

ASTRONOMY AND CONSTELLATIONS IN THE *ILIAD* AND *ODYSSEY*

E. Theodossiou and V.N. Manimanis

*Department of Astrophysics-Astronomy and Mechanics, School of Physics,
National & Kapodistrian University of Athens
Panepistimioupolis, Zographos 157 84, Athens, Greece.
E-mail: etheodos@phys.uoa.gr*

P. Mantarakis

*22127 Needles St, Chatsworth, California, U.S.A.
E-mail: zanipetros@socal.it.com*

and

M.S. Dimitrijevic

*Astronomical Observatory of Belgrade, Volgina 7, 11060 Belgrade, Serbia.
E-mail: mdimitrijevic@aob.bg.ac.rs*

Abstract: The *Iliad* and the *Odyssey*, in addition to their supreme status as cornerstones of world literature, are a rich source of information about the scientific and technological knowledge of ancient Greeks in both pre-Homeric and Homeric times. The two Homeric epic poems, which we date to the 8th century BC, include, *inter alia*, a wealth of astronomical elements, informing about the Earth, the sky, the stars, constellations and asterisms such as the Pleiades and the Hyades. They also offer a more erudite image of Homer, which reflects the cosmological views of his period. The model of the Universe that is presented is continuous and has three levels: the lower level corresponds to the underworld, the middle one to the Earth and the upper one to the sky. But the key point of this paper is to illuminate the fact that the ancient Greek appellations for many of the stars and constellations have remained the same even after three millennia.

Keywords: *Iliad*, *Odyssey*, Homeric cosmological model

1 INTRODUCTION

The *Iliad* and the *Odyssey* are not only of supreme literary importance, but are, as well, a rich source of historical, scientific, technological and astronomical knowledge of the ancient Greeks in pre-Homeric and Homeric times. These two epic poems, which we date to the 8th century BC, include a wealth of information about the Earth, the sky, the stars (e.g. Sirius), constellations such as Ursa Major, Boötes and Orion, and star clusters like the Pleiades and the Hyades. They therefore offer us the possibility of seeing the more general cosmological views of that time.

A large number of authors have considered different astronomical aspects, facts and allusions in the *Iliad* and the *Odyssey* (e.g. see Walker, 1872; Schoch, 1926a; 1926b; 1926c; Neugebauer, 1929; Lorimer, 1951; Dicks, 1970; Trypanis, 1975; Gendler, 1984; Lovi, 1989; Genuth, 1992; Kirk, Raven and Schofield, 1995; Konstantopoulos, 1998; Wood and Wood, 1999; Flanders, 2007; Baikouzis and Magnasco, 2008; Minkel, 2008; and Varvoglis, 2009). This illustrates the continuing interest in this attractive subject. It is our aim here to analyze the astronomical data and allusions in the Homeric epics in order to better understand the cosmological model of the Universe that would prevail for a millennium after the Trojan War.

D.R. Dicks (1970: 10) has stated that: "We can't form a clear idea about the shape and the position of the Earth with respect to heavens and the underworld from the Homeric epics." Strictly speaking, this may be true. However, we wish to explore the prospect that it is in fact possible to ascertain a cosmological model from the passages and astronomical information contained in the *Iliad* and the *Odyssey*. We will investigate which constellations and celestial phenomena

were known to Greeks of that era, and how these were woven into a complex model of the Universe. We will also consider the names of the stars and constellations, several of which are exactly the same today as in Homeric times.

2 THE POSITION OF THE OCEAN, THE EARTH AND THE SKY IN THE HOMERIC UNIVERSE

2.1 The Ocean and the Earth

The ancient teachings of Orpheus (dating as far back as the 13th Century BC) are considered to be the basis of the first mystic Greek religion, with poems and hymns of great beauty. Nearly all of the ancient Greek sages and writers drew inspiration from themes found in the Orphic Hymns, and were thus influenced in formulating their individual theories and teachings.

Besides the Orphic Hymns (Petrides, 2002), the Homeric epics are a rich source of historical and technological facts. Indeed, an astronomer who studies in detail the descriptions in the *Iliad* and the *Odyssey* will discover a treasure-trove of astronomical information. It is generally believed that Homer lived in the Iron Age (a period roughly spanning 1200 to 550 BC), but told stories that occurred in the Late Bronze Age (ca. 12th century BC).

As Emile Mireaux (1959: 9) writes:

The *Iliad* and the *Odyssey* contain elements from the old Mycenaean civilization; basically, however, although they refer to events of the 12th century BC, the lives of their heroes (social, political economical and family), their laws and customs ... all reflect the way of life witnessed by the poet who composed the epic.

The two epic poems took their definite form in the Ionic cities of Anatolia in the 9th or 8th century BC;

first came the *Iliad* and later the *Odyssey* (Trypanis, 1975). The poems describe the culture, religious beliefs, general knowledge and habits of Greek populations during this period. They also describe the cosmological model that would prevail for the next millennium, i.e. up to the time of Ptolemy and his *Almagest*.

The Earth of the Homeric Universe was a circular flat disk surrounded by a huge circular river, the Ocean, a model first appearing in the Orphic Hymn "X. To Pan, The Fumigation from Various Odors", verse 15: "Old Ocean [Okeanos] too reveres thy high command, whose liquid arms begirt the solid land."

This mythical 'river' is different from the seas: it is something that defines the boundaries of the terrestrial world. Above all, Ocean is the primal and original creative element, the starting point of all things: "I can put the currents to sleep and, if you wish, of the river Ocean, which was the beginning of everything." (*Iliad*: XIV, 245-246).¹ Ocean is the male ancestor of the gods, who had Tethys as his spouse during the Creation: "I shall go to the ends of the Earth to find the father of all gods, the Ocean and Tethys the mother." (*Iliad*: XIV, 200).

This mythical 'river' has no sources, nor estuary; it is "apsorroos", i.e. cyclically moving or backward-flowing. Its current goes back to where it started in a ceaseless and eternal motion. From this Ocean, mentioned 19 times in the *Iliad* and 14 in the *Odyssey*, all other waters on Earth were created: seas, rivers and lakes. This is mentioned in the *Iliad*: "The all-powerful Ocean, the deep-current one, from whom all sea, river, source and fountain springs, and every deep well." (*Iliad*: XXI, 195-197).

In the *Odyssey*, the Ocean is described as terrible and fearful: "... 'cause he has deep currents and large rivers in his midst, which no one without a fast ship can pass across." (*Odyssey*: XI, 160). However, we are not given a definite description of the exact shape or size of the Ocean; we just learn about its watery structure.

Although Dicks is correct that we cannot get a clear idea about the position of the Earth in the cosmos, it can certainly be said that in the Homeric cosmological model, the Earth is between the sky and the underworld. Its precise structure and shape are not known, we just suppose it is a circular disk since it is surrounded by the circular watery Ocean. In the *Iliad*: (VIII, 13-16), a contrary view about Tartarus (a 'deep place' below sky, Earth and the sea) is given when Zeus threatens the gods that he will send them there:

... or I shall throw him down with my own hands, in the darkness of Tartarus, long away to the depths of the world, that has iron gates and copper threshold, under the Hades as far as the heavens are from the Earth. (*Iliad*: VIII, 13-16).

In parallel, Homer imagines Hades in the depths of the Earth:

... and if you go to the ends of the Earth and the sea, where Japetus and Cronus reside, and winds do not blow on them, nor the sunlight shines on them and deep Tartarus surrounds them from everywhere. (*Iliad*: VIII, 480).

One can conclude Homer believes that a) Hades is below the Earth and surrounded by Tartarus; b) the Earth is the center of the Universe and of life; and c) the starry sky is supported by the Earth (*Odyssey*: ix, 534). This is depicted in Figure 1.

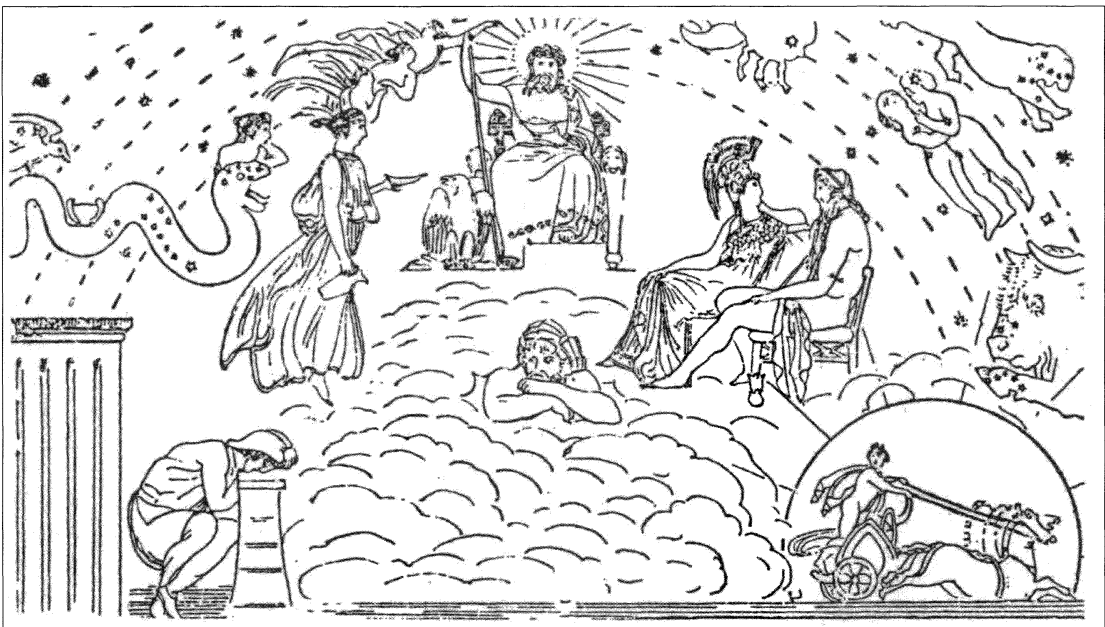


Figure 1: The Homeric Universe. In the Universe of Homer's times, the mountains can be seen to rise over the surface of the great disk of the Earth, the Ocean spreading around them, while the center is dominated by Mount Olympus which rises up to heaven. In its highest peak, the all-seeing Zeus is seated, supervising both immortal gods and mortal men, sometimes rewarding and sometimes punishing them. Beyond Olympus spreads Heaven, supported by the pillars of Atlas. In heaven we can locate the Moon, the stars and the constellations. In particular, in this figure we can distinguish the Pleiades open cluster and the constellations of Hydra, Corvus, Crater, Cancer, Leo, Gemini, Taurus as well – these constellations are not specifically referred to by Homer (after Cotsakis, 1976: 18).

2.2 The Sky

Heaven, with its luminous stars, is depicted as a hemispherical dome exactly covering the flat Earth (*Odyssey*: xi, 17). That is, the cosmos of this time was envisioned as a celestial dome over a disk-like Earth floating on water. The view of this age as recorded in the *Odyssey* is that the sky rests upon the Earth with the columns that keep the whole world in equilibrium held up by the mythical Atlas: "The daughter of the Atlas, of the one who knows the depth of every sea and he alone lifts the tall columns that divide Heaven and Earth in two." (*Odyssey*: i, 53-54).

For the ancient Greeks, the sky was a dome made of solid matter, iron or copper, held up there by tall columns or, according to another view, by some giant. Homer combines these two views by having Atlas supporting the columns. Hesiod in *Theogony* (1988: 517) writes that Zeus was the one who had assigned this duty to Atlas.

For Homer the sky was, more specifically, made of copper, as described in the *Iliad*: "... the Achaeans, white in dust to the top, for the horses were lifting it up to the copper sky with their feet." (V, 504). Or, in another passage: "They were fighting there and the iron noise was thundering up to the copper sky through the air." (XVII, 424-425). In another "polychalcus", that is "... of much copper." (*Iliad*: V, 504, *Odyssey*: iii, 2; *Iliad*: II, 458; XVI, 364; XIX, 351). There are also references to an iron sky in the *Odyssey*: (xv, 329 and xvii, 565), but it is not known whether this was meant metaphorically or in some other context.

We thus conclude that the sky was perceived by the ancient Greeks as something solid though unreachable. Its unimaginable distance was often used in similes to confer vastness. For example, the glory of Nestor's golden shield reached the skies: "... and then we shall take the shield of Nestor, whose glory has reached the stars." (*Iliad*: VIII, 192-193). Similarly, the glory of Penelope, which also was reaching the wide skies (*Odyssey*: xix, 108).

The space between sky and Earth was filled firstly by the dense air: "... up to the air its vast branches extended." (*Iliad*: XIV, 288), and over this layer and towards the direction of the sky there was the clean and transparent 'aether', lighter than the air. Aether is essentially the 'higher air', through which the heavens can be seen:

... and up to the stars, which twinkle in windless aether, charming around the luminous moon – every peak, every edge, every side is visible, as a vast aether opened by the sky, which made visible all the stars to the joy of the shepherds. (*Iliad*: VIII, 554-559).

Above the aether, on the peaks of Olympus that reach the sky, the gods dwell: "... and he offered a lot of sacrifices to the gods that dwell in heavens." (*Odyssey*: i, 68-69), and "Without the opinion of the gods, who dwell in heavens ... but now he is like the gods who enjoy the heavens." (*Odyssey*: vi, 242-245). The gods are described either as "Olympians" or "heavenly gods", because the tallest peaks of Olympus seemed to touch the heavens: "Our father, son of Cronus, first of the heavenly ones ..." (*Odyssey*: i, 46). Finally, it is mentioned that above the aether there was the "polychalcus" sky (*Iliad*: II, 458; XVI, 364; XIX, 351).

Of course, one should not assume that the Homeric sky was a barren metallic dome; it was, as Homer sings, full of life, the life of the stars and the constellations. Thus, the ancient Greeks were calling the sky "... full of stars." ("asteroeis") (*Iliad*: VI, 108; XV, 371), and star-decorated (*Odyssey*: ix, 535), as was natural for a people living in a country with few cloudy nights.

On this celestial dome, Helios, the god of the Sun, travels on its path, so he is described with the adjective 'ouranodromos' (sky-running): "For they were perished due to their own fault, the impious, who ate the oxen of the sky-running Helios and he deprived them of the day of their homecoming." (*Odyssey*: i, 7-9). This is only one out of 119 references to the Sun in the Homeric epics: there are 42 references in the *Iliad* and 77 in the *Odyssey*. As a god, Helios appears 34 times (8 in the *Iliad* and 26 in the *Odyssey*). In stark contrast, for the Moon (Selene) there are only three references in the *Iliad*: (VIII, 554; XVII, 367; XVIII, 484) and only two in the *Odyssey*: (iii, 46 and ix, 144). Besides, the Moon appears under its archaic name, "Mene" one more time in the *Iliad*: (XIX, 374). A possible explanation for the scarcity of lunar references is that the main events in the *Iliad*—that is, the battles—took place only during the daylight, whereas in the *Odyssey* the Moon was usually hidden behind the clouds: "For it was thick darkness around and the moon, hidden in clouds, didn't shine in the skies." (*Odyssey*: ix, 144).

Before moving on to examine the stars and constellations in the epics, it is interesting to present some meteorological and climatologic elements as they appear in the *Iliad* and the *Odyssey*. The air between the sky and the Earth is traversed by the winds and the clouds, through which the omnipotent Zeus covers the sky, sends the rains onto the Earth and throws his lightning and thunders (*Iliad*: XVI, 364-365; XII, 25-26; *Odyssey*: v, 303; xxiii, 330).

As is mentioned in Rhapsody V in the *Iliad*, the gates of both Heaven and Olympus are formed by dense clouds. Their guards are the Orae (Hours), goddesses of the seasons who regulate the weather conditions:

... and Hera moves the horses violently with the whip; the gate of Heaven thunders open in front of them, which the guardians of the vast Sky and Olympus, the Hours, block with the cloud or remove it. (*Iliad*: V, 749-751).

3 THE STARS AND THE CONSTELLATIONS IN THE *ILIAD* AND THE *ODYSSEY*

Let us now examine closely all the Homeric references to the constellations, the stars and the planet Venus, as they appear in the two epics.

Homer mentions in the *Iliad* the "autumnal" star:

Then Athena gave power and courage to Diomedes, so that excellently amidst the Greek multitudes he would be glorified and take shining fame everywhere. From his helmet and shield a flame was visible, which pours light without sleeping, as the autumn star, bathed in the Ocean, shines with its full light. (*Iliad*: V, 1-5).

The "autumn star" is actually Sirius, the brightest fixed star of the night sky. Sirius appears every year, for the geographical latitude of Greece, in the night

sky in late July or early August. This is mentioned also by Richard H. Allen, who writes (1963: 120):

Homer alluded to Sirius in the *Iliad* as Οπῶρινός , the star of Autumn; but the season intended was the last days of July, all August, and part of September – the latter part of summer. The Greeks had no word exactly to our ‘autumn’ until the 5th century before Christ, when it appeared in writings ascribed to Hippocrates. Lord Derby translated this celebrated passage: A fiery light. There flash’d, like autumn’s star, that brightest shines. When newly risen from his ocean bath.

Although it cannot be supported with certainty, the Homeric man, perceiving the Earth as a flat circular disk surrounded by the Ocean, considered that the Sun, the Moon and most stars rose from the Ocean and set back in it. The idea of a spherical Earth appeared much later, with the Pythagorean philosophers in the 5th century BC.

In the *Iliad*: (XVIII, 478-488) it is mentioned that on the shield of Achilles, which was constructed by the god Hephaestus (Vulcan) after an order by Thetis (Achilles’ mother), were depicted all of the constellations (Figure 2):

And he made first a powerful and large shield, all with art and triple circle around. With five bendings this shield was made and upon it various images he designed with his wise knowledge: The earth, the sky, the sea he drew, the untiring sun, the full moon, the stars that crown from everywhere the sky, Orion’s power, the Hyades, the Pleiades, the Bear, also called the Wagon, which rotates always at the same place, watching Orion, the only one that doesn’t experience the bathing in the Ocean.

Wood and Wood (1999) have speculated on how the sky during Homeric times may have appeared. Although interesting in its approach, their work is considered unproven and controversial.

The Hyades and the Pleiades, which are actually two

open clusters, were called ‘constellations’ by the ancient Greeks—today they are both included in the constellation Taurus. Taurus is not mentioned by Homer, although he mentions the adjacent constellation Orion, and with the stressing phrase “Orion’s power”. This is exactly the way Orion is mentioned by Hesiod (West, 1988: 598, 615, 619). Both authors refer to the constellation’s “power”, alluding to its apparent brightness.

Homer ends his stellar reference with the circumpolar constellation Ursa Major, which does indeed ‘watch’ Orion. Ursa Major does not “... experience the bathing in the Ocean ...”, i.e. it never ‘contacts’ the sea, because its position near the North Celestial Pole keeps it away from the horizon as the Earth rotates.

The Hyades and the Pleiades are mentioned together with the other star asterisms as ‘constellations’ in their own right, in both the *Iliad* and the *Odyssey* (v, 272-277). The Pleiades are mentioned just once in the first poem, together with the Hyades (in the passage above, XVIII, 485), and once in the *Odyssey*: (v, 272). Indeed, in the *Odyssey* there are references to all of the above-mentioned star clusters and constellations:

Then he set sail, a joyful Odysseus (Ulysses), and, sitting at the helm, was steering artfully; and no sleep closed his eyes as he was staring at the Pleiades, and the Shepherd, who is late to set, and the Bear, also called the Wagon by many, which rotates always at the same place, watching the Hunter, the only one that doesn’t bathe in the Ocean’s wave. For Calypso had told him to keep that star on his left hand while sailing. (*Odyssey*: v, 270-277).

As R.H. Allen (1963: 96) writes: “Homer characterized the constellation of Boötes as ‘ οψέ δῶον ’, meaning late in setting, a thought and expression [that has] now become hackneyed by frequent repetition.”

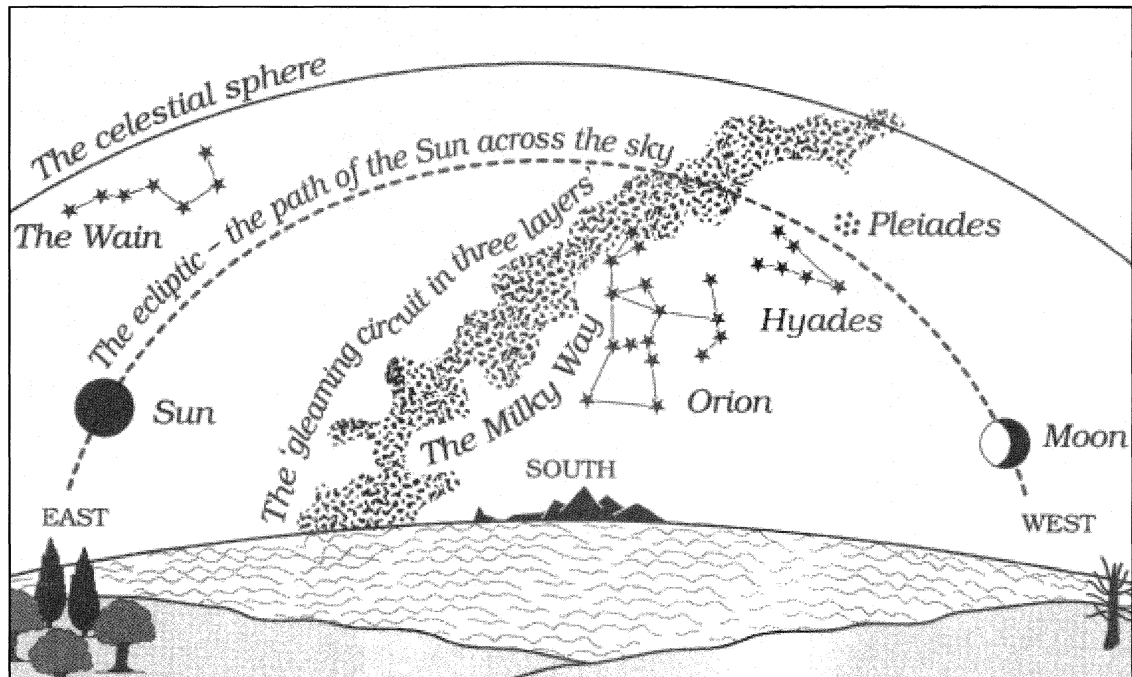


Figure 2: The Homeric Universe as it was depicted on the shield of Achilles (after Wood and Wood, 1999: 199).

Homer states that the constellation Boötes is late/slow in setting, and Aratos that it "... lingers more than half the night ..." (since it is very long and narrow with its long side oriented north-south on the celestial sphere). So Boötes rises 'on his side', all at once, and sets nearly vertically (starting from its right lower corner for the sky of Athens, and becoming more and more vertical), feet setting first, then his waist, and his upper body setting last, therefore taking only a short time to rise but a very long time to set.

It must also be noted in the cited verses that, for the first and only time in the epics, there is a reference to the use of constellations for orientation in the sea. Calypso advises Ulysses that, in order to keep the right course, he must keep always on his left the Bear (Ursa Major). Of course, this means that, having on his left a northern constellation, he would travel eastwards. So Homer was placing Ogygia, the island of Calypso, somewhere to the west of all Greece, since Ithaca, where he was bound, was in the western part of Greece itself.

As Homer believed that the Earth was a flat circular disk surrounded by the Ocean, he was certain that the Sun, the Moon and the stars rise from the Ocean and set in it; only Ursa Major did not set for ancient people living on the northern shores of the Mediterranean Sea. In Greek mythology, Zeus lusted after a nymph named Callisto. Hera, Zeus' wife, out of jealousy turned Callisto into a bear. Zeus later swept her, and her son Arcas, into the sky forming the constellation of Ursa Major. Aristotle mentions that the bear is the only animal that, because of its thick fur can dauntlessly roam the icy northern polar regions. The circumpolar character of Ursa Major is in our age only partial, but in protohistoric times, when Alpha Draconis (Thuban) was the 'Pole Star', all seven of the brightest stars in Ursa Major never set. Today, due to the precession of the Earth's axis, Alkaid (Eta Ursae Majoris, the last star in the tail) remains under the northern horizon of Athens, Ithaca and central Greece in general, for approximately three hours. Only in northern Greece and in places with a geographical latitude higher than $\varphi = 40.1^\circ$ are all of Ursa Major's brightest stars circumpolar. Allen (1963: 419) states: "Sir George Cornwall Lewiss writes – for Homer's line Arctos, sole star that never bathes in th' ocean wave (by reason of precession it then was much nearer to the pole than it now is)." The difference in the declination of Alkaid (η UMa) between Homeric times and today is $>15^\circ$, so in antiquity all of Ursa Major was circumpolar even from the southernmost tip of Greece.

Homer, however, does not mention explicitly the Great Bear, so a modern commentator could argue that Ursa Minor (the Lesser Bear), is meant, or even a combination of both. Most probably, though, he meant the Great Bear, as it has much brighter stars, it is a much larger and more impressive constellation, and, most important, Ursa Minor was (according to the tradition) introduced to the Greeks by Thales of Miletus in the 6th century BC—that is, two centuries after Homer. Ursa Minor is still a totally circumpolar constellation as seen from Europe.

The last constellation mentioned in the *Odyssey* is Orion the Hunter. Its appearance in the night sky each year coincided with the start of the rainiest and stormiest part of the year; therefore Orion is called "stormy"

and destructive. Both Hesiod and Aristotle mention that the rising of Orion was a certain warning for sailors that storms are coming (Hesiod, *Works and Days*: 598, 615, 619; Aristotle, *Meteorology*: 2.5.4).

In *Iliad's* Rhapsody XXII, both Orion and Sirius are mentioned. The brightest fixed star, Sirius, is referred to as Orion's dog. Today, Sirius is known as Alpha Canis Majoris, the brightest star in the constellation of Canis Major (the Great Dog). Homer presents Sirius as an ominous sign in the sky, as every summer it is connected with the so-called "dog burnings" (*The Iliad*, 1950: Chapter 22, verses 25-31):

... like the star that comes to us in autumn, outshining all its fellows in the evening sky – they call it Orion's dog, and though it is the brightest of all stars it bodes no good bringing much fever, as it does, to us poor mortals.

3.1 'Dog burnings' and 'Dog days'

In antiquity the heliacal rise of Sirius was connected with a period of the year of extremely hot weather, "κυνικά καύματα" ("kynica kavmata", canine burnings). This period corresponded to late July, August and early September in the Mediterranean region. Romans also knew these days as "dies caniculariae", the hottest days of the whole year, associated with the constellation of the Great Dog, the hunter's (Orion's) dog Sirius. Ancient Greeks theorized the extra heat was due to the addition of the radiation of bright Sirius to the Sun's radiation.

In ancient Greek folklore, people called the summer days after the heliacal rise of Sirius "dog burnings" without correlating them with the Dog star or the constellation, but with dogs in general, thinking that only dogs were so crazy as to go outside when it was so hot. This belief has persisted through the centuries and can be found in modern Greek folklore in the belief that during the hot days of July and August, and especially between July 24 and August 6 dog bites are infectious (Theodossiou and Danezis, 1991: 115).

According to an ancient myth, the inhabitants of the island Kea were dying from a famine caused by the drought brought on by the dog burnings around 1600 BC. Then, the god Apollo gave an oracle to call Aristaeus, the god's son, from the region of Phthia, in order to help them. Upon arriving on Kea, Aristaeus performed rituals, cleansings and sacrifices to Zeus Ikmaeus, the lord of the rains and the skies, and to Kyon Apollo, that means to Apollo the Dog. Both gods listened to his pleas and they sent Etesian Winds, the northern winds blowing over the Aegean Sea every mid-summer for forty days, so that people could survive the unbearable heat. After that, the people of Kea, incited by Aristaeus, made sacrifices to the constellation of Canis Major and to Sirius. In order to remember his beneficence, they honored Aristaeus as "Aristaeus Apollo" and pictured his head on one side of their coins, while on the other side they depicted Sirius crowned with rays.

The late Professor and Academician of the National Technical University of Athens, Pericles S. Theochares (1995: 183) wrote:

This myth alludes to the relation of Sirius with the Earth. The sacrifices were made to Zeus Meilichius, a god of the weather, of the sun and rain, and to Sirius, who causes the dog burnings on Earth; they believed

that not only the Sun is responsible for the great heat of the summer, but also Sirius when standing next to the Sun. This was probably the belief of the builders of the Argolis pyramids, orienting their entrance corridors towards the azimuth of Sirius.

In ancient poetry Sirius is mentioned as a star with especially negative influence, something obvious in the Homeric verse "... it bodes no good ... to us poor mortals." (*Iliad*: XXII, 25-31). Because the Greeks of that era had noticed that people tended to become sluggish during the dog days, they had consolidated the belief that Sirius was exerting a halting influence on human activities. For this reason, even Hippocrates refers to the bad influence of this star on humans. Hippocrates made much, in his *Epidemics and Aphorisms*, of this star's power over the weather, and the consequent physical effect upon mankind (Allen, 1963: 126).

3.2 The Planet Venus

Venus is mentioned in both the *Iliad* and the *Odyssey*. In *Iliad*'s Rhapsody XXII (verse 317) Homer mentions Hesperus, the Evening Star, and in XXIII (verse 226) Eosphorus (Lucifer in Latin), the Morning Star that brings the light of dawn. In both cases Venus is the object really mentioned, although Homer considers them most probably as two different stars:

And as amidst the stars the evening star proceeds bright, that most beautiful among the stars of the sky, likewise the lance was shining, which was thrown by his right hand with malevolent purpose towards divine Hector, watching to find an uncovered part of his soft body. (*Iliad*: XXII, 317-321).

Similarly in the second passage: "When Lucifer heralds the light and golden Eos (the Dawn) emerges from the sea's depths, the fire was fading and flames stopped." (*Iliad*: XXIII, 226-228).

In Homer's *Odyssey* the passage brings us once again to the sea: "As the all-bright star emerged that comes first to herald the light of the night-born Dawn, then the foam-happy ship was nearing the island." (*Odyssey*: xiii, 98-100). It means that Ulysses reaches Ithaca before dawn, the time Venus appears, as the brightest star 'coming' before dawn.

3.3 Solstices

Also in the *Odyssey*, there is a clear reference to the solstices as "turnings of the Sun": "Syria they call an island – if you ever heard of it – higher than Ortygia, to the turning of the Sun." (*Odyssey*: xv, 403-404).

3.4 Other Ancient Authors about the Stars, Constellations and Sirius

Homer's epics assuredly influenced other ancient Greek poets and authors who mentioned the stars and the constellations of the sky. The most references are to the brightest star, Sirius.

Due to its bright apparent magnitude (–1.46), Sirius had a special place in the mythology, legends and traditions of most peoples of the Earth. Its very name means in Greek "sparking", "fiery" or "burning", or "flamboyant"; this name is most ancient, as it occurs in the Orphic *Argonautics*: "... just when for three consecutive days lost its light the flamboyant sun." (*Argonautics*: 121-122; Petrides, 2005), as well as in Homer (*Iliad*: XXII, 25-32 and *Odyssey*: v, 4).

In about the same period as Homer, or slightly later, Hesiod in his famous book, *Works and Days*, mentions several constellations that the farmer needs to watch for his daily work as well as three references to the solstices. For example, Hesiod suggests that the harvest should start when the Pleiades rise (heliacal rise), while seeding should start when they are about to set. Hesiod spoke of all the stars and constellations mentioned by Homer, with a special reference to Sirius. Indeed, he mentions Sirius in three different passages. In the first one he gives some advices to his brother Perses about grape-gathering: "And when Orion and Sirius reach the middle of the sky and the rose-fingered Dawn watches Arcturus, then, Perses, gather all grapes and bring them to the house." (Hesiod, 1988: 609-610), while in the other two he speaks about the dog burnings: "Then Sirius, the star proceeds a little more over the head of the mortal men each day and takes a larger part of the night." (ibid.: 417) and "For Sirius dries the head and the knees and the body is dry from the heat." (ibid.: 587).

Another work by Hesiod, *Aspis Irakleous (Shield of Hercules)*, is to a certain extent an imitation of "Aspis Achilleos" (the Shield of Achilles) as it is described in the *Iliad*: (XVIII, 468-817). In this work, too, Hesiod mentions the bright star Sirius twice (Hesiod, 1988: 391):

"Their souls descend into Hades to be dressed with earth, while their bones, when the skin around them is melted by fiery Sirius, get rotten in the black earth." (Shield of Hercules, 151). And: "When the noisy, blue-winged cicada, sitting on a green branch in summer, starts singing to people, and his food and drink is the soft dew, and all day long, starting from the dawn, pours its voice in the most terrible heat, when Sirius burns the body, then primers start appearing on the millets that are sowed in summer".

The poet Aeschylus (525-456 BC) in his tragedy *Agamemnon* also mentions Sirius the dog (verse 967).

Apollonius of Rhodes (3rd century BC) wrote his *Argonautics*, a major epic poem remolding in a poetic form the mythical expedition of the Argonauts from Thessaly to Colchis of the Black Sea. Apollonius also mentions Sirius in connection with the unbearable heat of the summer (Apollonius, 1988: Song III, v. 517):

When Minoan islands were heated from the sky by Sirius and for a long time their dwellers didn't find any treatment to this ... [And later on] 'He appeared again like Sirius, which rises to the heights from Ocean's edge.' (ibid.: Song III, v. 956).

Theognis (570–480 BC), a significant elegy poet from Megara, wrote several symposium poems, distinguished for their dignity and their respect of the gods. He even gives a rule for wine drinking, adding some information for the period around the rise of Sirius: "Witless are those men, and foolish, who don't drink wine even when the Dog Star is beginning ..." (Wender, 1984: 1039-1040).

Eratosthenes (276-194 BC) uses the word "sirios" as an adjective, writing for example: "Such stars are called sirios by astronomers, due to the quivering motions of their light." (Eratosthenes, 1997: 34).

Nonnus, a Greek epic poet of the 5th century AD from the Egyptian city of Panopolis, writes in his *Dionysiaka* about the dog burnings of Sirius: "He sent

an opposite puff of winds to cut off the hot fever of Sirius.” (Nonnus, *Dionysiaka*: V 275).

In the Byzantine period, Princess Anna Comnene [Komnene, or latinized Comnena, according to Wikipedia] writes in her *Alexias*: “... even though it was summer and the sun had passed through Cancer and was about to enter Leo – a season in which, as they say, the star of the Dog rises.” (Comnene, 2005: Book 3, XII.4).

4 DESCRIPTION OF A TOTAL SOLAR ECLIPSE IN THE ODYSSEY

In Rhapsody XX of the *Odyssey* there is the following passage: “The entrance and all the yard is full from shadows of the dead, who run in the dark. The Sun disappeared from the sky, and a thick dimness fell everywhere.” (XX, 356-357).

This passage probably describes an astronomical phenomenon, possibly the most ancient Western record of a total solar eclipse. As totality is a relatively rare astronomical event for a given place, occurring on the average once every 360 years, if the area of totality is restricted then a very probable date could be determined for that eclipse (Varvoglis, 2009).

Although no solar or lunar eclipses are directly mentioned in a Homeric text, the previous verses motivated two astronomers, Constantinos Baikouzis from the Laboratory of Mathematical Physics at The Rockefeller University in New York and Marcelo Magnasco from the Proyecto Observatorio, Secretaría de Extensión, Observatorio Astronómico de La Plata, to attempt a precise determination of the date Ulysses returned to Ithaca. They hypothesized (2008) that in the *Odyssey*: XX, 356-357 Homer refers to a total eclipse of the Sun that occurred on the day Penelope’s suitors were exterminated.

A prediction of an event like this is included in the literature, as the oracle Theoclymenus had warned the suitors that “The Sun will be obliterated from the sky, and an unlucky darkness will invade the world when the householder comes back and blood will be found in their dishes.” (*Odyssey*: XX, 350-355).

This quotation was correlated by Baikouzis and Magnasco with other references to ancient solar eclipses in ancient texts, and certain similarities were found. Moreover, in the Homeric text there are another four astronomical ‘markers’ concerning the return of Ulysses to Ithaca.

The first one is the phase of the Moon: Homer notes more than once that it was the time of New Moon, so the prime prerequisite for a solar eclipse is satisfied, according to Baikouzis and Magnasco (2008).

The second has to do with Venus, which six days before the slaughter of the suitors was visible high in the sky: “As the all-bright star emerged that comes first to herald the light of the night-born Dawn, then the foam-happy ship was nearing the island.” (*Odyssey*: xiii, 98-100).

The third ‘marker’ is about the stars and constellations Ulysses was seeing when he left the island of Calypso: 29 days before the day in question, the Pleiades were visible after sunset, as well as the constellation Boötes.

The fourth is the reference to the god Hermes (Mercury) who “... flies westwards ...” of the Ogygia island 33 days before the eclipse. According to Baikouzis and Magnasco (2008) this is a reference to the planet Mercury appearing low in the sky before sunrise. The planet undergoes retrograde motion once every 116 days, around the eastern edge of its apparent orbit.

Haris Varvoglis (2009), Professor of Astronomy at the University of Thessaloniki, notes that if we suppose that this last passage refers to the planet Mercury, then its western elongation (to the west of the Sun) and its turn to the east, along with the position of the Pleiades over the western horizon after sunset, and the simultaneous visibility of Boötes and with the apparition of Venus as ‘Morning Star’, all coincide once every 2000 years. Since it is known from the archaeological excavations of Troy that its destruction occurred around 1190 BC, it is clear that, if in the decades before or after that year such an astronomical coincidence happened, this can not be anything other than an independent confirmation of the year of Troy’s destruction (Varvoglis, 2009: 3).

Knowing the probable year of Troy’s destruction, combining all the previous astronomical information in Homer, and considered 1684 New Moons between 1250 and 1125 BC, Baikouzis and Magnasco used planetarium software to research the astronomical past of the Ionian Sea region. They discovered that a total solar eclipse occurred in 1178 BC and was visible as such from Ithaca. After a more precise calculation, they verified the exact date on the Julian calendar: 16 April in 1178 BC. They set this date as the day the suitors were exterminated. If this is true and the wanderings of Ulysses indeed covered ten years, as Homer states, then the capture and destruction of Troy should have happened in 1188 BC.

Baikouzis and Magnasco say that their research may not prove beyond a doubt the timing of the return of Ulysses to Ithaca, but it at least proves that Homer knew of certain astronomical phenomena that occurred centuries before his own age. If they are right and Homer ‘tied’ that date to astronomical events that can be verified, then this fact can help historians to date the fall of Troy with far greater precision.

A possible counter-argument to that position is that Homer, who is presumed to have lived in the 8th century BC, would have found it difficult to describe astronomical events that occurred more than four centuries earlier. Also, although the words of Theoclymenus seem to describe a solar eclipse, the poet may have merely wanted to give a general image in fitting with the dark fate of Penelope’s suitors. Science journalist J.R. Minkel (2008) reports in *Scientific American*:

Researchers say that references to planets and constellations in the *Odyssey* describe a solar eclipse that occurred in 1178 B.C., nearly three centuries before Homer is believed to have written the story. If correct, the finding would suggest that the ancient poet had a surprisingly detailed knowledge of astronomy ... Greek scholars Plutarch and Heraclitus advanced the idea that Theoclymenus’s speech was a poetic description of an eclipse. They cited references in the story that the day of the prophecy was a new moon, which would be true of an eclipse. In the 1920s researchers speculated that Homer might have had a real eclipse in mind, after

calculating that a total solar eclipse (in which the moon blocks out the sun) would have been visible on April 16, 1178 BC over the Ionian Islands, where Homer's poem was set. The idea languished, however, because the first writings on Greek astronomy did not come until centuries later.

Minkel's reference to "... some researchers in the 1920s ..." includes a link to an article by C. Schoch (1926a), who first determined 16 April 1178 B.C. as the date of the total solar eclipse connected with the words of Theoclymenus (but see, also, Schoch, 1926b; 1926c; and Neugebauer, 1929).

5 CONCLUSIONS

The cosmological model of Homer, which records the views of his age, and perhaps older views as well, survived in Ionia for centuries after his death.

Writing most probably in the 8th century BC, Homer presents the Earth as a disk surrounded by the watery Ocean on all sides. The starry sky is a solid vault that must be supported in order not to fall, while Hades, an underworld, exists below Earth, being as far from the Earth as the sky.

Not all of the planets known in antiquity were mentioned in the Homeric poems, but there is persuasive evidence that their characteristics and the correlation of the state of the sky with the passage of time on Earth were widely known after a great number of empirical observations had been carried out.

In conclusion, it can be said that the Homeric references show that certain constellations and certain celestial phenomena were known to the Greeks of that age. A number of stars had been named, and they were so familiar that they were used in similes regarding gods and humans. Another interesting point is that Homer mentions some stars and several constellations under exactly the same names as used today.

Beginning with the *Iliad*, the first reference to a star occurs in the 5th Rhapsody (V, 5), where Sirius is presented as an autumnal star; it seems natural that the first star mentioned is the brightest one of the night sky. A richer astronomical reference is in the description of the shield of Achilles (XVIII, 478-488). Homer states that upon it were depicted Orion, the Hyades, the Pleiades and the Bear or Wagon, "... which rotates always at the same place, watching Orion ..." and without ever touching the Ocean. This seems to be a clear implication that this constellation is circumpolar and always visible from the northern latitudes where the epic's story is taking place. This fact makes the Bear suitable as an easily-seen navigator's aid, so its inclusion in a popular poem would be of practical use for the society. Towards the end of the *Iliad* Homer again mentions Sirius, calling it Orion's dog (XXII, 29).

In the *Odyssey* there is again a reference to circumpolar stars and to the usual constellations (v, 279-287), but this time Boötes is added.

So, in total, Homer mentions three constellations (the circumpolar Ursa Major, Orion and Boötes); two open clusters, which were then known as constellations (the Pleiades and the Hyades); the bright star Sirius indirectly (as the autumn's star and the 'bad star' bringing the dog's burnings to people); and the planet Venus as a star with its ancient Greek names for

the Evening Star and the Morning Star.

There is a 'star' mentioned without a name in the *Odyssey* (V, 286): "For she told him to keep that star on his left hand when sailing in the sea." The mathematician Konstantinos Mavrommatis (2000) suggests that this is probably the Pole Star of that age. Also, the astronomer Chariton Tomboulidis (2008) mentions that in the *Iliad* goddess Athena is likened to a 'spark' star: "From the peaks of Olympus she dashed as the star that Cronides threw as a sign to humans ... a bright star and infinite the sparks that are thrown." (IV, 75-78). Probably Homer alludes here to a shooting star or meteor, as such 'stars' would be more often observed back then in the very dark skies of ancient Greece.

In the *Odyssey* there is also a very clear reference to solstices (xv, 403-404) and a probable one to the phenomenon of stellar scintillation (xii, 318).

Finally, although solar or lunar eclipses are not explicitly mentioned in the Homeric epics, it has been suggested (Schoch, 1926a; Baikouzis and Magnasco, 2008) that in the *Odyssey* (XX, 356-357) Homer alludes to a total solar eclipse from which even a specific date for the arrival of Ulysses in Ithaca can be extracted. However, caution should be taken in this instance not to confuse poetic metaphors with real astronomical events, as Homer lived approximately four centuries after the mooted eclipse of 16 April 1178 BC.

It is a fact that there is only one case of using stars or constellation(s) for orientation purposes in Homeric texts (*Odyssey*: v, 271-277). The task of teaching practical applications of astronomy was undertaken by Hesiod half a century later, with his opus *Works and Days*, which offered to Greek people the first calendar for agricultural works, a guide of seasonal activities based on the heliacal rising or setting of various stars, constellations or of the Pleiades open cluster.

The Homeric astronomical literary tradition was followed by several ancient Greek authors, such as Hesiod with his books *Works and Days* and *Shield of Hercules*, the tragic poet Aeschylus in his tragedy *Agamemnon*, Apollonius of Rhodes with his *Argonautics*, Eratosthenes of Cyrene with his *Catasterismoi*, Nonnus with his *Dionysiaca* and even the Byzantine Princess Anna Comnene with her *Alexias*.

All these references indicate that at least since Greek antiquity, starting with the Orphic Hymns (2006) and subsequently Homer's epic poems, and up to this day, certain stars and the surviving constellations retain exactly the same names.

6 NOTES

1. All the English translations from the *Iliad* and the *Odyssey* in this paper are from the Loeb editions, unless otherwise noted.

7 REFERENCES

- Aeschylus, 2000. *Agamemnon*. Athens, Daedalus-Zacharopoulos Publications [in Greek].
 Allen R.H., 1963. *Star Names - Their Lore and Meaning*. London, Constable.
 Apollonius of Rhodes, 1988. *Argonautics*. Athens, Kardamitsa Publications [in Greek].
 Aristotle, 1952. *Meteorologica*. London, Heinemann (The

- Loeb Classical Library; English translation by H.D.P. Lee).
- Baikouzis, C., and Magnasco, M.O., 2008. Is an eclipse described in the *Odyssey*? *Proceedings of the National Academy of Sciences*, 105, 8823-8828.
- Connene, A., 2005. *Alexias*, Books I to XV. Athens, Agra Publications [in Greek].
- Cotsakis, D., 1976. *The Pioneers of Science and the Creation of the World*. Athens, Zoe Publications [in Greek].
- Dicks, D.R., 1970. *Early Greek Astronomy to Aristotle*. London, Thames and Hudson.
- Eratosthenes, 1997. *Catasterismoi*. Translated by Theony Contos in *Star Myths of the Greeks and Romans: A Sourcebook*. Grand Rapids, Phanes Press.
- Flanders, T., 2007. Did the Greeks, in Homer's time, name a constellation or asterism after Achilles? *Sky and Telescope*, 114(8), 82.
- Gendler, J.R., 1984. Jupiter-Saturn conjunctions in Homer's *Odyssey* and *Iliad*. *Bulletin of the American Astronomical Society*, 16, 489-490.
- Genuth, S.S., 1992. Astronomical imagery in a passage of Homer. *Journal for the History of Astronomy*, 23, 293-298.
- Hesiod, 1914. *The Homeric Hymns and Homerica (Theogony)*. London, Heinemann (The Loeb Classical Library; English translation by Hugh G. Evelyn-White; reprinted 1954).
- Hesiod, 1988. *Theogony and Works and Days*. Oxford University Press (Oxford World's Classics; translation, Introduction and notes by M.L. West; reprinted 1999).
- Homer, 1924. *The Iliad*. London, Heinemann (The Loeb Classical Library; English translation by A.T. Murray).
- Homer, 1950. *The Iliad*. New York, Penguin Books (English translation by E.V. Rieu).
- Homer, 1919. *The Odyssey*. London, Heinemann (The Loeb Classical Library; English translation by A.T. Murray, revised by G.E. Dimock; reprinted 1995).
- Kirk, G.S., Raven, J.E., and Schofield, M., 1995. *The Pre-socratic Philosophers: A Critical History with a Selection of Texts*. Cambridge, Cambridge University Press (First printed 1883).
- Konstantopoulos, P., 1998. *Homeric Greeks*. Two Volumes. Athens, Metron Publications [in Greek].
- Lorimer, H.L., 1951. Stars and Constellations in Homer and Hesiod. *The Annual of the British School in Athens*, 46, 86-101.
- Lovi, G., 1989. Stargazing with Homer. *Sky and Telescope*, 77(1), 57.
- Mavrommatis, K., 2000. Astronomical elements in Homer's *Odyssey*. *Ouranos*, 35, 112-114 [in Greek].
- Minkel, J.R., 2008. Homer's *Odyssey* said to document 3,200 year-old eclipse – clues in the text hint that the poet knew his astronomy. *Scientific American* (<http://www.scientificamerican.com/article.cfm?id=homers-odyssey-may-document-eclipse>).
- Mireaux, E., 1959. *Daily Life in the Time of Homer*. New York, The Macmillan Company (English translation by Iris Sells).
- Nonnus, *Dionysiaca*, (s.d.). Athens, Georgiades-Elliniki Agoge Publications (translated by E. Darviri) [in Greek].
- Neugebauer, P.V., 1929. *Astronomische Chronologie*, Berlin, Walter de Gruyter.
- Orphic Hymns*, 2006. Athens, Ideotheatro Publications [in Greek].
- Petrides, S., 2002. *The Orphic Hymns – Astronomy in the Age of Ice*. Athens, privately published.
- Petrides, S., 2005. *Orpheus' Argonautica – A Dissertation on Seafaring of the Late Pleistocene*. Athens, privately published.
- Schoch, C., 1926a. The eclipse of Odysseus. *The Observatory*, 49, 19-21.
- Schoch, C., 1926b. Die Datierung des Trojanischen Krieges und der Irrfahrten des Odysseus. *Die Sterne*, 6, 88.
- Schoch, C., 1926c. *Die sechs griechischen Dichter-Finsternisse*. Berlin, Steglitz, Selbstverlag.
- Theocharas, P., 1995. *The Pyramids of Argolis and their Dating*. 11th Panhellenic Conference, Nafplio [in Greek].
- Theodossiou, E., and Danezis, E., 1991. *The Stars and their Myths – Introduction to Uranography*, Athens, Diavlos Publications [in Greek].
- Theognis, 1997. *Lyrical poems III*. Athens, Epikairoitita Publications [in Greek].
- Tomboulidis, C., 2008. Homer's astronomical elements. *Ouranos*, 67, 130-133 [in Greek].
- Trypanis, K.A., 1975. *The Homeric Epics*. Athens, Prometheus-Hestia Publications [in Greek].
- Varvoglis, H., 2009. Pharmacology and astronomy in *Odyssey*. *BemaScience, History*, p. 3 [in Greek].
- Walker, G.J., 1872. Astronomical allusions in Homer, Dante, Shakespeare and Milton. I. *Homer. The Astronomical Register*, 10, 229-237.
- Wender, D., 1984. *Hesiod and Theognis*. New York, Penguin Books.
- West, M.L. (ed.), 1988. *Works and Days*. Oxford, Oxford University Press.
- Wood F., and Wood, K., 1999. *Homer's Secret Iliad: The Epic of the Night Skies Decoded*. London, John Murray.
- Dr Efstratios Theodossiou is an astronomer, and an Associate Professor of History and Philosophy of Astronomy and Physical Sciences in the School of Physics at the University of Athens. His scientific interests include observational astronomy and astrophysics, satellite spectrophotometry of Be stars and history and philosophy of astronomy. He has published more than 200 scientific papers in international refereed journals and proceedings of astronomical conferences, 300 articles in Greek newspapers and journals and sixteen books on history and philosophy of astronomy and physics. He is a member of IAU Commission 41.
- Dr Vassilios N. Manimanis is a post-doctoral researcher in the School of Physics at the University of Athens. His scientific interests include observational astronomy and astrophysics, photometry of cataclysmic variable stars, history and philosophy of astronomy and sciences, popularization of astronomy and bioastronomy. He has published 25 research papers in international refereed journals and many articles in popular magazines.
- Petros Z. Mantarakis received a B.S. in astronomy from the California Institute of Technology, and an M.S. in astronomy from the University of Arizona. He worked in industry for thirty years, where he attained the level of President of several companies. He has 20 patents, and has published two books and numerous articles. He lives in Los Angeles, California, where he continues to write and do consulting work.
- Dr Milan S Dimitrijević is an astronomer at the Belgrade Astronomical Observatory. His scientific interests include spectroscopy of astrophysical and laboratory plasma, stellar astrophysics, collisions and their influence on spectral lines, and history and philosophy of astronomy. He has published several books, around 200 papers in international journals and several hundred contributions in conference proceedings and newspapers.