crowd?	?Grus or ? η Cen	Lu.LIM	Deer	Cas (without β) (31)
XII	KUA	Fish	PsA or Fomal. (33)			

setting, and significance for agriculture and mythology; it says their heliacal rising occurs in the relevant month. This was true in many cases – e.g. month I included mul-APIN (Triangulum) and 1-Iku (Square of Pegasus) as well as Venus (!), while month II included Perseus and the Pleiades – but the following statement, that heliacal setting occurs six months later, shows that the astronomical basis of these tables had been seriously corrupted. Indeed, the positions of some entries must have been scrambled, either because the copyists made errors (which are evident among the surviving versions) or because the layout was done for non-astronomical reasons. Two closely similar texts survive which list ‘12 stars of Elam, 12 stars of Akkad, and 12 stars of Amurru’ – the three ancient countries that bordered Sumer on the east, north, and west.⁴⁻⁶ Although these could indicate that stars (like other omens) were assigned astrologically to different countries, van der Waerden^{4,6} suggested that these were actually the oldest, locally-based, popular star lists, dating from ≥ 1700 BC, and that they were systematised in the Old Babylonian empire to fit the ‘3 stars each’ mythology without great regard for astronomical sense.

These lists are reproduced in Table 2A, B, C. The surviving version of the ‘Stars of Elam’ is incomplete, and has been completed here on the assumption that constellations included in other permutations of *Three Stars Each* tablets, which are not otherwise included here, belonged to the Stars of Elam. Many of the constellations listed have already been encountered, and were presumably shared with the religious pictograph tradition. But the zodiac is remarkably poorly represented. One can argue that only the Pleiades, Leo, Scorpius and Aquarius are shared with the pictographs of

the zodiac at this stage, and they were probably all in the Stars of Elam. In the other lists we find Gemini (obvious in any tradition), Cancer? (out of place), and Libra (the detached claws of the Scorpion); the last two were not in the pictographs, and probably were farming-calendar constellations. We also find Anunitum and Shimmah, which conflicted with the later zodiacal constellation of Pisces, and the lists do not include any part of Aries, Virgo, Sagittarius, or Capricornus. This seems to be a tradition separate from that of the zodiacal pictographs, and this is confirmed when we move on to the *MUL.APIN* tablets.

Fourth phase: the *MUL.APIN* tablets, ~1100–700 BC^{6,7,8}

The second formal compendium of Babylonian astronomy is the pair of tablets called *MUL.APIN* after the opening words, which are the name of the first constellation of the year. These tablets also exist in several copies, the oldest being from 687 BC, and some of the lists also appear in related tablets from the same period. The *MUL.APIN* tablets were the astronomical textbook of Babylon – a compilation of the catalogues produced up to that time, which apparently date from ~1000 BC. The star-lists are direct descendants of the *Three Stars Each* lists, including the same stars, the same purposes, and some of the same descriptions. But they had been reworked on the basis of accurate observations around 1000 BC, and are much more extensive and systematic and accurate astronomically. They record more constellations, including most circumpolar ones for the first time; the new ones include more of the zodiacal figures, and

Table 3. Mesopotamian constellations and stars: MUL.APIN list I

This is List I of the *MUL.APIN* tablets, from the translation by Hunger & Pingree⁸.
 Column 1: Transliteration of the name. All names were prefixed by mul-, except those for which the prefix d- is shown.
 Column 2: Whole text, translated into English. [In italics, notes on the named deity¹²; also see text.]
 Column 3: Identification. [In brackets, possible alternatives. For further opinions on identifications, see table 2 and ref.27.]

A: Northern sky (the Stars of Enlil)

<i>Name (transliteration)</i>	<i>Translation</i>	<i>Identification</i>
mulAPIN	The Plough, Enlil, who goes at the front of the stars of Enlil.	Tri + γ And
UR.BAR.RA	The Wolf, the seeder of the Plough.	α Tri
SHU.GI	The Old Man, Enmesharra [<i>shadowy ancestor of Enlil</i>].	Perseus
GAM	The Crook, Gamlum.	Auriga
MASH.TAB.BA.GAL.GALLA	The Great Twins, Lugalgirra and Meslamtaea.	α + β Gem, etc.
MASH.TAB.BA.TUR.TUR	The Little Twins, Alammush and ^d Nin-EZENxGUD.	ζ + λ Gem, etc.
AL.LUL	The Crab, the seat of Anu.	Cancer
UR.GU.LA	The Lion, Latarak [<i>lion-headed protector god</i>].	Leo
LUGAL	The star which stands in the breast of the Lion: the King.	Regulus
--	The dusky stars which stand in the tail of the Lion:	5, 21 Leo? [Coma Cluster?]
--	the Frond (of the date palm) of Eru, Zarpanitu [<i>wife of Marduk</i>]	γ Com
SHU.PA	SHU.PA, Enlil who decrees the fate of the land.	Boötes
Hegalaau	The star which stands in front of it: the Abundant One, the messenger of Ninlil [<i>wife of Enlil</i>].	β Com?
BAL.TESH.A	The star which stands behind it: the Star of Dignity, the messenger of Tishpak [<i>god of armies</i>].	Corona Bor.
MAR.GID.DA	The Wagon, Ninlil [<i>wife of Enlil</i>].	Ursa Major
--	The star which stands in the cart-pole of the Wagon:	
KA5.A	the Fox, Erra, the strong one among the gods.	80-86 UMa [Alkor?]
Ug	The star which stands in front of the Wagon: the Ewe, Aya.	NE. Boötes? [η UMa?]
MU.BU.KESH.DA	The Hitched Yoke, the great Anu of Heaven.	Thuban?
MAR.GID.DA.AN.NA	The Wagon of Heaven, Damkianna.	Ursa Minor
IBILA.E.MAH	The star which stands in its rope: the Heir of the Sublime Temple, the first-ranking son of Anu.	Polaris?
--		
DINGIR.GUB.BA ^s	The Standing Gods of Ekur,	ζ + η Her?;
DINGIR.TUSH.A ^s	the Sitting Gods of Ekur [<i>the great temple of Enlil</i>].	ε, π, ρ, θ Her?
UZ	The She-goat, Gula.	Lyra
UR.KU	The star which stands in front of the She-goat: the Dog.	S. Hercules
^d LAMMA	The bright star of the She-goat: Lamma, the messenger of Baba.	Vega
^d Nin-SAR u ^d Erragal	The two stars which stand behind it: Nin-SAR and Erragal.	ζ + ε Lyr
UD.KA.DUH.A	The Panther: Nergal.	Cyg, Lac, part of Cep.
SHAH	The star which stands at its right side: the Pig, Damu [<i>god of healing</i>].	Head of Draco? [Del?]
ANSHE.KUR.RA	The star which stands at its left side: the Horse.	α, β, γ, δ Cas [Peg/Lac/Eq!]
lu-lim	The star which stands behind it: the Stag, the messenger of the Stars.	E. And. [+ Cas?]
--	The dusky stars which stand in the breast of the Stag:	18,31,32 And?
^d Harriru	Harriru, the Rainbow.	[Andromeda Neb?]
--	The bright red star which stands in the kidney of the Stag:	
KA.MUSH.I.KU.E	the Deleter.	β And [α Cas?]
--	When the stars of Enlil have finished,	
--	one big star -- (although) its light is dim -- divides the sky	
--	in half and stands there: the star of Marduk, the Ford,	Jupiter (on the
mulSAG.ME.GAR	Jupiter, keeps changing its position and crosses the sky.	meridian at dawn)
--	33 stars of Enlil.	

Table 3 (cont.)
B: Equatorial sky (the Stars of Anu); Southern sky (the Stars of Ea)

<i>Name (transliteration)</i>	<i>Translation</i>	<i>Identification</i>
ASH-IKU	The Field, the seat of Ea, which goes at the front of the stars of Anu.	Sq. of Pegasus
Shinunutu ₄	The star which stands opposite the Field: the Swallow.	W. Fish + Head of Peg
Anunitu ₄	The star which stands behind the Field: Anunitu [<i>goddess of childbirth</i>].	N. Fish
luHUN.GA	The star which stands behind it: the Hired Man, Dumuzi.	Aries
MUL.MUL	The Stars, the seven gods, the great gods.	Pleiades
GU ₄ AN.NA ^d is le-e	The Bull of Heaven, the Jaw of the Bull, the crown of Anu.	Taurus, Hyades
SIPA.ZI.AN.NA [<i>Akk.</i> : Shitaddalu]	The True Shepherd of Heaven, Papsukal, the messenger of Anu and Ishtar.	Orion
MASH.TAB.BA	The twin stars which stand opposite the True Shepherd of Heaven: Lulal and Latarak [<i>two domestic protector gods</i>].	$\pi^3 + \pi^4$ Ori? $\zeta + \xi$ Gem? [$\alpha + \beta$ CMi?]
DAR.LUGAL	The star which stands behind it: the Rooster.	Lepus or CMi?
KAK.SI.SA	The Arrow, the arrow of the great warrior Ninurta.	Sirius, etc.
BAN	The Bow, the Elamite Ishtar, the daughter of Enlil.	S. CMa (& part of Puppis)
MUSH [<i>Akk.</i> : Nirah]	The Snake, Ningizzida, lord of the Netherworld.	Hydra (inc. β Cnc)
UG ₄ mushen	The Raven, the star of Adad.	Corvus (inc. Crater?)
AB.SIN	The Furrow, Shala, the ear of corn.	Spica (etc?)
ZI.BA.AN.NA	The Scales, the horn of the Scorpion.	Libra
^d Za-ba ₄ -ba ₄ TI ₈ mushen, AD ₆	The star of Zababa, the Eagle, and the Dead Man.	In Oph-Ser-Aql?; Aquila; Delphinus?
Dili-bat	Venus keeps changing its position and crosses the sky.	Venus
Salbatanu	Mars keeps changing its position and crosses the sky.	Mars
UDU.IDIM.SAG.USH	Saturn keeps changing its position and crosses the sky.	Saturn
UDU.IDIM.GU ₄ .UD	Mercury, whose name is Ninurta, rises or sets in the east or in the west within a month.	Mercury
--		
--	23 stars of Anu.	
KU ₆	The Fish, Ea, who goes at the front of the stars of Ea.	PsA
GU.LA; NUN ^{ki}	The Great One, Ea; the star of Eridu [<i>the city</i>], Ea.	Aquarius; Canopus
Nin-mah	The star which stands at its right: Ninmah [<i>goddess of motherhood</i>].	Most of Vela
EN.TE.NA.BAR.HUM	EN.TE.NA.BAR.HUM, Ningirsu.	Centaurus (+ Crux?)
gishGAN.UR	The star which stands at its side: the Harrow, the weapon of Mar-bitu, inside of which one sees the subterranean waters.	E. part of Vela [star fields inc. η Car nebula?]
--		
^d Shullat u ^d Hanish	The two stars which stand behind it: Shullat and Hanish, Shamash and Adad.	$\mu + \nu$ Cen? [$\alpha + \beta$ Cen?]
--		
Nu-mush-da	The star which stands behind them rises like Ea and sets like Ea: Numushda, Adad.	η Cen?
UR.IDIM	The star which stands at the left side of the Scorpion: the Mad Dog, Kusu.	Lupus
GIR.TAB	The Scorpion, Ishhara, goddess of all inhabited regions.	Scorpius
GABA GIR.TAB	The Breast of the Scorpion: Lishi, Nabu.	Antares
--		
^d Sharur ₄ u ^d Shargaz	The two stars which stand in the sting of the Scorpion: Sharur and Shargaz.	$\lambda + \nu$ Sco
Pa-bil-sag	The star which stands behind them: Pabilsag.	Sagittarius
MA.GUR ₈ u	The Bark and	ϵ Sgr [CorAus?];
SUHUR.MASH ^{ku6}	the Goat-fish.	Capricornus
--		
--	15 stars of Ea.	

Nebulae: The Babylonians may have named five naked-eye nebulae or clusters, four of them in this Table. The first two are the only entries for 'dusky stars' in this list: the Coma Cluster (no.10 of Enlil; the Frond) and the Andromeda Nebula (no.31 of Enlil; the Rainbow). The Pleiades (no.5 of Anu; the Stars) were also called Zappu, meaning tuft or mane (of the Bull's neck?). The star-field around the η Carinae nebula may be no.6 of Ea, "inside of which one sees the subterranean waters"; in classical maps, this marked the point where the prow of Argo disappeared into the mist on the horizon. Fifthly, the Praesepe cluster was not listed in *MUL.APIN*, but was later known as Kushu (a water animal?) (see text under 'Cancer').

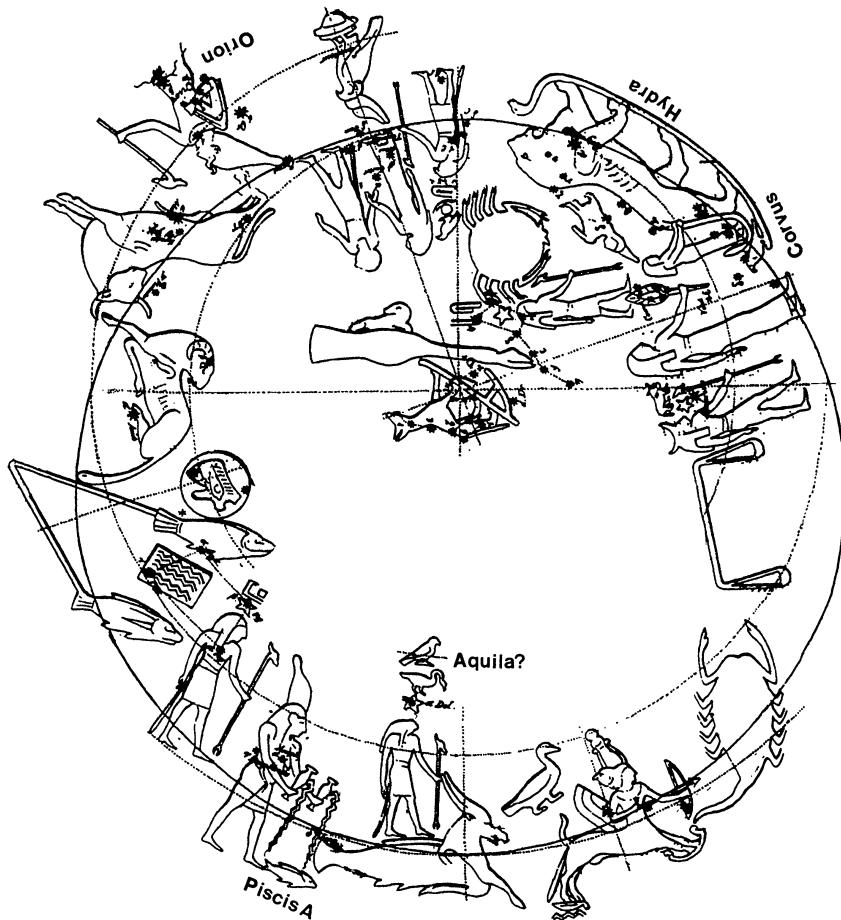


Figure 6. The zodiacal and para-zodiacal constellations from the Dendera Zodiac (Egypt, ca.36 BC). The rest of the sky is filled with the Egyptian constellations, most of which have been deleted from this copy for clarity, although a few of the interpolated human figures remain. On this copy, some stars and classical coordinates are superimposed – though the positioning, for example of Cancer and Libra, is irregular. The para-zodiacal constellations are labelled. For complete copies, see Refs. 6, 14.

several portraits of deities, but also more depicting farming activities and animals. The rustic nature of these latter constellations may seem surprising for Mesopotamia which, then as now, had a reputation for despotic rule by priests and warriors. We do not know if they were really new at the time of *MUL.APIN*. Perhaps they came from a long-standing popular tradition that had never been fully written down before, dating from early times in the countries preceding or surrounding the kingdom of Sumer, before the great empires arose. In any case, the *MUL.APIN* lists (Table 3) clearly encompass both the divine and the rustic tradition.

The tablets were described in some detail in Ref. 6, and a complete transcription and translation is in Ref. 8.

The lists on the first tablet are:

I. Catalogue of ‘stars’ in the 3 Ways: 71 constellations, stars, and planets (Table 3). This catalogue includes all the ‘stars’ in the earlier lists (Table 2) (except Bir) and all the ‘stars’ in the following lists in *MUL.APIN* (except for a few single stars). A constellation is usually listed by its name (prefix mul-) followed by the name of a god associated with it (prefix d-) and often by some other brief epithet. A star is usually listed as ‘The star which stands...’ in some relation to another constellation, and sometimes has its own stellar name (mul-) or divine name (d-). But the distinction is not absolute.

II. Dates of heliacal risings. These are indicated by sequential numbers in Table 2. The list seems to date from 1300–1000 BC.⁴ (Papke²⁶ revised many of the star identifications and deduced an earlier date, ~2300 BC, which van der Waerden has supported; but Hunger and Pingree⁸ explain that the arguments for 1300–1000 BC are much stronger.) A sign that it is later than ~2200 BC is that the year begins with heliacal rising of lu-Hunga (Aries), not Taurus.

III. Pairs of constellations which rise and set simultaneously.

IV. Time-intervals between dates of heliacal risings. Essentially the same data as List II, but with some differences in rounding-off; these suggested to van der Waerden⁴ that this was derived from an earlier list with its start at Sirius, which had later been re-set to agree with List II.

V. Pairs of constellations which are simultaneously at the zenith and at the horizon. Hunger and Pingree⁸ worked out that lists III and V date from about 1000 BC at 36°N, supporting the date of list II.

VI. The path of the Moon and planets. ‘The gods who stand in the path of the Moon, through whose regions the Moon in the course of a month passes and whom he touches: The Pleiades, the Bull o’H, the Shepherd o’H [Orion], the Old Man [Perseus], the Crook [Auriga], the Great

Twins, the Crab, the Lion, the Furrow [Virgo], the Scales, the Scorpion, Pabilsag [Sagittarius], the Goat-Fish, the Great One [Aquarius], the Tails [?of] the Swallow, [?and of] Anunitu, the Hired Man [Aries].⁷ [Ref. 8.]

Of these 18 names, the Tails is the only one not prefixed by mul-, so it probably qualifies the Swallow (a bird with a forked tail), and does not indicate the Fishes tied by their tails. Therefore, this list contains most of the zodiacal constellations, but with rustic alternatives for Pisces, Aries, and Virgo; they are not strictly organised into the 12 signs, and some others intrude. Note that the Pleiades and Taurus were named first; they marked the spring equinox before 2200 BC.

The main lists on the second tablet are:

- VII. Solar calendar, with dates when the Sun is at the cardinal points.
- VIII. The planets and the durations of their solar conjunctions.
- IX. Stellar risings and planetary positions for predicting weather and dictating leap years (intercalary months).
- X. Telling time by length of the gnomon shadow.
- XI. Length of night watches through the year, by water clock, and rising and setting of the Moon.
- XII. Omens connected with appearance of stars, planets, ?comets (mul-U.RI.RI), and winds (though not with the zodiac).

A missing third tablet seems to be implied by some versions, but this was probably just an optional appendix or link to other texts, concerning omens.⁸

Let us now take stock of these Mesopotamian constellations. Many of them comprised a mundane object or animal attached to a divine name; others were purely rustic or purely divine. In keeping with their use as a farming calendar, rustic constellations were numerous. In the zodiac we have noted the Hired Labourer (later Aries), the Furrow (later Virgo) and the Scales (Libra), while other constellations included the Shepherd (Orion), the Crook (Auriga, apparently a goat-herd), their Plough (mul-APIN, perhaps preserved in Triangulum), the Field (Square of Pegasus), the Harrow (star-fields in Argo?), and around the pole the two Wagons and the Hitched Yoke. The Yoke was also an alternative name for Boötes (Table 2).³ The Field was named for a unit of area, and on the Dendera Zodiac it was shown as a square with a pattern of furrows or waves denoting agriculture (Figure 6).¹⁸

The circumpolar constellations were no use for the farming calendar, and appeared for the first time in *MUL.APIN* (Table 3, the Stars of Enlil, numbers 15 to 22). None of these were the same as the classical constellations. They had two Wagons (not bears) revolving around the star(s) of the Hitched Yoke. (The descriptions indicate that the Wagons were travelling backwards around the Pole.) The pole would still have been near the tail of Draco, and it was named for the sky-god Anu. Ekur was the great temple of Enlil, and like other great temples it was regarded as a cosmic 'mooring-rope of heaven and earth',¹² which may also be alluded to in

the names of Thuban and Polaris. The name for our Polaris is intriguing – it could suggest that the Babylonians knew the pole was precessing towards this star, although it is not thought that they understood the phenomenon of precession.

No original pictures of the non-zodiacal constellations have survived. However, some texts give more details of star positions which imply that constellations named for deities such as Eru and Zababa and Ninmah, and perhaps even the Bow, were complete portraits with heads and hands and feet.^{28,29} Indeed we shall see evidence that the goddesses Shala and Gula were portrayed (in our Virgo and Lyra) as alternatives to the rustic assignments of the same stars. A tablet from Asshur in Assyria¹³ actually describes the figures for the first part of the Stars of Enlil, roughly as listed in *MUL.APIN*. There are many gaps in the surviving text but some interesting glimpses remain. The Greater and Lesser Twins were both pairs of clothed, bearded men holding weapons. After the Crab, four constellations were listed instead of just Leo: SAG.ME.GAR (Jupiter, which was identified astrologically with Cancer³), UR.GU.LA (lion or great dog), UR.MAH (lion), and Eru. Clearly she was a whole constellation, occupying the area of Coma and Canes Venatici under the Wagon:

'Eru, a clothed figure... A star is in her head; she holds a whip in her right hand; the leather [handle?] of the whip is directed towards the tail of UR.GU.LA; in her left hand she holds a star.'

Then the two Wagons are described (but not Boötes), and then:

'UR.KU: a dog, which sits on its hindquarters, looking at ... Gula. Two stars in its breast. 7 stars in its tail..... the boundary. 9 stars of the Sitting Gods, 3 stars of the Standing Gods, and 6 stars of the boundary of the Way of Anu. The stars of the goddess Gula.... 2 stars are shown side by side under the base of her throne.'

Gula was identified with Lyra in *MUL.APIN*, but the constellation name was there given as the Goat, so this passage shows that the associated divinity was also drawn in the sky. This tablet does not go further, so sadly we have no description of the huge Panther(-griffin) ('Demon with gaping mouth'). In list V of *MUL.APIN*, four stars of the Panther are listed separately, probably γ Cyg at its side, α Cyg at its breast, α Lac at its knee, and β Cas at its heel.⁷ It was named for Nergal (see above). With the Panther (-griffin) above the Eagle, and the Centaur-archer and Goat-fish below it, this part of the sky was an exotic exception to the general rustic scene.

Turning towards the autumn side of the northern sky (Figure 7), there were the Horse and Stag and Anunitum (in the area now occupied by the Andromeda legend). Remarkably, pictures of them may have been transmitted to post-classical times, as we shall see below.

But outside the zodiac only a few of the Mesopotamian constellations have survived into our sky-map. Three of these (Orion and Perseus and Andromeda) were human figures which could have been independently invented. Another may be the Mad Dog (Lupus), but there are several dogs in both sky-maps. Otherwise, the only clear survivals seem to be the divine 'signs of the zodiac', and four parazodiacal constellations, which we discuss in detail below: Piscis Austrinus, Aquila, Hydra, and Corvus.

Origins of the ancient constellations

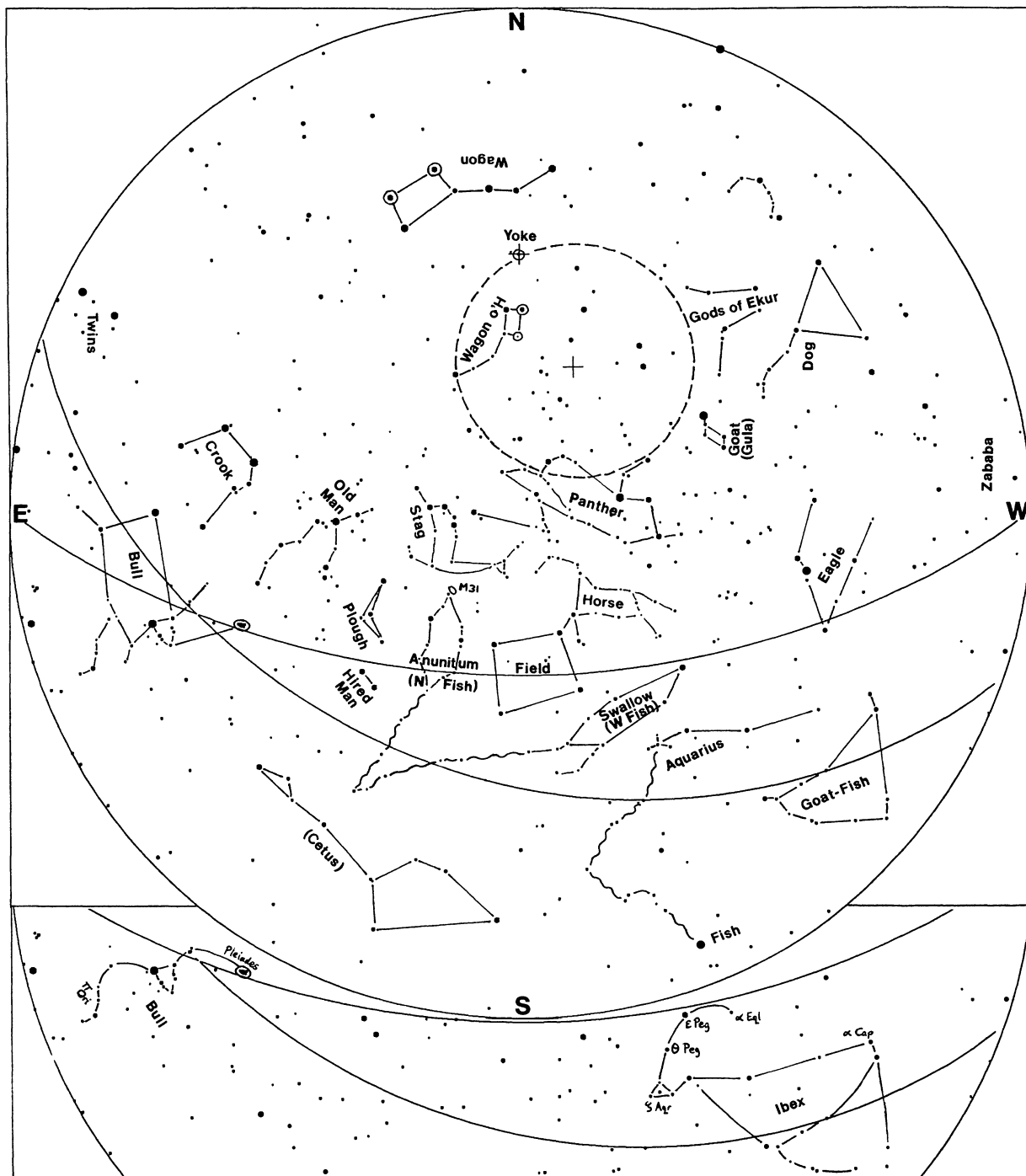


Figure 7. The night sky of late summer in 2800 BC at 36°N, showing Babylonian constellations. Solid lines mark the equator and ecliptic; the celestial pole (Thuban, 'Hitched Yoke of Heaven') is ringed. A cross marks the ecliptic pole; a dashed circle centred on it marks the path of the celestial pole through the precession cycle. For orientation, note that Ursa Minor, Aquila, Capricornus, and Perseus are shown with their modern shapes, as is Cetus although the Babylonians listed no constellation there. The shapes of the Wagons and Dog are from the description found in Asshur. The shapes in the Pisces region are from Ref. 6. The shapes of the Stag and Horse are inferred from later Arabic manuscripts. Note that these and several other constellations are oriented so as to appear upright when they are rising, consistent with the importance of heliacal risings. The shape of the Panther (griffin) is unknown but has been reconstructed as a sitting, winged panther similar to our Leo, consistent with the star-names in *MUL.APIN* List V. The shape of the Bull is drawn so as to agree with the figure on the Seleucid and Dendera zodiacs. The inset at bottom, to the same scale, shows the alternative shapes of the Bull and the Ibx as proposed by Hartner [Ref. 18]. The base star-map, which takes account of proper motion, is complete to magnitude 4.7. It was produced using the *CyberSky* program, author Stephen Schimpf, with help from Simon Mentha. *J. H. Rogers.*

Fifth phase: astrometric diaries, 750–60 BC^{6,9}

From about 750 BC, the Babylonians began precise chronicles of both historical events and astronomical measurements. A few such ‘diaries’ survive from 650 BC onwards, and many from 384 BC onwards. They included precise measurements of planetary positions in degrees, minutes, and seconds of arc, relative to the standard 12 signs of the zodiac (after 420 BC)^{5,6,11} and also relative to 31 stars spaced around the zodiac. (These were different from the 36 constellations referred to above, and also from the 36 stars or ‘decans’ which the Egyptians used for their calendar, spaced rather more evenly at 10-day intervals around the zodiac.) There were few if any new constellation names.

The division of the zodiac into 12 equal ‘signs’ was made in this period, possibly around 600 BC, certainly before 475 BC^{5,6} – about the same time that zodiacal horoscopes were introduced (Paper II). In place of the 17 ‘Stars in the path of the Moon’ listed in *MUL.APIN*, texts from the Persian period list just the classical twelve, but with *lu-Hunga* (the Hired Labourer) for Aries and ‘tails’ or the Field for Pisces. The signs were defined so that the cardinal points were in the middle of them. Originally, therefore, the spring equinox was at ‘15° of *lu-Hunga* [Aries]’. Later Babylonian lunar tables put it at 10° or 8°, thus accounting for precession.^{5,6} Other hints that the Babylonians may have known about precession are their name for Polaris (see above), and the bull-slaying motif of the Mithras cult (Paper II). However, it is not thought that they understood the phenomenon of precession, and they may have attributed the shifting cardinal points to increasing accuracy rather than steady motion. They retained the equinox at 8° through the 2nd century BC, when it should have been at 4°.⁵ Greek and Roman authors still had the equinox at 8°. Only after Hipparchus discovered precession was the equinox set to 0° of Aries, correct for that time, for the purpose of astrology (Paper II).

After the conquest of Babylon by the 25-year-old upstart

Alexander in 331 BC, the astrometry continued under his successors; indeed, these Seleucid kings had ever-greater demands for astrology. The last diaries date from about 60 BC, when the region was conquered by Persians, and the very last cuneiform astronomical records date from 75 AD. From this period also come the only extant pictures of the zodiac, the Seleucid and Dendera Zodiacs (see above and Figure 6). Worship of Babylonian astral deities did continue for some time in southern Arabia, however.

Last phase: Survival in the desert?³⁰

Were the rustic constellations completely lost? Between the downfall of Babylon and the advent of Islam, the nomadic Bedouin Arabs of the desert had a rich astronomical culture and a great variety of constellations.³¹ A small group of their constellations may have been relics of the Babylonian farming-calendar tradition, which were illustrated for the first and last time in Arab manuscripts.

The Bedouin constellations were described in detail by al-Sufi along with his descriptions of the classical constellations.^{30c} These descriptions were summarised by Allen,¹ and many have been sketched by Staal.³³ One class consisted of familiar figures swollen to gigantic size: the lion (Leo) spread from Spica to Castor, the giant (Orion) expanded into Gemini, and a pair of huge arms extended from the Pleiades into Cassiopeia and Cetus. Another class, covering most of the sky, comprised not ‘join-the-dots’ figures like ours, but flocks of animals, each star being an individual. Thus there were goats in Auriga (which we also have); camels in Draco and Lepus and the Hyades; gazelles running in the preceding part of Ursa Major; the vultures (or eagles) of Vega and Altair; a great Fold around the North Pole, containing camels, sheep, calves, wolves, and a shepherd with his dog; a similar Pasture in Hercules and Ophiuchus; and ostriches standing and nesting and hatching and running around much of the southern horizon. This was an engaging tradition, but perhaps not a very ancient

nor serious one. A few of the figures do evoke reflections of the Babylonian sky. Thus most of Hydra survived as the Vertebrae; where the Babylonians had the Standing Gods of Ekur, the Bedouin had the Images or Statues; and the two circumpolar Wagons became the two Funeral Biers, not bears. The Square of Pegasus was an enormous Bucket; was this a desert parody of the irrigated Field or the ‘celestial sea’?

Most interesting, though, are three animal figures which flanked the Square of Pegasus. They differed from other Bedouin constellations in several ways: they were the only animals formed as ‘join-the-dots’ figures like ours, they cut across several of the previously described constellations, and they were the only ones to be illustrated in manuscripts of al-Sufi.³⁰⁻³² The illustrations reproduced here^{30b,30c} (Figures 8 & 9) show the stars only schematically, but other

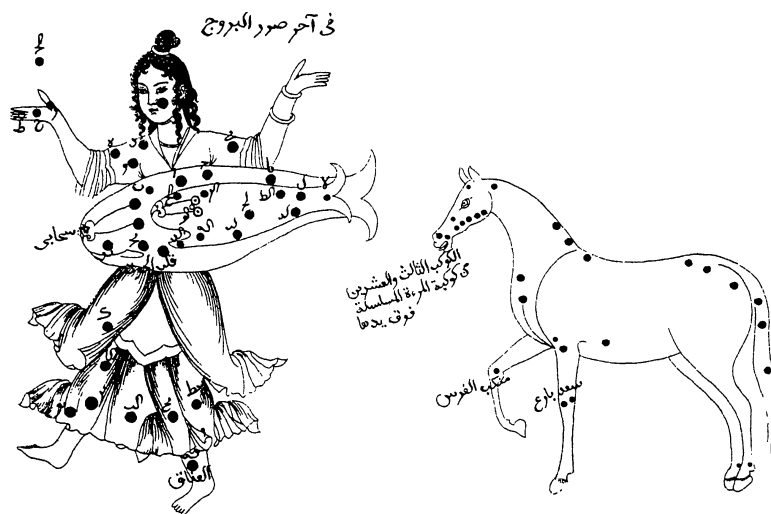


Figure 8. The old Arab constellations of the Northern Fish and the Horse, from an edition of al-Sufi [Ref. 30c]. The stars are more accurately and recognisably shown on other editions [Refs. 30a & 33]. Reproduced by permission of the Syndics of Cambridge University Library.

copies of al-Sufi^{30a,30b,33} show them accurately enough for their stars to be identified (Figure 7). One was the Northern Fish of Pisces, in the larger form that corresponded to the Mesopotamian goddess Anunitum, with its snout at the Andromeda Nebula; the clearest illustration^{30a} shows the lady Andromeda with what looks like a brace of halibut in her lap. The second was the Horse, possibly the Horse of *MULAPIN* (Table 3A); it fitted between our Pegasus, Equuleus, and Cygnus, but unlike Pegasus it was whole and upright.^{30a,33} The third was the Camel, first described as an Arab constellation by Ptolemy, which covered Cassiopeia;^{30b,31–33} this may have evolved from the Babylonian Stag. β Cas was the Camel's hump, and was not part of the Stag; and the figure indeed has the 'bright red star' α Cas in its loin, and the Andromeda Nebula close to its breast, as described in *MULAPIN* (Table 3A).

So in these three animals, we apparently see relics of the animal constellations of the Mesopotamian farming calendar, still being portrayed a millennium after the downfall of Babylon.

The zodiacal and parazodiacal constellations

Let us now review how the 12 zodiacal and 4 parazodiacal constellations developed, both in Mesopotamia and in their later transmission to classical Greece and Rome. They can be grouped into quartets, each of which has marked the cardinal points at a different epoch.

Zodiac I

The first four zodiacal constellations were early enough that they were fitted into the calendrical star-lists – unlike some of the other eight which we will consider hereafter. Some of them have since been reduced in size, but never replaced.

These earliest zodiacal constellations must have been established in Sumer or earlier in Elam. Three were large, conspicuous, realistic animals, symbols of strength and power: the Bull, the Lion, and the Scorpion. Along with the water-pouring god, Aquarius, they contained the four cardinal points around 4400–2200 BC. It is hard to be more precise about these dates because of the large sizes of the constellations, but Hartner¹⁸ pointed out that around 4000 BC the cardinal points in the calendar were marked by heliacal risings of the Pleiades, Regulus, and Antares, then around 2800 BC, the cardinal points in the sky were close to these same stars.

Hartner¹⁸ proposed that the quartet was completed with an even earlier constellation of the Ibex, marking the winter solstice, as ibexes were common motifs in proto-Elamite art of ~4000 BC. Sometimes the horns of the ibex enclosed a star or Sun or patterned square, which he saw as the pictograph for 1-iku (the Field). His Ibex was formed from stars of our Aquarius, Capricornus, and the head of Pegasus (Figure 7 inset). However there is no direct evidence for this constellation, and the pottery with ibexes and geometric patterns was a distinctive proto-Elamite tradition, quite separate from the bulls and lions and scorpions that prefigured the other three constellations.

Bulls and lions were very common in art from ~3200 BC onwards, and the water-pouring god and scorpions and scorpion-men from ~2600 BC onwards. One common motif was the Lion-attacking-Bull, seen on seals of the 4th millennium,^{17,18} which reached its monumental climax in Persepolis around 500 B.C.¹¹ Hartner¹⁸ noted that as Taurus set, Leo was at the zenith, and he argued that this motif represented the changing of the seasons. (However, other common artistic motifs had no evident astronomical meaning.)

These constellations each contain first-magnitude stars (Aldebaran, Regulus, Antares, and Fomalhaut), which were close to the cardinal points and became known as the Royal Stars in later Persia.¹ However, Fomalhaut was too far south to be clearly seen at that epoch; Altair may have been adopted instead, and this may have been the origin of the Eagle as another 'royal' constellation. The four royal stars may be symbolised in Persepolis, in a vast bas-relief of a king slaying a griffin, which has the horns and body of a bull, mane and forelegs of a lion, tail of a scorpion, and wings and hindlegs of an eagle.²⁵ Variants with parts of a man instead of a scorpion were first seen on a 19th-century BC stone from Syria,¹⁷ and later in *Ezekiel* 1: 1-28 and *Revelation* 4: 6-7.

Taurus: The Bull was the Bull of Heaven to the Sumerians.

It marked the spring equinox and the start of the new year. Its head has always been the Hyades, including Aldebaran. Our Taurus, showing just the front half emerging from a storm cloud, is reminiscent of the Bull of Adad in the pictographs. But the posture was probably different in the Mesopotamian sky (Figure 7). The Pleiades may have formed the upper horn. Hartner¹⁸ suggested that the π Ori star-chain was the lower horn (Figure 7 inset). In Figure 7 I offer an alternative which matches the picture on the Seleucid and Dendera Zodiacs. Only in classical Greece were the horns turned forwards to give the classical picture.

Leo: The Lion marked the summer solstice for the Sumerians. Regulus (Latin 'little king') was called Sharru ('the king') by the Babylonians. Leo is the 12th largest constellation.

Although the star cluster of Coma Berenice belonged to the figure of Eru in the Babylonian sky-map, it may alternatively have figured as the tuft of the lion's tail, as it did to some Greeks and Muslims. But Eratosthenes and Hyginus instead described it as the hair of Queen Berenice of Egypt, hence our present little constellation.

Scorpius: The Scorpion marked the autumn equinox. It was larger at first; the stars that are now Libra were its two claws.* Scorpius plus Libra together would be the 10th largest constellation. It was split into the two constellations at least as early as the *Three Stars Each* texts (Table

*Indeed, the Northern Claw (β Lib) was its brightest star according to Eratosthenes and Hipparchus.^{1,25} To Ptolemy and to al-Sufi^{25,30c} β Lib and Antares were both 2nd magnitude, and since then, β Lib has gradually faded while Antares has brightened. Antares was listed as second magnitude up to AD 1430, then as first magnitude into the 19th century. From AD 1880 onwards it varied between magnitude 1.2 and 1.8 with a cycle of 5 years, but in modern catalogues the range is now 0.9 to 1.2.



Figure 9. The old Arab constellations of the Northern Fish, the Camel and the Horse, probably relics of the equivalent Babylonian constellations of Anunitum, the Stag, and the Horse. This previously unpublished drawing is from an AD 1171 edition of al-Sufi [Ref. 30b], and is the only one to show them together in the sky, along with our Andromeda. However the stars are not shown accurately; only the W of Cassiopeia is recognisable, the Square of Pegasus has disappeared, and the Fish seems to be a hybrid of two alternative Fishes shown in other manuscripts. It was probably made from incomplete descriptions of the figures, rather than from actual maps. Other editions of al-Sufi give more accurate maps of the individual constellations [Refs. 30a & 33]. I am grateful to Dr E. Savage-Smith and to Doris Nicholson of the Bodleian Library for help in obtaining this illustration. *Bodleian manuscript Hunt. 212, folio 74v*, reproduced by permission of the Bodleian Library.

[The original is marred by bleed-through of writing from the other side of the page; in this copy, the bleed-through has been partly suppressed and the outlines of the figures enhanced.]

2), but Libra was still referred to as the ‘horn’ or ‘claws’ of the Scorpion in *MUL.APIN* and through into Greek times (see below).

This conspicuous animal shape attracted attention from other cultures as well. The Chinese divided the zodiac into only four constellations, and here was the Dragon, stretching from Sagittarius to Virgo, with Spica and Arcturus as its horns.

Aquarius: The winter solstice of 4400–2200 BC was marked by the Water-Pourer, which represented Ea himself from Sumerian times. In the common pictograph (Figures 2, 5, 6) Ea, often standing atop a sacred mountain or ziggurat, was pouring two streams of water from his shoulders or from vases, with fish below. *MUL.APIN* called the figure Gu.La (‘The great one’). In Greek times the figure was unnamed, with a single vase from which poured a substantial stream down to Piscis Austrinus. Aquarius is now the 10th largest constellation.

Four parazodiacal animals

Although many of the *MUL.APIN* non-zodiacal constellations had divine associations, only a few of them have survived into our sky-maps, and these four animals were associated with the summer and winter solstitial signs in the old pictograph tradition. So these are the only non-

zodiacal constellations to have been shared by both Mesopotamian traditions and also transmitted to the classical tradition, and they are also shown on the Dendera Zodiac (Figure 6) and on Mithraic shrines (Paper II).

Piscis Austrinus: The Southern Fish has always been attached to the zodiacal figure of Aquarius. In classical maps it mysteriously swallows the stream which he pours out, but perhaps originally it just swam in it, as in Figure 2.

Aquila: The Eagle was perhaps associated with the ancient zodiac by virtue of its ‘royal star’ Altair. Eagles were common in ancient art, but Aquila may be shown with Aquarius on the Seal of Adda (Figure 2). It is not known if the Eagle had any divine significance, but the adjacent constellation was Zababa, who was also represented by the vulture/eagle-head standard on the boundary stones. On the Dendera Zodiac, there are three birds in this general area though none of them is really large nor aquiline.

Hydra and Corvus: The huge Serpent, uniquely, belongs to all our constellation traditions: the farming calendar lists, the boundary-stone pictographs, and also the ancient Mediterranean tradition, as it marked the celestial equator around 2800 BC (see Paper II). It was associated with Leo, which was shown standing on the

serpent on a boundary stone (Figure 3), and also in later versions of the pictograph tradition, viz. the Seleucid and Dendera Zodiacs (Figure 6).

Corvus is the Crow or Raven that is mysteriously perched on Hydra. Although there are no early pictographs of this association, the Raven is listed in *MUL.APIN* and shown on the Seleucid and Dendera Zodiacs. As visualised by the Greeks, the constellation Crater (the Cup) was also part of the group, and the trio was even preserved into the Mithras cult (Paper II).

Why were these such a significant group, even when they no longer marked the equator? The classical myth does not seem helpful (Paper II). But note the entry for Hydra in *MUL.APIN*: ‘The Snake [Akkadian: Nirah], Ningizzida, lord of the Netherworld’. Also note the following passage from the description of the funeral of Gilgamesh, giving offerings to the gods of the dead:

‘Bread for Neti the Keeper of the Gate [= Nedu; see Sagittarius]; bread for Ningizzida the god of the serpent, the lord of the Tree of Life; for Dumuzi also, the young shepherd [see Virgo and Aries]...’—[*The Epic of Gilgamesh*, Ref. 24]

Ningizzida and Dumuzi stood together in the underworld, and Ningizzida and Pabilsag (see Sagittarius) governed the household of the queen of the underworld. Therefore I suggest that Hydra represented the entrance to the underworld, joined by the Crow and Cup as symbols of death.

Zodiac II

The other eight zodiacal constellations were mostly established by the time of the *MUL.APIN* lists, though not all included in them. Virgo and Sagittarius may be descended from the fertility goddess and the hunting god shown on pictographs of ~2500 BC onwards, and Sagittarius and Capricornus are found on boundary-stones from the second millennium BC, just as they are shown on the Dendera zodiac. Gemini, Cancer, and Libra were first recorded in the *Three Stars Each* and *MUL.APIN*. Only Pisces and Aries were late additions, though pictographic evidence suggests that both might have existed in the second millennium BC.

Thus the set comprising Gemini, Virgo, Sagittarius, Pisces, is definitely old; but how old? They are very large, non-representational, and include three of the four humanoid (or divine) figures in the zodiac. These attributes led Gurshtein^{34,35} to propose that they were the most ancient of all. They would have marked the cardinal points around 6600–4400 BC, well before urban civilisation. But there is no historical evidence for them being even as early as the Zodiac I set. More likely their divine forms were invented around 2300 BC, when Mesopotamian religion became more systematic. Their large size may be due to the happenstance that, outside the four animal figures of Zodiac I, there were large amorphous sky areas waiting to be filled.

Why were they created? Not for astronomical reasons: even though the cardinal points were then drifting out of the Zodiac I constellations, no special significance was given to the Zodiac III constellations which succeeded them (see below). Nor for astrological reasons; the zodiac did not

figure as a distinct or important feature of omen texts until the mid-first millennium.⁵ Probably for religious reasons, to extend divine symbols around the remainder of the path of the gods (the planets). Thus a fertility goddess was placed next to Ishtar’s Lion; a hunting god was placed in the dawn sky of autumn; Ea at the winter solstice was supported with his Goat-fish on one side and Fishes on the other; and eventually the shepherd god of spring, Dumuzi, furnished a Ram for the spring equinox.

Gemini: The Twins has been the most stable of this set.

Its striking pair of first-magnitude stars was called the Great Twins. They were identified as Lugalgirra and Meslamta-ea, armed twin gods who guarded doorways, with aspects of Nergal. To their south were the Lesser Twins, later combined in the same constellation. In the first Greek account of them, by Aratus, the Twins were not named. Later they were identified as Castor and Polydeuces (by Eratosthenes), or as Apollo and Heracles (by Hyginus and Ptolemy).

Virgo: While there are plenty of men among our constellations, there are only three women; but the Virgin makes up for this imbalance by being the second largest constellation and embodying the oldest of deities – the Earth Mother. The classical Virgo has always held a sheaf of corn, so she was clearly a goddess of fertility. Thus Virgo was Demeter in Greece, who was analogous to Ishtar in Babylon and Isis in Egypt. Each of these goddesses travelled to the underworld to rescue a dead loved one – Demeter’s daughter Persephone, Ishtar’s husband Dumuzi (Tammuz), and Isis’ husband/brother Osiris – and this was the mythical origin of autumn and spring. In *MUL.APIN*, Virgo was identified with Shala, who was not Ishtar; but the early pictographs show Ishtar, with lions and holding vegetable produce (see Figure 2); so perhaps the attributes of Shala were derived from Ishtar. We can only speculate as to whether this great earth goddess was implicitly identified with this constellation in earlier times. Shala and/or her ear of corn were certainly shown on Kassite boundary-stones.

This figure co-existed with a different Babylonian constellation, the Furrow (Ab.sin). This was obviously one of the ‘farming’ constellations, and one is tempted to think the furrow was made by the ploughman Boötes, although he is not known to have been a ploughman in Babylon. Anyway, the two traditions were recognised by the description in *MUL.APIN*: ‘The Furrow, the goddess Shala’s ear of corn.’ Actually, the Furrow seems to have been just Spica or the surrounding area, but the name was later applied to the whole zodiacal sign in the last phase of Babylonian astronomy, even while the figure was that of the goddess with the corn that had perhaps grown from the furrow.

Sagittarius: The Archer has a long and perplexing history, which likewise may represent confusion between two parallel Mesopotamian figures. The name for the constellation in *MUL.APIN* was Pabilsag; he was a little-known Sumerian god, later identified with Ninurta. However another Babylonian name for it is recorded, Nedu,⁹ which means ‘soldier’ and was also the gatekeeper of the

underworld (see Hydra, above); he perhaps represents a different tradition, and we do not know if he had a bow and arrow. But it is not known if either divinity was relevant to the zodiacal sign, a centaur with a bow and arrow, which was already present on a few boundary stones in the second millennium BC (Figure 5). The earliest Greek portrayal of the Archer was apparently a satyr (with two legs, of a goat) rather than a centaur (with four legs, of a horse). He was said to be the son of Pan (goat-god) and Eupheme (human); Eratosthenes described him as a satyr, and this is how he is shown on the *Farnese Atlas* (Paper II). In classical times he became a centaur, as the ancient four-legged zodiacal sign was reconciled with the constellation.

Only in modern America has Sagittarius been ignominiously turned into a teapot – although to most Americans, a teapot is as exotic as a centaur.

Sagittarius is the 15th largest constellation.

Pisces: This is the 14th largest constellation, but it seems larger as it sprawls over long distances, and it originally sprawled even further, completely embracing two sides of the Square of Pegasus. But it contains no bright stars and its meaning is an enigma. It consists of two fishes with their tails tied together by a ribbon. Perhaps it refers to catching fish, in keeping with the various agricultural constellations, but I do not know if anyone has ever caught fish by lassoing their tails. It is also part of the ‘celestial sea’, most of which consists of watery constellations derived from Ea.

However, it was one of the last constellations to be established. In *MUL.APIN* and earlier,^{4,6,8,11} the western fish was called the ‘Great Swallow’, which also included the ‘neck’ of Pegasus. (If ϵ Peg was included, it may have belonged to the Ibex and Swallow and Fish in succession, before it ended up in Pegasus). The northern fish, which also included the middle of Andromeda, was called Anunitum, ‘Lady of the Heavens’ and goddess of childbirth. We have seen this fish illustrated by the Arabs (Figures 8 and 9). The *MUL.APIN* tablets do not mention the Fishes; the single reference to the Tails (Zibbatimash) probably refers to the Swallow, not the Fishes, as we noted above; but this name came to symbolise the zodiacal Pisces later. Other late Babylonian sources name it as DU.NU.NU or Rikis-nu.mi, meaning ‘Fish-cord’^{3,9} – the first clear reference to Pisces. Yet others list the zodiacal sign as 1-iku (the Field, our Square of Pegasus), whose pictograph is wedged between the Fishes on the Dendera Zodiac (Figure 6). Hartner¹⁸ suggested that this was an ancient pictograph, but this remains speculation as no such sign has been found in the astral traditions we have examined.

I suggest that Pisces did in fact come from the ancient pictographic tradition, in that Aquarius (Ea) originally poured out two streams with fishes, as on the old pictographs (Figure 2). One stream ran south to Piscis Austrinus, the other ran east through Pisces. Perhaps the streams of water were misinterpreted by later copyists, giving rise to the strange postures of the three fishes today.

Zodiac III

These four constellations include the last additions to the zodiac, even though they are the set which gave their names to the First Point of Aries and the Tropic of Cancer. Capricornus was an ancient divine symbol, but the other three are the smallest and faintest of the zodiacal constellations, and seem not to have been securely defined until classical times. They were needed then to mark the cardinal solar points of the zodiac (which had precessed away from the Zodiac I constellations) and to complete the equal division of the zodiac into 12 ‘signs’ in the middle of the first millennium BC. These three were perhaps originally rustic constellations (the crab of the marshes, the scales of the village market, and the hired farm-labourer) which only belatedly acquired symbolic importance as signs of the zodiac. The farm-labourer was replaced by the divine symbol Aries when it superseded the Plough (mul-APIN) as the first constellation of the year.

Aries: The Ram was a major cult figure in ancient civilisations – e.g., for Ea in Mesopotamia and for Ammon in Egypt – but there is no Mesopotamian record of it as a constellation. The ‘farming’ constellation was the Hired Farm-labourer, listed in *MUL.APIN* as ‘mul luHun-ga, ^dDumuzi’. There are several plausible origins for the Ram which replaced it. First: the ram’s-head symbol of Ea, which added to his representation in adjacent constellations. Second:⁹ the name lu-Hun-ga (Farm-labourer, though ‘Lu’ meant sheep), which in Babylon became both Agru (Farm-labourer) and Immeru (Sheep); hence, the Ram. Third, and perhaps most likely: Dumuzi (Tammuz), who as a dying and rising god was a suitable custodian of the spring equinox, was a shepherd (see Hydra and Virgo, above). Moreover, unlike all the other major gods, he was never illustrated – which is consistent with the paucity of pictographs of Aries. However, a ram like Aries was shown on Kassite boundary-stones with Shala’s ear of corn, so perhaps this symbol was transferable among the fertility deities.

Aries has no very bright stars, but contained the spring equinox after ~2200 BC, so the intersection of ecliptic and equator has ever since been known as the First Point of Aries.

Cancer: The Crab seems to date from the *Three Stars Each* phase, though its early history is as vague as its stars. The constellation of Al.lul (Crab) was listed in the *Three Stars Each* but in the wrong place (Table 2B); and it was in *MUL.APIN*, but may have been Cancer and/or Procyon, while β Cnc, which lies between them, was included in Hydra. Later, as a zodiacal sign, Cancer was also known as Kushu (a water-animal, perhaps a crab; formerly read as Nangar), which denoted just the nebula Praesepe.^{3,6} Cancer was occupied by a scarab in Egypt, so the general shape of animal may have been suggested by Praesepe. To the Greeks, Cancer marked the summer solstice.

Libra: The Weighing-scales also has a dual history. Its two bright stars originally formed the claws of the Scorpion (see above). They were split off to form the Scales as

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early as the *Three Stars Each* (Table 2), perhaps because they were a 'farming' constellation; and this was also the zodiacal sign as shown on the *Dendera Zodiac*. But the original figure was not forgotten: *MUL.APIN* still listed Libra as 'The Scales, the horn of the Scorpion', and Aratus and Ptolemy still gave it the alternative name of Chelai, 'the Claws', saying that Libra came from Chaldaea. The constellation of Libra, the 'point of balance' at the autumn equinox, was finally ordained by Julius Caesar, who represented himself on coins holding the Scales of Justice.

Capricornus: This more ancient and substantial constellation, marking the winter solstice, is a Goat-Fish hybrid (Figure 5) – not a goat. It dates back to pictographs before 2000 BC, and was a symbol of Ea on boundary-stones.

In Paper II, we will review how the Babylonian zodiac and para-zodiacal constellations were combined with non-Mesopotamian constellations – probably from an ancient Mediterranean seafaring culture – to make the Greek sky-map which we have inherited.

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Pre-canonical group: S5; S9; S63; S12/London-101; S14/H10; S25/London-103; S29/H1 (also pictured in Fig.7 of Ref.12).
Canonical group: S32/H6; S31/H18 with S33/H19 (top and bottom halves of different stones which were very similar to S32/H6); S40/H21 (**Figure 4 herein**); S48/H2 (also pictured in Refs.6 and 18); S49/H17; S61/H8; S62/H7/London-99 (**Figure 3 herein**); S67/H22/London-100 (also pictured in Fig.98 of Ref.17, and Fig.90 of Ref.12); S68/H23; S71/London-XI (also pictured in Ref.11); S74/H32/London-102; S78/H25; S79/H24/London-105; S80/H26/London-106 (also pictured in Fig.99 of Ref.17, and in Ref.25).
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Received 1996 November 8; accepted 1997 January 4

Origins of the ancient constellations: II. The Mediterranean traditions

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The classical map of the sky, with the 48 Greek constellations, was derived from at least two different pre-Greek traditions. One tradition comprised the 12 signs of the zodiac, with several associated animal constellations, all of which developed over ~3200–500 BC in Mesopotamia in a religious or ritual tradition. These were taken over by the Greeks around 500 BC. However the other Babylonian constellations, their farming-calendar tradition, were not adopted. The other tradition was not Mesopotamian; it comprised large constellations which appear to date from ~2800 BC, probably from the Mediterranean region, devised for the navigators of ships. They include huge bears and serpents which marked the celestial pole and equator at that time, and probably the four anonymous giants which we know as Hercules, Ophiuchus, Boötes, and Auriga, as well as some of the large southern ‘marine’ constellations. The origins of some other constellations, including the Perseus tableau and various animals, are unknown; they may have been new creations of the Greeks. The Greeks assembled the classical sky-map from these different sources between 540–370 BC, but many of the familiar legends were only applied to the constellations later.

Introduction

The heavens appear to us to be filled with fantastic figures of the imagination – heroes and monsters, animals and artefacts – which have been a source of inspiration to artistic map-makers for two millennia, as was beautifully shown in a recent exhibition and book.¹ But these maps do not answer the crucial questions: Why were these figures put there; when and by whom; and for what purpose? Most of them are in no way suggested by the actual scatter of stars in the sky.

The constellations we are concerned with here are the 48 constellations of the classical world – the Greek and Hellenistic and Roman cultures. They were first described by Eudoxus and Aratus, a few centuries BC, and the definitive list of 48 was given by Ptolemy, in Roman Egypt. I will not describe the later constellations, nor the classical Greek myths of the Ptolemaic ones; these are thoroughly covered in books such as Refs. 2–5, and many of the myths were undoubtedly applied retrospectively to pre-existing celestial figures. I will not generally consider the names of individual stars, either, since these (being mostly classical or Arabic) are later than the classical constellation figures, and mostly refer to positions in those figures.^{6,7} Nor will I describe the constellations of other cultures. Even Egypt and India, which were in contact with the Mediterranean world, had largely different star systems (although they all adopted the classical zodiac in Hellenistic times, and some other congruencies are noted below). China had an altogether different map of the sky.

In Paper I,⁸ we saw that only a subset of the classical constellations came from Babylonia – the zodiac and four associated animals: serpent, crow, eagle, and fish. In this paper, we review the literature which has deduced the origin of the remainder. Much of the historical and mythological information herein is derived from various books on ‘constellation lore’^{2–4} of which Sesti² is the most substantial. However much of their information on the earliest origins seems to have come from late nineteenth-century books by Allen⁶ and Brown;⁹ although those authors explored a wealth of historical sources with which modern astronomers are not familiar, some of their data were in-

accurate or, in the case of Mesopotamian constellations, simply wrong.

There have been useful short reviews of some aspects of our topic.^{10–13}

It is clear, from the positions of the Greek constellations themselves, that many were much older than classical Greece. The original descriptions of their risings and settings, by Eudoxus and Aratus, were erroneous unless they referred to a much earlier epoch, around 2000 BC – a fact first noticed by Hipparchus, and developed in more recent times by Proctor,¹⁴ Maunder¹⁵ and Crommelin¹⁶ and most recently Ovenden¹⁷ and Roy.¹⁸ These authors showed that the actual forms of the constellations indicate an even earlier origin. The best estimate¹⁷ is 2800 BC (± 300 yr). The date is given by the effects of precession (see Paper I for definitions); while the ecliptic is fixed relative to the stars, the celestial pole and equator slowly drift. Precession shifts the North Pole; in 2800 BC, conveniently, the Pole Star was Thuban rather than Polaris (Figure 1). It shifts the South Pole and thus the ‘zone of avoidance’, where southern stars could not be seen from north temperate latitudes; so the stars of Centaurus and Argo were more visible at that time, and the stars of Eridanus and Piscis Austrinus are more visible now. It shifts the zodiac, so the cardinal points shift from one constellation to the next every 2160 years. And it shifts the dates of heliacal risings relative to the seasons. The result is that the ancient mythological, calendrical, and navigational meanings of the constellations gradually became invalid, but these authors have worked back in time to deduce when they were valid. They also deduced the latitude of the constellation-makers, 36°N, from the radius of the ‘zone of avoidance’ within which Ptolemy recorded no stars; it was centred on the pole of ~2800 BC (though see Ref. 19 for a contrary view).

Previous authors have implicitly assumed that the classical constellations were created at a single place and time, but this leads to a historical paradox. The only plausible centres of civilisation at the right time and latitude were Mesopotamia and the Mediterranean. Mesopotamia has long been assumed, but we have examined the Babylonian records in Paper I, and they show that while the classical constellations of the zodiac and some others developed

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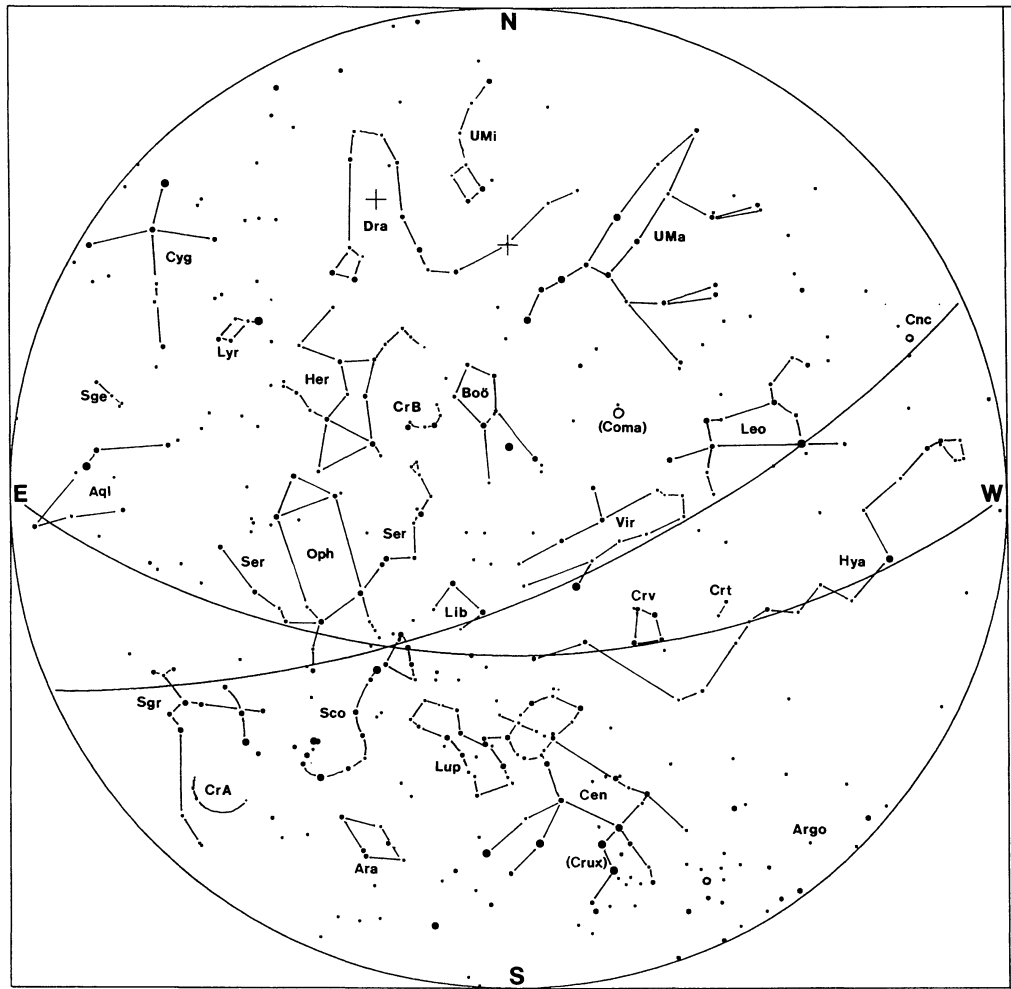


Figure 1. The night sky of late winter in 2800 BC at 36°N, showing the classical constellations. Solid lines mark the equator and ecliptic; crosses mark the celestial pole (Thuban) and the ecliptic pole. Naked-eye clusters or nebulae are marked by circles. Hydra marks the equator, and the tail of Serpens roughly continues it east of the ecliptic. Centaurus (including the Southern Cross) and Argo (now split into four) rise well above the horizon, in contrast to their situation now. The base star-map takes account of proper motion (note the positions of Altair, Arcturus, and Rigil Kentaurus) and is complete to magnitude 4.5. It was produced using the CyberSky program, author Stephen Schimpf, with help from Simon Menth. *J. H. Rogers*

progressively from the fourth to the first millennium BC, many of our constellations were in fact unknown in Mesopotamia. Conversely Ovenden¹⁷ favoured the Mediterranean region, particularly Minoan Crete. However this would be incompatible with the documented development of the zodiacal constellations in Mesopotamia. We are forced to the conclusion that the classical sky-map was synthesised from several unrelated sources, as follows.

First, there are some constellations that were known to all cultures. The only star-groups mentioned by Homer and by Hesiod, around 700 BC (and also in the *Book of Job*), were the Bear (presumably the seven stars of our Plough), Arcturus, Sirius (the Dog-star), the Pleiades, the Hyades, and Orion. Hesiod's great poem provided a farming calendar based on heliacal risings and settings, like that of the Babylonian *MUL.APIN* (Paper I), but with only these few star-groups. Thus he wrote:

'When the Pleiades, Atlas' daughters, rise [at dawn],
Begin your harvest, and plowing when they set [at dawn].'

The second set comprises the constellations which best marked the celestial coordinates around 2800 BC¹⁵⁻¹⁷ – enormous serpents, bears, and giants. With one exception (Hydra), these are not found in the Babylonian texts. So it is likely that they were invented by a Mediterranean people, for use in navigation at sea.¹⁷ We may call these people the Navigators. There is no documentary evidence as to who they were, but the most likely candidates are the Minoans;¹⁷⁻¹⁸ their seafaring civilisation was beginning around 2800 BC, and was destroyed following the great volcanic eruption of Thera in the 16th or 15th century BC. These constellations allowed navigators to find north, south, east and west even on a partly cloudy night, by viewing the serpentine constellations which marked out the celestial coordinates, or by observing the points on the horizon at which certain star-groups were rising or setting. Unlike the first set, these would of course only have been relevant during the hours of darkness. The zodiacal stars would not have been specially significant to the Navigators.

The third set is the twelve ‘signs of the zodiac’, plus the ‘parazodiacal’ animals (Hydra, Corvus, Aquila, and Piscis Austrinus). We have seen how they developed in Mesopotamia from ~3200 to 500 BC (Paper I).^{8,10,20,21} They were signs of the gods, and at the end became important for astrology, which seems to be why they spread rapidly through the Egyptian and Mediterranean worlds soon after 500 BC. They were among the last to acquire Greek legends; Aratus did not give any for them.

Finally, some of the classical constellations cannot be shown to belong to any of these groups, and some of these represent Greek myths quite coherently, so they may have been invented by the Greeks themselves. The Greeks also synthesised the preceding traditions to give the classical list.

History of the constellations in Greece and thereafter

Some of the classical constellations were already known in Greece in the 5th century BC. But the earliest known description of the full set (with a few exceptions) was by Eudoxus, around 370 BC. He learnt much of his astronomy during a visit to Egypt, and is said to have made the first celestial globe, showing the constellations with both equatorial and ecliptic coordinates. Eudoxus’ book of the constellations, the *Phaenomena*, was rewritten as a long poem of the same name around 275–250 BC by Aratus of Soli. This poem survives in Greek, in Latin translations (including one by Cicero and one by Germanicus Caesar) and in later editions, and it became one of the most popular scientific texts in the classical world and up to medieval times. It described the shapes of the constellations and positions of the stars, gave the relative times of their risings and settings, referred only briefly to some Greek myths about them, and explained their use for weather-forecasting for seamen. The later editions were supplemented by more extensive mythology and illustrations from later authors, e.g. from the *Katasterismoi*^{3,13,30} attributed to Eratosthenes (2nd or 1st century BC), and from Hyginus (1st or 2nd century AD) who described the full-blown classical myths of the constellations. No original Aratus manuscripts survive, but European copies from the time of Charlemagne (ca. AD 800) onwards are illustrated with paintings of the constellation figures,^{1,22} though not with actual star maps.

Perhaps the greatest Greek astronomer up to his time was Hipparchus, who worked in Nicaea then Rhodes, ca. 150–130 BC. He wrote a *Commentary on the Phaenomena of Eudoxos and Aratos*, which survives complete, and criticised many of their apparent errors. Thereafter, by 128 BC, having produced an accurate star catalogue from his own observations, he discovered the phenomenon of precession, which explains the apparent errors in the *Phaenomena*. The star-lore of Eudoxus and Aratus apparently dates from at least 1000 years earlier. Ovenden,¹⁷ who analysed their lists of simultaneous risings and settings in detail, deduced an epoch of 2600 (±800) BC. Roy¹⁸ further analysed Aratus’ lists of the stars on the Equator and the Tropics, and found

them valid for 2000 (±200) BC. Likewise the calendar of heliacal risings etc. of Geminus,²³ nominally dating from ca. 200 BC, agrees well with the *MUL.APIN* calendar and must also date from before 1000 BC. The Greek authors before Hipparchus had apparently been repeating star-lore for one or two millennia without realising that it was becoming so out-of-date as to be useless.

Finally, around AD 130–160, classical astronomical knowledge reached completion with Ptolemy of Alexandria and his *Syntaxis Mathematicke* (or *Almagest*). This great book included an expanded star catalogue, instructions for making a globe, and the final definition of the 48 constellations.

So, when and where were the navigators’ and zodiacal traditions combined to form the classical sky map? Almost certainly, in Greece itself between about 540 and 370 BC. Before then, as the zodiac had no special significance in the Navigators’ constellations, it is most unlikely to have been transmitted from them to Mesopotamia; conversely, the zodiac as we know it could not have been transmitted from Mesopotamia to the west before the mid-first millennium, because it was not complete until then. The historical record of Babylon shows the zodiac developing in stages up to the 6th century BC, when the twelve constellations were defined with equal boundaries, after which the zodiac quickly spread to neighbouring cultures. And the historical record of Greece is stated:

‘The obliquity [of the zodiac] is supposed to have been made known first by Anaximandros of Miletus in the 58th Olympiad [548–545 BC]. Subsequently Kleostratos made known the signs in it, starting with Aries and Sagittarius.’ [Pliny, quoted in Refs.20,21.]

(The obliquity of the zodiac was of course known to the Babylonians long before, but this passage implies that it was not embodied in the Navigators’ constellations known in Greece.) The Greeks also attributed individual constellations to the East, e.g. Ptolemy said that Libra came from Chaldaea, and Eratosthenes said that Pisces symbolised a great Syrian goddess.⁶

But this raises a paradox: how did Eudoxus describe positions of zodiacal constellations for ~2000 BC if they had not been adopted until ~500 BC? If the zodiac was already developed in 2000 BC, it must have been kept as a cult secret or in some non-Babylonian country; this would be a 1500-year conspiracy theory. More likely is the individual cockup theory, viz. the naivety of Eudoxus himself. Previous authors have suggested that Eudoxus deduced his lists of ‘phenomena’ from his star-globe, not from observations, and that he was actually given his star-globe during his visit to Egypt. Roy¹⁸ speculated that the Egyptian priests gave him an antique Minoan globe dating from before the Minoans’ destruction in the mid-second millennium BC. I suggest that this showed only the Navigators’ constellations, with the pole and equator of 2000 BC, perhaps with the stars accurately plotted, and that Eudoxus made a copy of it onto which he mapped both the Babylonian zodiac and more recent Greek mythological constellations. This was the first complete synthesis of the classical constellations. Then he used his globe to read off his ‘phenomena’, and never checked them against the actual sky.

Astral cults in classical times

Meanwhile, of course, astrology had developed in parallel with astronomy.^{21,24} To someone familiar with claims that personal horoscopes are based on ancient wisdom, it may be a surprise to learn that this type of astrology – using the location of the sun, moon, and planets at the exact time of a person's birth – only originated in the middle of the first millennium BC, in Babylonia, perhaps with admixture of Egyptian ideas. The first records are of predictions by 'Chaldeans' (from Babylonia) in the 5th century BC.

'Eudoxus wrote that not the least credence should be given to the Chaldeans in their predictions and assertions about the life of a man based on the day of his birth.' [Cicero, quoted in Ref.21].

There is none of this astrology in Aratus. Ptolemy wrote the definitive work on astrology, the *Tetrabiblos*, which is almost as long as his great work on astronomy. However, the *Tetrabiblos* is didactic and merely qualitative in style, in contrast to the empirical and quantitative nature of the *Syntaxis*. Most of the qualities attributed therein to the various planets and zodiacal signs appear to be arbitrary. As the zodiacal signs have not been adjusted for precession, they are now offset by one constellation from the stars that defined them in Ptolemy's time. So whatever astrologers think is the source of influence, it cannot be associated with the stars, but with the directions of abstract celestial coordinates determined by the tilt of the Earth's axis.

Another astral cult which flourished around that time was the religion of Mithras, and this may hold clues as to how the synthesis of constellations happened.^{21,25,26} It was a secret cult of Middle Eastern origin, popular among soldiers and administrators of the Roman Empire, and the true origin and identity of its images was never revealed. But the central image in its temples showed Mithras, as sun-god and ruler of the stars, surrounded by the zodiac, slaying a bull.^{21,25,26} This has been identified with the ending of the age of Taurus as the spring equinox, due to precession, which occurred around 2200 BC.^{25,26} This idea is supported by the presence of other animals in the tableau: a scorpion (sometimes nipping the Bull's most sensitive organ), a dog, a snake, a crow, and sometimes a cup and a lion. These seem to be the equatorial constellations of the 3rd millennium BC:^{25,26} Taurus and Scorpius in the zodiac; Hydra with Corvus and Crater; plus Leo at the summer solstice. (The dog could be Lupus or Canis Minor.) Remarkably, these are the constellations which were shared by all of the pre-classical traditions. Moreover, the god himself might be Perseus, who was worshipped in Cilicia in Asia Minor.^{6,25,26} Mithras' dress and weapon and pose above the Bull are similar to those in the Perseus constellation (though Orion might also be a candidate). The Perseus constellation in Babylon had been an Old Man who represented the shadowy ancestor of the king of the gods.

What this implies depends on when Mithraism really started. Although Mithra was an ancient Persian god, he did not have these astronomical associations, and the Mithraic cult was first recorded in 67 BC, among pirates from Cilicia. It may have been a new religion then.^{25,26} It might indeed have celebrated the recently-discovered phenomenon of precession, controlled by the sky-god. But this does not explain why Hydra, Corvus, and Crater were represented,

as they were not regarded as special in classical times. I suggested in Paper I that they represented the entrance to the underworld in Babylon, and perhaps that was a remembrance that they once marked the celestial equator. Previous scholars have believed that Mithraism developed from Mesopotamia around the 6th century BC. Thus van der Waerden^{20,21} argued that its astronomical content probably came from the Magi in late Babylon, and that an occult 'Hymn to King Helios' by the Roman emperor Julian referred to Mithras creating the *Three Stars Each* system of ancient Babylon. If so, the Mithraic iconography may be evidence that the Babylonians did know about precession – though perhaps the knowledge was kept as a cult secret.

Classical sky-maps

What maps do we have of the ancient constellations? As mentioned above, zodiacal symbols are common in Mesopotamian and Egyptian art. But only two actual maps of the sky are known from classical times, carved in stone, both showing only figures, not individual stars.

One is the Dendera Zodiac, described in Paper I, which shows the Mesopotamian zodiac surrounded by the Egyptian constellations for the rest of the sky. The other is the Farnese Atlas, a sculpture from the 2nd century AD, who carries a celestial globe that is probably a direct descendant of Eudoxus' globe¹ (Figure 2). It shows the classical constellation figures, which were to be portrayed in almost exactly the same way for the next 1500 years.

Although globes were the main form of celestial 'map' in classical times (being described by Eudoxus and Ptolemy), polar projection maps of the figures if not of the stars apparently did exist, as direct copies have survived in three cultures: (i) European manuscripts of Aratus from the early 9th century AD;^{1,22} (ii) a Byzantine manuscript of Ptolemy from the early 9th century AD;²⁷ (iii) an Islamic palace ceiling from the early 8th century AD.^{27,28}

The classical sky-picture was transmitted not only through these rather schematic illustrations, but also through accurate Islamic star-globes, as well as the written specifications of the figures in Ptolemy's *Almagest*. It reappeared almost unchanged in a Vienna map of about AD 1440, which was the model for subsequent Renaissance maps of the sky.¹

The 48 constellations

Now let us examine the origin of each of the 48 constellations, grouping them according to their meaning and probable origin. Many of the oldest ones are also among the largest, so I note their order of size among the modern constellations, although these are only approximations to the original figures which did not have distinct boundaries. The groups are as follows.

1. Landmarks of the Milky Way

Some star-groups, which are real clusters or associations in the Galaxy, are so distinct that they have been named in

every culture. The most obvious are the Plough (in Ursa Major), the Pleiades (in Taurus), and Orion. Also, the Milky Way itself was the inspiration for the constellations of Ara in antiquity and Scutum in our own times.

Orion. This splendid set of stars looks so much like a human figure that it has always been identified as one. In Mesopotamia it was the True Shepherd of Heaven (Sipa.zi.an.na in Sumerian), identified with Papsukal, messenger of the gods (Paper I). (Suggestions that the constellation was Tammuz, and also a Sumerian sun-god Uru.an.na which provided the name Orion,⁹ are now known to be unfounded.) The Greeks chose to identify him as Orion, who was the tallest and most handsome of men. In mythology he was never recorded as fighting a bull; but in the sky he carries a club and lion-skin and confronts the Bull.

Curiously, there seems to be a continuous subtext to both traditions. The equivalent Babylonian name in *MUL.APIN* (Sitaddalu) means 'he who was smitten by a weapon'.²⁹ This relates to the Babylonian constellations covering our Canis Major, which were a Bow and Arrow, aimed at Orion (Paper I). Similarly in Hindu myth,^{4,6} Sirius was a hunter, while Orion was a giant incestuously pursuing his own daughter (Aldebaran); the hunter duly shot him with an arrow, which was embedded in his body as the stars of 'Orion's belt'. In similar vein, one of the Greek legends of the death of Orion had him being shot by an arrow from the goddess Diana while he was swimming far out at sea.

Ara. The Altar may not be very old, and its stars are of mediocre brightness, but it marks the point on the horizon from which the summer Milky Way streams upwards like a glowing, writhing column of smoke.

2. Bears, serpents, and giants: the ancient pole and equator

In the third millennium BC, only three of our present constellations were circumpolar (Figure 1). They do not stand out as obvious animal figures in the sky. They clearly were designed symmetrically to mark the North Pole – the dragon which also marks out the North Ecliptic Pole, and the two bears, back to back on either side of the Dragon, which circle endlessly around each other. Meanwhile, the serpent Hydra would have marked the celestial equator. Three of these four constellations are among the largest in the sky. For these reasons, it is thought that these constellations date from the Navigators of ~2800 BC.¹⁵⁻¹⁷

In the same family as Draco and Hydra, two other great serpentine figures, Serpens and Cetus, could have pointed to the celestial equator and equinoxes at the same epoch. Also, four large human figures are drawn on the northern sky, but again they are not evident from the star patterns. Their origins are unknown; from their great size, orientation, and association with giant serpents, they seem likely to belong with the circumpolar constellations just described. The Greeks identified them with great men of history or legend, but only belatedly; the original figures were anonymous, and only one (Ophiuchus) is doing anything at all heroic. Rather, two of them are taking care of livestock. Who knows? – perhaps even Ophiuchus is not a god tearing apart the cosmic dragon, but merely a farmer protecting his herds.

These are the major constellations that were inherited from the putative Navigators. None of these constellations except Hydra were known in Mesopotamia. The references to Phoenicia and Crete for Ursa Minor (below) are consistent with an origin among Mediterranean seafarers.

Draco. The only possible reason for forming this random scatter of mediocre stars into a Dragon seems to be that

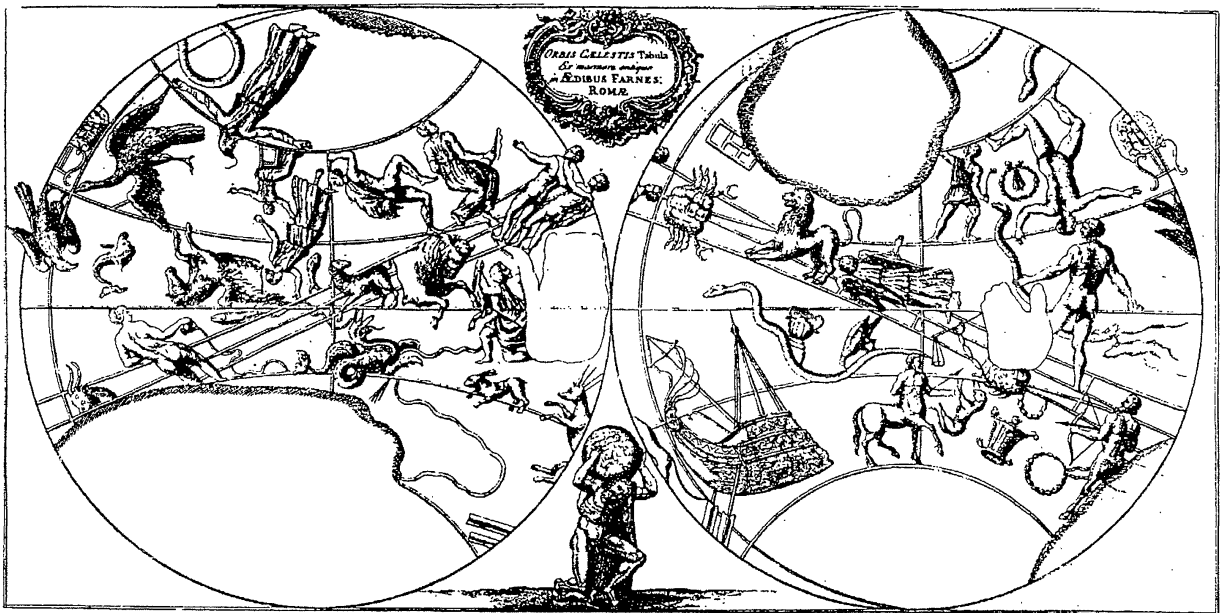


Figure 2. The figures on the Farnese Atlas – a second-century AD globe which is the only surviving map or globe of the heavens from Greek or Roman antiquity, probably copied from Eudoxus' globe. The figures are back-to-front because the 'celestial sphere' is being viewed from outside. The globe is in the National Museum in Naples (for photos see Refs. 1 and 10). This map of the globe is from Manilius' *Astronomicon* (1739).

Origins of the ancient constellations

HEMISPHERIUM BOREALE.

Ordo stellarum 

Figure 3 (above and facing page). The classical constellation figures, on star maps for approx. AD 1. This 18th-century reconstruction may have been based mainly on the Farnese Atlas, as well as on the classical writings. Sagittarius is a satyr, not a centaur, and Centaurus holds a thyrsus, not a spear. Hercules has his original name of Engonasin. Coma Berenices has been added. From an edition of *Katasterismoi* (Ref.30), from the library of the Royal Astronomical Society.

it marked the two poles, the North Ecliptic Pole which is fixed (in the middle of its coils) and the North Celestial Pole of ~2800 BC (Thuban, which is in its tail). (A date 1000 years on either side would also fit the configuration.) It is the 8th largest constellation.

Ursa Minor. Our Polaris has only become the Pole Star within the last thousand years; before that, the Little Bear was just a small reflection of the Great Bear, each lying with its back to the Dragon, as they were described by Aratus (Figure 3). The Greeks dated the Little Bear only as far back as Thales, the ‘father of Greek astronomy’:

‘According to Strabo it was not admitted among the constellations of the Greeks until about 600 BC, when Thales, inspired by its use in Phoenicia, his probable birthplace, suggested it to Greek mariners in place of its greater neighbour, which till then had been their sailing guide... Thales is reported to have formed it by utilising the ancient wings of Draco.’ [Ref.6]

The Greeks had various myths of the two bears, perhaps grafted on to an earlier tradition. They may have been Callisto and her son Arcas, transformed into bears as casualties of one of Zeus’ many philanderings. Or they may have been two bears which had saved the infant Zeus from his cannibalistic father, as Aratus wrote:

[The ancients] would have us believe that they ascended to heaven from the island of Crete by the powerful assistance of Zeus himself, because these bears, when they deceived Cronos, placed him [Zeus] while still an infant in a place odoriferous with flowers near Mount Ida, and nourished him for a whole year.’

Either way, their long tails were said to be the result of stretching when Zeus swung them up into the sky.

Ursa Major. This enormous Bear (the third largest constellation) at least looks like an animal, though its tail is too long for any bear.

Origins of the ancient constellations

HEMISPHAERIUM AUSTRALE.

Ordo stellarum \odot \circ \bullet \ast \cdot \cdot

The well-known Plough or Wain (Wagon) is only part of it, and being very conspicuous, this has been a separate constellation as far back as records go. Our folk-name 'Charles' Wain' dates back at least as far as AD 1000 and referred to King Charlemagne;⁶ but it was a wagon long before that. These seven stars were the long Wagon to the Babylonians, the Hearse to the pre-Islamic Arabs and Syrians, the heavenly Plough pulled by oxen in many Euro-Asiatic countries, the 'Seven Oxen' to the Romans (Septem Triones, from which is derived the word 'septentrio' for north), and the severed leg of an ox to the Egyptians. Our word 'arctic' derives from the Greek 'arktos' meaning Bear.

Remarkably, even the natives of North America saw these seven stars as a bear.⁴⁻⁶ The details varied between tribes, but a typical image had the four leading stars as the Great Spirit Bear, and the three 'tail' stars as three hunters pursuing it. Most oddly, for a circumpolar constellation, they all agreed that the hunters killed the bear each winter, only for it to come back to life in the spring. Although this American bear could be a coincidence, it may reflect a tradition of a bear perpetually

tracking around the North Pole ever since the Stone Age.¹⁰

In modern America, the Plough is called the Big Dipper.

Hydra. This is the largest constellation in the modern sky, but it too is a string of undistinguished stars, whose only reason for existence seems to have been to mark the celestial equator around ~2800 BC¹⁵⁻¹⁷ (Figure 1). It does not have the multiple heads of the Greek monster Hydra which Heracles killed; rather, it is a sea-serpent, which balances the marine constellations of the opposite hemisphere. It was also a Mesopotamian constellation (Paper I), both in the early pictograph phase – Leo was sometimes shown standing on it – and in the later *MUL.APIN* phase, when it seems to have been even longer so that its leading star was β Cancri. Hydra with Corvus and Crater may have symbolised the entrance to the underworld.

Hercules (Engonasin). He is the largest of the giants (the 5th largest constellation) and at present appears upside down; but he would have been the right way up, above the pole star, around 2800 BC. But the figure was not

Hercules. The Greek and Roman astronomers always called him Engonasin, ‘the kneeling one’, and Aratus wrote that ‘no-one knows his name nor the cause of his toil’. He appears to be trampling the Dragon’s head, which has inspired mythological identifications (e.g. Marduk and Tiamat), but there is no evidence for them. The idea that this was Hercules in the Garden of the Hesperides – where he had subdued the guardian dragon and then persuaded Atlas to steal the golden apples while Hercules shouldered the burden of holding up the sky – is attractive but anachronistic. He was first identified as Heracles in the 5th century BC by the Greek Panyassis (an enthusiast who had written many books on Heracles), and this was repeated by the later classical mythologists,^{3,13} but was not generally adopted by astronomers until the Renaissance. Only then did he acquire his club and lionskin.

Ophiuchus, with **Serpens**. Ophiuchus (the 11th largest constellation) simply means ‘serpent-bearer’, and he wrestles with this huge Serpent. The feet of Ophiuchus intrude on the Scorpius sector of the ecliptic, though he has never been included in the zodiac. This seems to be a relic of the combination of traditions; the apparently unnecessary and unremarkable feet of Ophiuchus (at ξ Oph and ψ Oph) have never been removed. Both halves of Serpens happen to consist of roughly straight lines of stars, which intersect near ξ Oph, but the figure as drawn is much more serpentine, so that the cranial end and the caudal end project to an intersection some 13° away near ψ Oph – which marked the autumn equinox in 2870 BC (± 500 yr). At that time, the tail of the serpent ran along the celestial equator, and the cranial half ran due north.^{15,17} Then, Ophiuchus and Engonasin, the two giants with their defeated serpents, would have stood opposite each other with their heads meeting at the zenith.

The Greek identification with Aesculapius is certainly a late confabulation – his snake was nothing like this one.

Boötes. This male figure (the 13th largest constellation) follows Ursa Major in the sky, and has always been associated with it, as a hunter of the bear, a guardian of the bears, a herdsman of the oxen, a driver of the wagon, or a ploughman with the plough. Boötes probably means Ox-Driver, and Arcturus means Keeper of the Bears (a name dating back to Hesiod, 8th century BC). Because of proper motion, Arcturus was originally near the centre of the figure (Figure 1).

In Mesopotamia this area, or especially Arcturus, was somehow identified with the god Enlil; but there was an alternative name Shudun, meaning Yoke, which perhaps suggests that the association with oxen did reach Mesopotamia.

Auriga. This is the Charioteer, but he has never had a chariot. Instead, he has always carried a goat (Capella, ‘She-Goat’) and two kids, as if he were a shepherd. This accords with the Babylonian constellation Gam, which has generally been translated as ‘curved sword’ (sickle or scimitar), but is now translated as ‘crook’ (of a shepherd).²⁹ Various authors have placed Gam anywhere

from Aries to the Sickle of Leo, but it really seems to have been Auriga, or especially Capella. Moreover, the Bedouin Arabs probably had a family of goats here (Paper I). So the goats may have infiltrated from the East, sitting uneasily with the anonymous Charioteer.

Cetus. This huge constellation, the 4th largest, is not a whale; it is a Sea-monster, with carnivorous head but a curled fishy tail. The Greeks identified it as the monster in the Andromeda myth (below). It may have been a counterpart to Serpens, for finding the celestial equator and equinoxes through gaps in the clouds. The line of stars of Cetus projects to intersect the ecliptic near ϵ Tau in the Hyades ($\pm 5^\circ$), where the spring equinox was in 2870 BC (± 360 yr), and this line would then have made an angle of just over 45° with the equator.

3. The Zodiac

We have already reviewed the twelve zodiacal constellations in Paper I. They reached their classical form in Babylon around 500 BC, and were adopted in Greece very soon after (see above). The first four (Taurus, Leo, Scorpius and Aquarius) had been established some time around 3000 BC, when they marked the cardinal points, and they were present in all known traditions thereafter. The next four (Gemini, Virgo, Sagittarius, and Pisces) developed during the third or second millennium BC, as did Capricornus. But the last three (Aries, Cancer, and Libra) were not fully accepted until classical times, and are the least conspicuous of the zodiacal constellations, although they then marked the cardinal points as a result of precession.

4. The southern sea

In the ancient summer nights, the southern sky was filled with watery images – rivers, fishes, and sea-monsters.¹² It was already called ‘the water’ by Aratus. Some authors have associated this ‘sea’ with the rains of winter, because the Sun was there in winter; but it seems unlikely that solar dates were important for most of these southerly constellations. Rather, the region could be seen in summer, showing two great rivers meandering down to the ‘ocean’ below the southern horizon, with fishes and sea-monsters disporting themselves around them.

Some authors have regarded this as a very ancient seascape, perhaps portraying Tiamat and her monsters in the primeval ocean, but there is no evidence for this; there are no Babylonian records of the sea-monster (Cetus), the river (Eridanus), or the horse rising from the waves (Pegasus). However the other ‘watery’ constellations did belong to the Way of Ea, the great god who lived in the deep waters; the Great One (Aquarius), the Goat-fish (Capricornus), the Fish (Piscis Austrinus), and the Field (our Square of Pegasus), were all identified personally with Ea. Pisces was not recorded until later, but I suggested (Paper I) that Ea was originally represented by two fish-filled streams pouring from Aquarius – one running south to Piscis Austrinus, and the other running east through Pisces, around the irrigated Field.

The stars of Cetus and Eridanus did not appear at all in the Babylonian lists. This may be because they were very

far south, below the spring equinox, which made them useless for heliacal risings. They did outline the 'zone of avoidance' (the Greeks could have listed stars further south but did not), so these may be associated with the ancient serpentine constellations – particularly as they are so large and Cetus looks like a dragon.

All these constellations are described in other sets except for Eridanus.

Eridanus. This is now the 6th largest constellation, and represents a River, meandering southwards. It has been identified with various terrestrial rivers but its origin is unknown. The name was cited by Aratus, and appeared first in Hesiod for a real river in Turkey.⁶ Originally the River extended only to θ Eri (now Acamar). The first-magnitude star α Eri (now Achernar) was much too far south to be seen, and was only added in the 18th century AD. (Both star names are corruptions of the Arabic Akhir al-Nahr, 'end of the river'.) However, Ptolemy did list a spurious first-magnitude star just below his horizon at the end of Eridanus, so he may have heard reports of Achernar and intended to include it.¹⁹

5. Two great southern myths

In the night sky of the ancient winter, below the long sea-serpent Hydra, there were just two huge constellations – at least, according to the later Greeks, who identified them with two great Greek myths. These were the Centaur and the ship Argo. But they must have dated from before 2000 BC because of the 'zone of avoidance'. The Babylonians had several constellations here whose names and locations are unclear, but they do not seem to have matched the classical ones. Therefore, it seems quite likely that the Centaur and the Argo came from the Navigators of around 2800 BC. This would accord with the statements of some classical authors that 'Argo' represented the first ocean-going ship (below). The Greeks could not see the whole of these constellations, as precession had pushed their southern stars permanently below the horizon, so Ptolemy's catalogue degenerated into an inaccurate jumble in these parts. Now, European observers can see hardly anything of these constellations. Modern astronomers have cut them into smaller pieces for convenience.

Several authors over the past century have matched these and other constellations to the Mesopotamian epic of Gilgamesh, which included the prototype of the Biblical Flood. It has been suggested that Argo is the Ark (which might be true), Centaurus is Utnapishtim/Noah (but he was not a centaur), Ara is the altar on which Noah sacrificed, and Sagittarius is Enkidu (but although he was half-beast, he was not an archer). So it seems that there are no celestial versions of these crucial figures of the story, and Gilgamesh is an unlikely candidate for any of the heroes in the sky. The only constellation which certainly does relate to this myth is Columba (Noah's Dove), but that is a Christian addition.

Centaurus, with Lupus. The traditional maps of the constellations show a magnificent tableau here: two great centaurs, Sagittarius and Centaurus, facing each other across the Altar and the Milky Way. Both look fearsome,

Sagittarius with his bow and arrow, and Centaurus with a spear which impales a Wolf. One is reminded of the trident nature of centaurs, and of the battle of the Centaurs and the Lapiths as engraved on the Parthenon. However, this tableau was the end-result of a long development. In early Greek times, Sagittarius was not a centaur while Centaurus was not wielding a spear, and classically, both figures were identified with the most peaceful of the centaurs, Chiron.⁴ This wise creature educated several Greek heroes and invented the constellations; he made Sagittarius in his own likeness to guide the Argonauts. Although immortal, he was accidentally wounded by Heracles with an arrow dipped in the venomous Hydra's blood, which caused such agony that he begged to die; Zeus complied, and put him in the sky as Centaurus.

In classical times our Lupus, the Wolf, was merely 'the Beast', which Centaurus was carrying to sacrifice on the Altar (Ara).^{3,11} Centaurus was not killing the Beast with a spear, but was grasping the animal with one hand while the other hand held a thyrsus, an ivy-covered wand for Dionysian rites (Figures 2 and 3). Originally, the Wolf and the Centaur may even have been engaged in a Dionysian coupling.²

Centaurus is now the 9th largest constellation. The original figure included the brilliant stars, poorly catalogued by the Greeks, that have now been split off as Crux, the Southern Cross. With Crux included, Centaurus would be in 7th place.

Argo. Argo was the ship in which the Greek heroes sailed to fetch the Golden Fleece. It sailed majestically on the Milky Way which lay along the winter horizon. For some reason, its bow has always been missing, hidden in mist (Aratus) – or perhaps it might have dipped below the southern horizon, along with the Milky Way? It was by far the largest of the ancient constellations, but does not count in modern lists as it has been dismantled into four parts: Carina (the keel), Puppis (the stern), Pyxis (the compass or mast), and Vela (the sail).

It has been suggested^{2,6,16} that these stars also formed a ship – in fact, the Ark in the Flood – to the Egyptians and Hindus. But there was another tale, referring to the origin of the Greek race:

'Another Greek tradition, according to Eratosthenes, asserted that our constellation represented the first ship to sail the ocean, which long before Jason's time carried Danaos with his fifty daughters from Egypt to Rhodes and Argos.' [Ref.6]

6. The Andromeda legend

Whereas the northern sky of spring is dominated by the ancient anonymous giants, the northern sky of autumn is a diorama of a great Greek epic. Although some of the figures may have existed in earlier Mesopotamian forms (Andromeda and Perseus), the complete set was surely invented by the Greeks, simply to illustrate the myth.

Cepheus and Cassiopeia were king and queen of Ethiopia. When Cassiopeia compared the sea-nymphs unfavourably with herself in beauty, their father Poseidon

created a ferocious sea-monster, Cetus, which ravaged the coast of Ethiopia. The king had no choice but to put out his daughter Andromeda, chained to a rock, as a sacrifice to the monster. Meanwhile the hero Perseus, having cut off the snake-covered head of the Medusa, mounted Pegasus, the horse born from Poseidon's splashing waves (according to some versions), and flew to Ethiopia. There he killed the monster with his sword and with the Medusa's still-petrifying gaze, and rescued Andromeda. These are the figures placed in the sky.

Cepheus and Cassiopeia. In Babylon these prominent star-groups had been split between the Panther-griffin and the Stag (Paper I).

Andromeda. In Babylon she was the fertility goddess Anunitum, the Lady of the Heavens, but she occupied what is now the northern Fish of Pisces plus only the middle stars of Andromeda. It may be only coincidence that a female figure reappeared in this region in the Greek sky-map.

Perseus. In Babylon this was the Old Man, identified with the shadowy ancestor of the ruler of the gods. We saw above that the person and constellation of Perseus may have been adopted as the sky-god in the Mithras cult. It may be relevant that Perseus himself was said to be the ancestor of the Persian nation. However, the Greek figure betrays nothing of all this. The variable star Algol marks the Medusa's head.

Pegasus. The Winged Horse is another mystery, but seems to arise from the 'celestial sea'. The Square is an obvious star-pattern, and comprised the separate constellation of the Field to the Babylonians. We do not know when a horse was first formed there, nor why it is upside down. The Greek Pegasus was created by Poseidon and arose from the sea, as this one is doing; but some classical authors omitted the wings, or just called it 'the Horse'. This is now the 7th largest constellation.

(Cetus, the sea-monster, was described in set 2 above.)

7. Various animals and objects

The first six of these are animal figures containing first-magnitude stars, and may have been created to embody them. Three of the animals were Babylonian para-zodiacal constellations (see Paper I), but some others were not formed before Greek times.

Following the animals, we end with an assortment of knick-knacks, some of which may be quite old, but whose original purpose is unknown.

Piscis Austrinus. The Southern Fish was a para-zodiacal constellation associated with Aquarius from earliest times in Mesopotamia, even though it only rose a few degrees above the horizon then. It consists of little more than the star Fomalhaut, which was shared with Aquarius in Ptolemy's catalogue and for a long time thereafter. In the classical sky-map, strangely, it is drawn as swallowing the stream that pours from Aquarius.

Aquila. The Eagle was another para-zodiacal constellation in Mesopotamia, possibly because of its bright star Altair; either Altair or Fomalhaut was the 'royal star'

associated with the winter solstice (Paper I). So the Greeks inherited it along with the zodiac. The name Altair comes from the later Arabic al-Nasr al-Tair, 'the flying vulture/eagle'.

In classical times, Aquila was seen as the Eagle of Zeus, and hence Aquarius became named as Ganymede, the boy who was carried off by the Eagle to become Zeus' cupbearer and catamite. Then, an adjacent area directly under the Eagle was named as Antinous, catamite of the emperor Hadrian. Modern sensibilities have not permitted these identifications to survive.

Lyra. The Lyre was originally a stringed instrument made on a turtle-shell, called Kitara (turtle) (hence the word 'guitar'). In the sky it has always been carried by a bird, typically a vulture/eagle, partner to Aquila; the name Vega is derived from the Arabic al-Nasr al-Waki 'the falling vulture/eagle'.

Cygnus. The Swan is flying down the Milky Way, with Deneb in its tail; but this posture, while shown on the Farnese Atlas, was not universal in antiquity. Earlier Greeks simply called it the Bird or, often, the Hen; some later Arabian authors also called it a hen, just standing upright.

Canis Major. To the Greeks, Sirius and Procyon (Canis Major and Minor) were Orion's hunting-dogs. Canis Major superseded the Babylonian picture of a bow and arrow aimed at Orion (q.v.).

Canis Minor. This Lesser Dog contains little more than Procyon.

Lepus. The Hare is being chased by Orion's two dogs.

Delphinus. This little Dolphin is probably a Greek addition to the celestial sea.

Equuleus. The Little Horse, first named by Ptolemy. It would not be missed.

Corvus, with Crater. Corvus (the Crow or Raven) and Crater (the Cup) belong together in Greek myth, the Crow being barred from the Cup of water by the serpent, Hydra, as a result of his disobedience to Apollo on an errand. However, this bizarre fable does not explain the great antiquity and importance of the trio, in spite of their lack of bright stars. Corvus was a para-zodiacal constellation in the Babylonian lists, probably including the stars of Crater, and was shown perching on Hydra in the Seleucid and Dendera Zodiacs (Paper I). Possibly they were symbols of death (Paper I).

Corona Borealis and Corona Australis. The Northern and Southern Crowns (circlets of stars); originally triumphal wreaths.

Sagitta. The Arrow, with which Hercules shot the Eagle of Zeus – although in the sky, the shot seems to be wide of the mark.

Triangulum. The Triangle! To the Babylonians this (with γ And) had been mul-APIN, the Plough (Paper I). The Triangle may have been kept as a memorial of this first constellation of the ancient list.

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Received 1996 November 8; accepted 1997 January 4

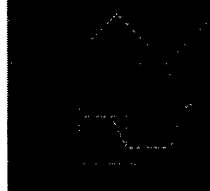
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