

Origins of the ancient constellations: II. The Mediterranean traditions

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

Introduction

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

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

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

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

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

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

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

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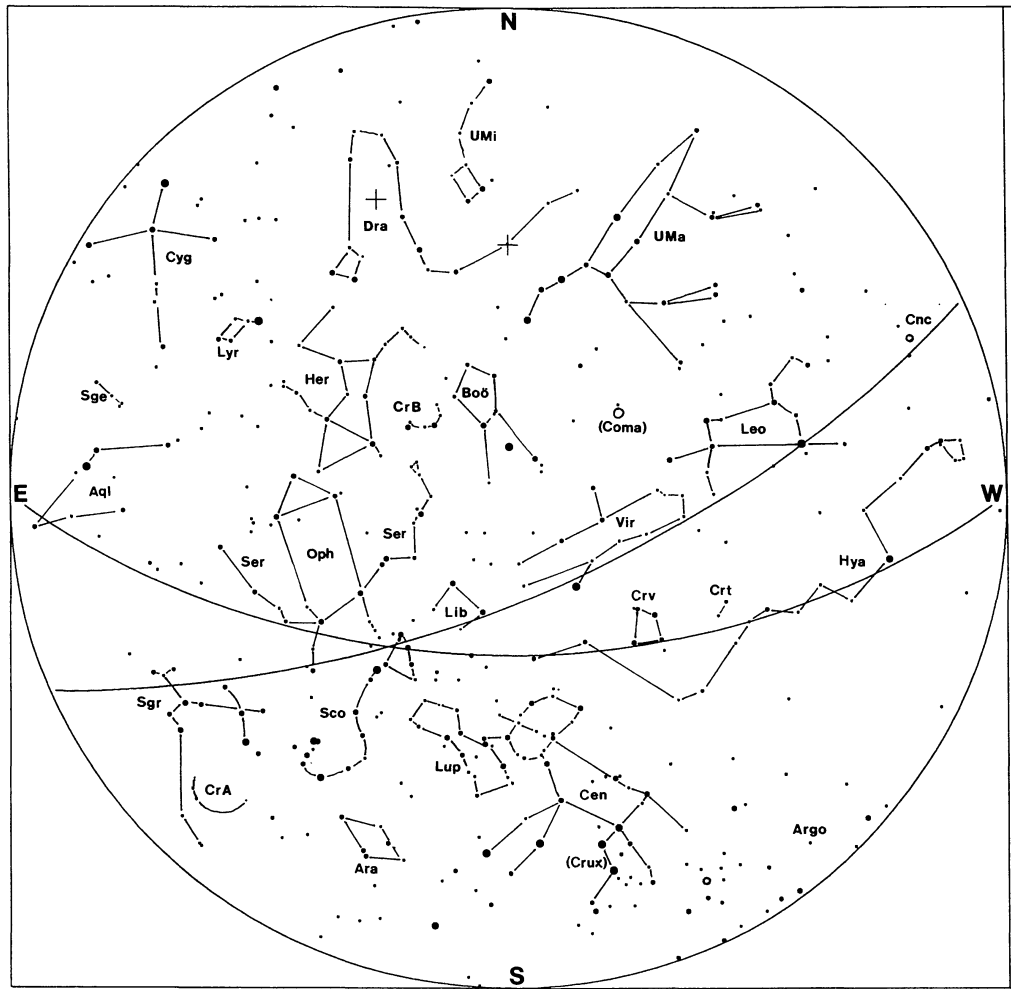


Figure 1. The night sky of late winter in 2800 BC at 36°N, showing the classical constellations. Solid lines mark the equator and ecliptic; crosses mark the celestial pole (Thuban) and the ecliptic pole. Naked-eye clusters or nebulae are marked by circles. Hydra marks the equator, and the tail of Serpens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

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

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

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

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

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

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

History of the constellations in Greece and thereafter

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

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

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

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

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

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

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

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

Astral cults in classical times

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

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

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

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

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

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

Classical sky-maps

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

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

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

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

The 48 constellations

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

1. Landmarks of the Milky Way

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

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

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

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

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

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

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

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

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

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

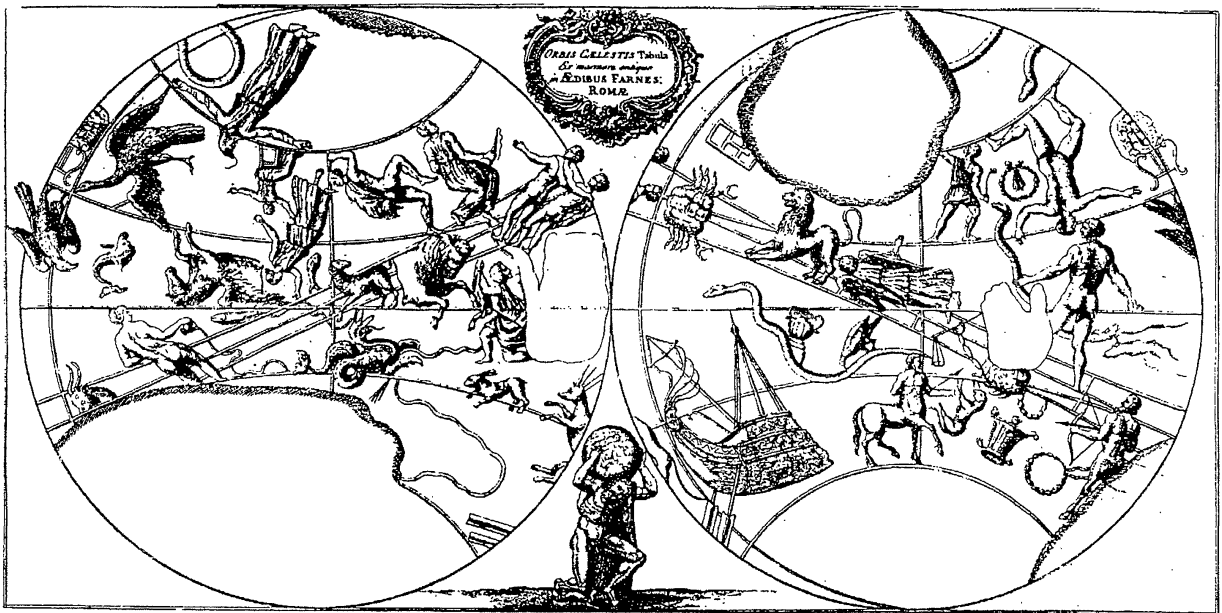


Figure 2. The figures on the Farnese Atlas – a second-century AD globe which is the only surviving map or globe of the heavens from Greek or Roman antiquity, probably copied from Eudoxus' globe. The figures are back-to-front because the 'celestial sphere' is being viewed from outside. The globe is in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

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HEMISPHERIUM BOREALE.



Ordo stellarum 1 2 3 4 5 6

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

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

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

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

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

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

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

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

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HEMISPHAERIUM AUSTRALE.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. The Zodiac

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

4. The southern sea

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

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

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

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

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

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

5. Two great southern myths

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

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

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

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

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

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

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

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

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

6. The Andromeda legend

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

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

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

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

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

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

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

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

7. Various animals and objects

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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References

- 1 Whitfield P., *The Mapping of the Heavens*, British Library, 1995
- 2 Sesti G. M., *The glorious constellations: history and mythology* (translated by K. H. Ford from the Italian *Dimore del cielo*), Abrams, New York, 1991
- 3 Ridpath I., *Star Tales*, Lutterworth, Cambridge, 1988
- 4 Lum P., *The Stars in our Heaven: Myths and fables*, Thames & Hudson, London, 1951
- 5 Staal J. D. W., *The New Patterns in the Sky*, McDonald & Woodward, Blacksburg, Va., 1988
- 6 Allen R. H., *Star-names and their meanings*, Stechert, New York, 1899
- 7 Kunitzsch P., *Arabische Sternnamen in Europa*, Wiesbaden, 1959
- 8 Rogers J. H., *J. Brit. Astron. Assoc.*, **108**(1), 9; Paper I (1998)
- 9 Brown R., *Researches into the origin of the primitive constellations of the Greeks, Phoenicians, and Babylonians* (2 vols), William & Northgate, London; 1899, 1900. But see book reviews in *J. Brit. Astron. Assoc.*, **9**, 386; **10**, 414.
- 10 Gingerich O., 'The origin of the zodiac', *Sky & Telesc.*, 1984 March, 218–220
- 11 Ridpath I., 'Origin of the constellations', *Astronomy Now*, 1995 Sep., 40–43
- 12 Lovi G., 'Rambling...' columns in *Sky & Telescope*, including: 1981 Dec., p.570, 'Pisces'; 1986 Mar., p.275, 'A March sky long long ago'; 1987 Dec., p.625, 'The celestial sea'; and others in 1991 and 1993.
- 13 Krupp E., 'Pumping sky', *Sky & Telesc.*, 1995 July, p.60–61. [Also Schaaf F., *ibid.* p.64–65]
- 14 Proctor R. A., cited in Ref.16.
- 15 Maunder E. W., *The Astronomy of the Bible*, Hodder & Stoughton, London, 1909
- 16 Crommelin A. C. D., in: *Splendour of the Heavens*, ed. Phillips T. E. R. & Steavenson W. H., Hutchinson, London, 1923, pp. 640–669
- 17 Ovenden M., 'The origin of the constellations', *Philosophical Journal*, **3**, 1–18 (1966)
- 18 Roy A. E., 'The origin of the constellations', *Vistas in Astronomy*, **27**, 171–197 (1984)
- 19 Gingerich O. & Welther B. L., 'Some puzzles of Ptolemy's star catalogue', *Sky & Telesc.*, 1984 May, p.421–423
- 20 Van der Waerden B. L., 'History of the zodiac', *Archiv für Orientforschung*, **16**, 216–230 (1953)
- 21 Van der Waerden B. L., *Science Awakening II: The birth of astronomy*, Noordhoff [Leiden] & OUP [New York], 1974. (Translation and revision of: Van der Waerden B. L., *Die Anfänge der Astronomie*, Noordhoff [Gröningen], 1965; in German)
- 22 Katzenstein R., *The Leiden Aratea: ancient constellations in a medieval manuscript*, Getty Museum, Malibu, Calif., 1988. [This is also called the *Codex Vossianus*, and was also illustrated in the definitive book on classical star-maps: Thiele G., *Antike Himmelsbilder...* Berlin, 1898]
- 23 Hartner W., 'The earliest history of the constellations in the Near East and the motif of the lion-bull combat', *J. Near Eastern Studies*, **24**, 1–16 (1965)
- 24 O'Neil W.M., *Early Astronomy from Babylonia to Copernicus*, Sydney University Press, 1986
- 25 Ulansey D., 'The Mithraic Mysteries', *Sci. Am.*, 1989 Dec., p.80–85
- 26 Ulansey D., *The Origins of the Mithraic Mysteries*, Oxford University Press, 1989
- 27 Wellesz E., 'An early al-Sufi manuscript in the Bodleian Library in Oxford', *Ars Orientalis*, **3**, 1–26 (1965)
- 28 Savage-Smith E., 'The Islamic tradition of celestial mapping', *Asian Art* **5** (no.4), 5–27 (1992)
- 29 Hunger H. & Pingree D., *MUL.APIN: An astronomical compendium in cuneiform*. *Archiv für Orientforschung*, Supplement **24** (1989)
- 30 Schaubach I. C., *Eratosthenis Catasterismi...*, Göttingen, 1795. [An edition of 'Eratosthenes' *Katasterismoi*.]

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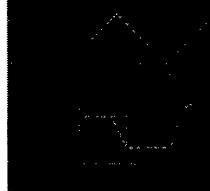
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