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.

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.

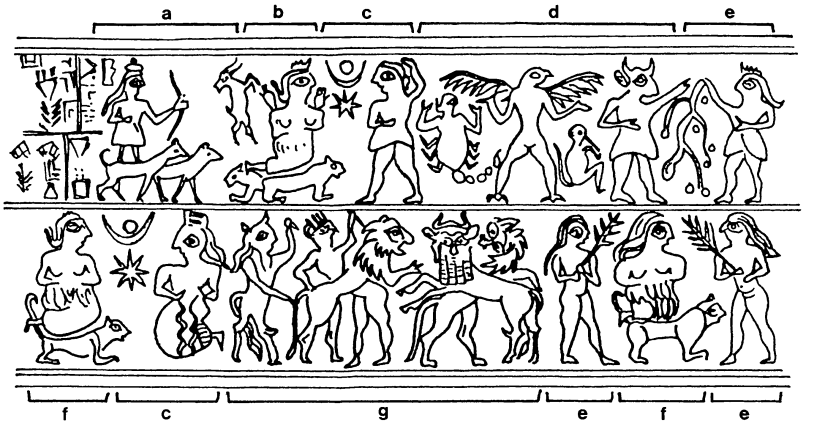

Figure 1. A cylinder-seal impression from the Elamite capital of Susa, ~2500 BC. **Key:** (a) Hunting god standing on two dogs, aiming a bow at a goat; (b) Goddess on two lions, with weapons or wings at her shoulders (similar to later figures of Ishtar); (c) Sun, Moon, and Venus, and a worshipper; (d) 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.*

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 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 Hartner[18] 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. King[20] 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

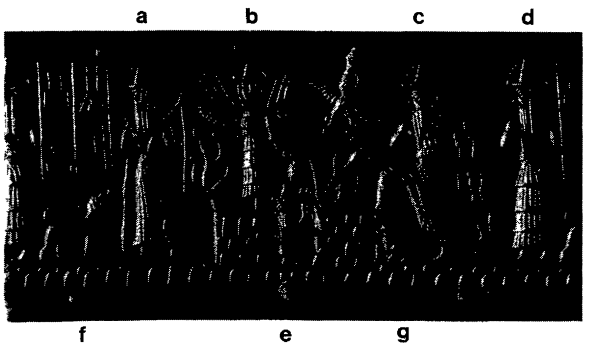

Figure 2. Wax impression of the 'Seal of Adda', ~2300 BC. Original in the British Museum, no. WA 89115. **Key** [Refs. 15, 16]: (a) An unidentified hunting god with a bow. (b) The goddess Ishtar with weapons at her shoulders, holding a bunch of dates. (c) The god Ea, with two streams filled with fish 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.

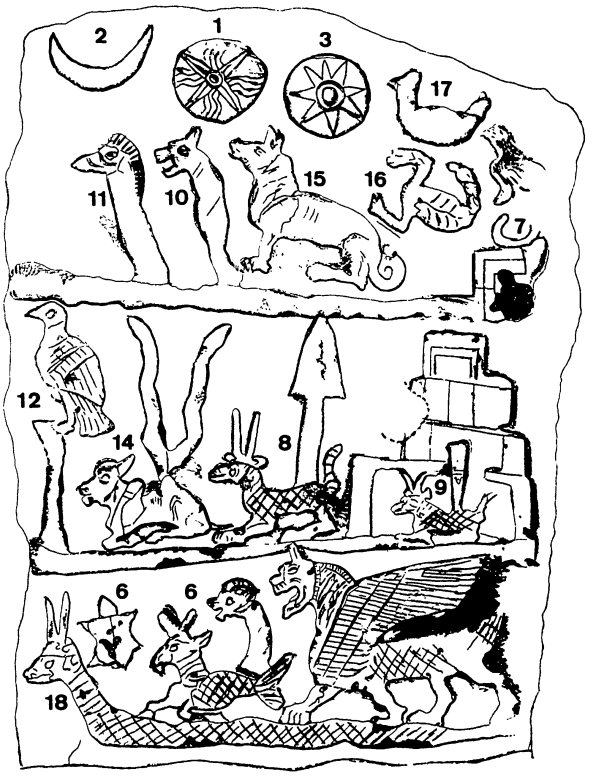

Figure 3. Symbols on a late Kassite boundary stone from the reign of Marduk-apal-iddina I: specimen S62/H7/London-99 [Ref. 22], in the British Museum (IV.R.38/43); see Ref. 20 for detailed description. See Table 1 for key. The composition is typical of the vertical slab boundary stones, with the symbols 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.*

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.)

Table 1. Symbols on Babylonian boundary stones

Key	Symbol	God	Astral identity	Frequency: Period: (Total):	Pre. (7)	Canon. (14)	Post. (3)
Disks at top:							
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
Shrines ± symbols:							
4	Shrine & head-dress	Anu	*Equatorial sky*		2	13	3
5	Shrine & head-dress	Enlil	*Northern sky*		2	13	3
6	Goat-fish) Ram's-head) Turtle)	Ea	*Southern sky;* Capricornus, Aquarius, etc.		7	13-14	3
7	Omega?Yoke?	Ninharsaga	(Part of Argo)		0	11-12	3
Standards or shrines ± heraldic animals:							
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	Aquila; **Saturn?**		3-4	10-12†	2
12	Perched bird	Shuqamuna & Shumalia? 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
Stand-alone figures:							
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 Nirah	Hydra Milky Way?		6*	14	2*
19	Walking bird	Papsukal	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 *MUL.APIN*, 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. *MUL.APIN* 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 *MUL.APIN*, 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, Scorpius 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 bestiaries. 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).

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]; ^{d}Dumuzi [Aries]; ^{d}Ningizzida [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]; Ku_6 [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.

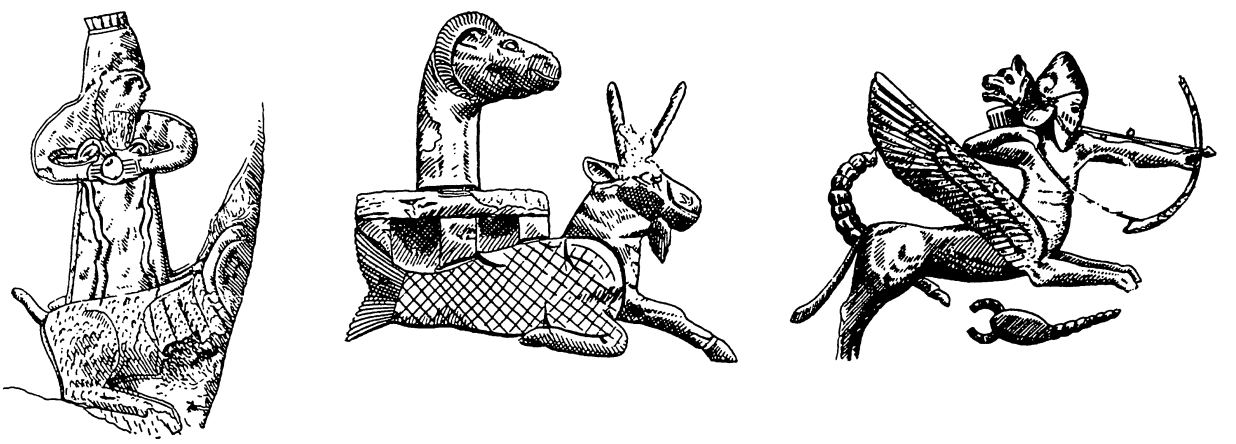

Figure 5. Three symbols from boundary stones which show zodiacal figures almost exactly as on the Dendera Zodiac (Figure 6). The water-pourer is from a fragmentary stone in the Louvre. The goatfish is common on boundary stones and elsewhere; a contemporaneous stone basin from Elam, in the Louvre, is 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 *Stars of Akkad*	*Translation*	*Modern stars*		B *Stars of Amurru*	*Translation*	*Modern stars*	
I	^{mul}APIN	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 (= Shudun)	? (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	?Eql, 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*		KA_5.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).

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.

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 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. Heliacal 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] Hartner[18] 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 *Stars of Elam, etc.*	*Translation*	*Modern stars*	D *Others in MUL.APIN*	*Translation*	*Modern stars*
I	*DILI.PAT*	--	*VENUS*	Lu.HUN.GA (= Agru)	Hired farm labourer	Aries (1)
				GAM	Scimitar/Crook	Capella or Auriga (2)
II	^{mul}MUL Is-li-e	Star of stars Bull's jaw	Pleiades (3) Hyades inc. Aldeb. (4)	GUD.AN.NA	Bull o'H	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 + ß 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 & Pingree[8].
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 deity[12]; 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)

Name (transliteration)	*Translation*	*Identification*
^{mul}APIN	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 *[shadowy ancestor of Enlil].*	Perseus
GAM	The Crook, Gamlum.	Auriga
MASH.TAB.BA.GAL.GAL.LA	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 *[lion-headed protector god].*	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 *[wife of Marduk]*	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 *[wife of Enlil].*	β Com?
BAL.TESH.A	The star which stands behind it: the Star of Dignity, the messenger of Tishpak *[god of armies].*	Corona Bor.
MAR.GID.DA	The Wagon, Ninlil *[wife of Enlil].*	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]?
U8	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,	Polaris?
--	the first-ranking son of Anu.	
DINGIR.GUB.BA^{s} DINGIR.TUSH.A^{s}	The Standing Gods of Ekur, the Sitting Gods of Ekur *[the great temple of Enlil].*	ζ + η Her?; 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 *[god of healing].*	Head of Draco? [Del?]
ANSHE.KUR.RA	The star which stands at its left side: the Horse.	α,β,γ,δ Cas [Peg/Lac/Eql?]
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? [Andromeda Neb?]
^{d}Harriru	Harriru, the Rainbow.	
--	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 meridian at dawn)*
^{mul}SAG.ME.GAR	Jupiter, keeps changing its position and crosses the sky.	
--	33 stars of Enlil.	

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

Name (transliteration)	*Translation*	*Identification*
ASH-IKU	The Field, the seat of Ea, which goes at the front of the stars of Anu.	Sq. of Pegasus
Shinunutu4	The star which stands opposite the Field: the Swallow.	W. Fish + Head of Peg
Anunitu4	The star which stands behind the Field: Anunitu *[goddess of childbirth].*	N. Fish
^{lu}HUN.GA	The star which stands behind it: the Hired Man, Dumuzi.	Aries
MUL.MUL	The Stars, the seven gods, the great gods.	Pleiades
GU4AN.NA ^{d}is le-e	The Bull of Heaven, the Jaw of the Bull, the crown of Anu.	Taurus, Hyades
SIPA.ZI.AN.NA [*Akk.:* 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 *[two domestic protector gods].*	π^3 + π^4 Ori? ζ + ξ Gem? [α + β 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 [*Akk.:* Nirah]	The Snake, Ningizzida, lord of the Netherworld.	Hydra (inc. ß Cnc)
UGA^{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-ba4-ba4 TI8^{mushen}, AD6	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.GU4.UD	Mercury, whose name is Ninurta, rises or sets in the east	*Mercury*
--	or in the west within a month.	
--	23 stars of Anu.	
KU6	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 *[the city]*, Ea.	Aquarius; Canopus
Nin-mah	The star which stands at its right: Ninmah *[goddess of motherhood].*	Most of Vela
EN.TE.NA.BAR.HUM	EN.TE.NA.BAR.HUM, Ningirsu.	Centaurus (+ Crux?)
^{gish}GAN.UR	The star which stands at its side: the Harrow, the weapon of	E. part of Vela [star fields
--	Mar-biti, inside of which one sees the subterranean waters.	inc. η Car nebula?]
^{d}Shullat u ^{d}Hanish	The two stars which stand behind it: Shullat and Hanish, Shamash and Adad.	μ + ν Cen? [α + β Cen?]
--	The star which stands behind them rises like Ea	
Nu-mush-da	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
--	The two stars which stand in the sting of the Scorpion:	
^{d}Sharur4 u ^{d}Shargaz	Sharur and Shargaz.	λ + υ Sco
Pa-bil-sag	The star which stands behind them: Pabilsag.	Sagittarius
MA.GUR8 u SUHUR.MASH^{ku6}	The Bark and the Goat-fish.	ε Sgr [CorAus?]; 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').

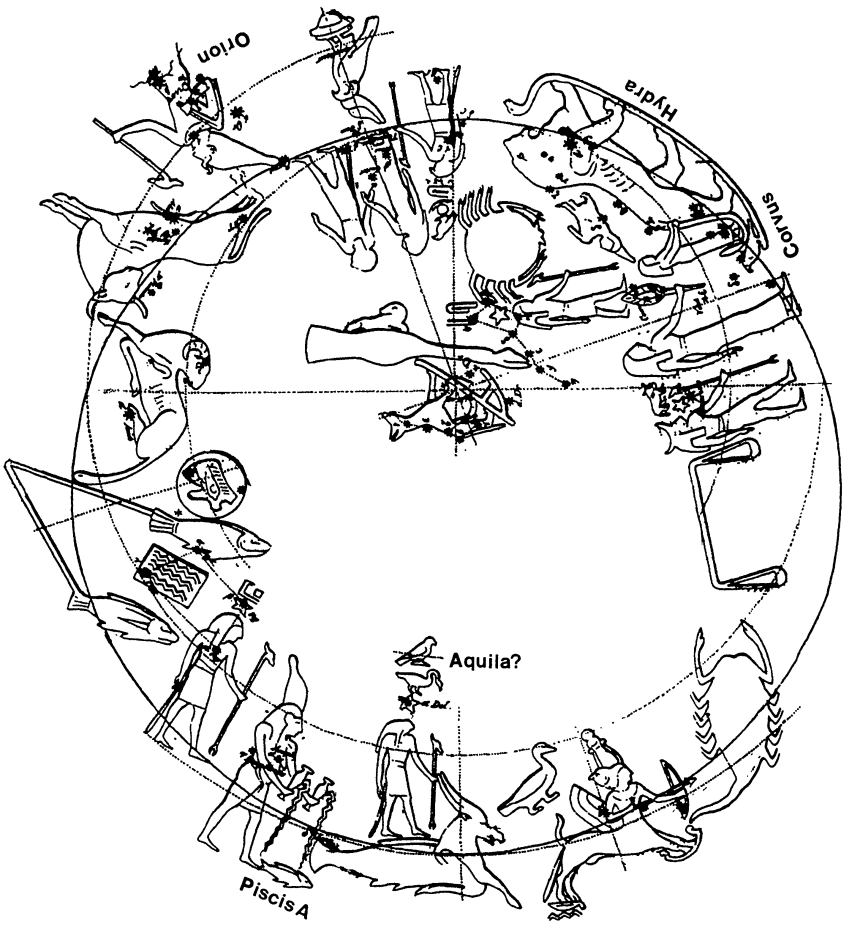

Figure 6. The zodiacal and para-zodiacal constellations from the Dendera Zodiac (Egypt, ca.36 BC). The rest of the sky is filled with the Egyptian constellations, most of which have been deleted from this copy for clarity, although a few of the interpolated human figures remain. On this copy, some stars 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] (Papke[26] revised many of the star identifications and deduced an earlier date, ~2300 BC, which van der Waerden has supported; but Hunger and Pingree[8] 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 Waerden[4] 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 Pingree[8] 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].' [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 Assyria[13] actually decribes 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 Cancer[3]), 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 para-zodiacal constellations, which we discuss in detail below: Piscis Austrinus, Aquila, Hydra, and Corvus.

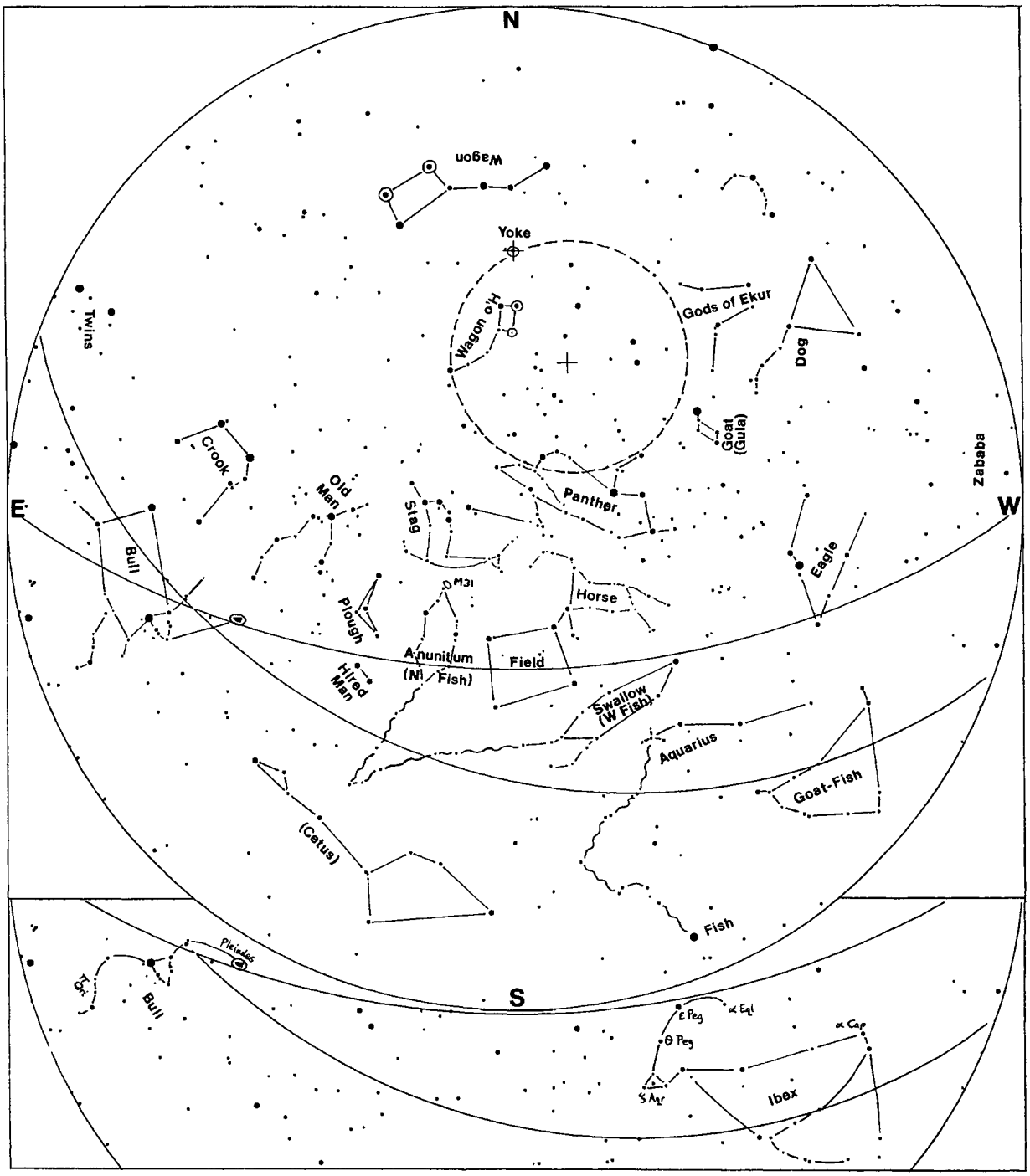

Figure 7. The night sky of late summer in 2800 BC at 36°N, showing Babylonian constellations. Solid lines mark the equator and ecliptic; the celestial pole (Thuban, 'Hitched Yoke of Heaven') is ringed. A cross marks the ecliptic pole; a dashed circle centred on it marks the path of the celestial pole 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 Ibex 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.

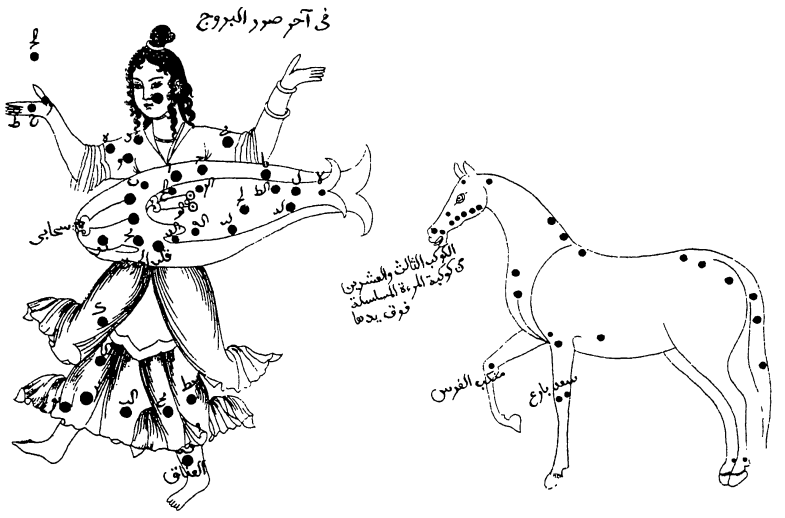

Figure 8. The old Arab constellations of the Northern Fish and the Horse, from an edition of al-Sufi [Ref. 30c]. The stars are more accurately and recognisably shown on other editions [Refs. 30a & 33]. *Reproduced by permission of the Syndics of Cambridge University Library.*

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

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 *MUL.APIN* (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 *MUL.APIN* (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 Hartner[18] 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.

Hartner[18] 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] Hartner[18] 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. Hartner[18] 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 solsticial 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 (Zibbati-mesh) 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). Hartner[18] 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 $lu_{Hun\text{-}ga}$, ^{d}Dumuzi'. 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

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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Abbreviations: ill. = illustration; ltr. = letter to the Editor; mtg. = meeting contribution; news = in 'Notes and News' or 'BAA Update'; rvw. = publication review

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