

# SIRIUS IN ANCIENT GREEK AND ROMAN LITERATURE: FROM THE ORPHIC ARGONAUTICS TO THE ASTRONOMICAL TABLES OF GEORGIOS CHRYSOCOCCA

Efstratios Theodossiou<sup>1</sup>, Vassilios N. Manimanis<sup>1</sup>,  
Milan S. Dimitrijević<sup>2</sup> and Peter Z. Mantarakis<sup>3</sup>

<sup>1</sup>Department of Astrophysics-Astronomy and Mechanics, School of Physics, National and Kapodistrian University of Athens, Panepistimioupolis, Zographos 157 84, Athens, Greece.

E-mail: etheodos@phys.uoa.gr; vmaniman@phys.uoa.gr

<sup>2</sup>Astronomical Observatory of Belgrade, Volgina 7, 11060 Belgrade, Serbia.

E-Mail: mdimitrijevic@aob.bg.ac.rs

<sup>3</sup>22127 Needles St, Chatsworth, California, USA

E-mail: zanispetros@socal.rr.com

**Abstract:** The brightest star of the night sky, is Sirius, Alpha Canis Majoris ( $\alpha$  CMa). Due to its intense brightness, Sirius had one of the dominant positions in ancient mythology, legends and traditions. In this paper the references of the many ancient classical Greek and Roman authors and poets who wrote about Sirius are examined, and the problem of its 'red' color reported in some of these references is discussed.

**Keywords:** Seirios, Sirius, Dog Star, Canis Major, scorching star, Maira

## 1 INTRODUCTION

Sirius, Alpha Canis Majoris ( $\alpha$  CMa), is the brightest star in the night sky. It is visible throughout Greece on clear winter nights, and for this reason occupies a significant place in ancient mythology, legends and traditions. The original Greek name, 'Seirios', meant 'sparkling', 'shining', 'fiery' or 'burning'.

In this work, ancient Greek and Roman and some Byzantine references to Sirius will be considered, which led to the popularization of its name in the Greco-Roman literature. The same is true for the myths and classical traditions associated with it; the classical folklore associated with Sirius became known and was enriched through the work of the main Latin authors. In this way, both the name and the myths were long established in Western culture and thus survived. We will also examine and discuss the problem of the 'red' color of Sirius, which arises from references of some ancient authors.

## 2 SIRIUS IN THE CONSTELLATION CANIS MAJOR

Canis Major is an average-sized southern constellation with 95 stars visible to the naked eye. Its brightest star, Sirius, is almost four times brighter than any other star visible from the latitude of Athens ( $38^\circ$ , central Greece). One must go further south than  $37^\circ$  N, to Rhodes or Crete, in order to observe the next brightest star, Canopus, which is half as bright as Sirius (Canopus is the brightest star of the constellation Carina, and is Alpha Carinae).

We now know that Sirius is one of the closest stars to the Earth at a distance of just 2.64 parsecs (8.60 light years), and it has an apparent magnitude  $m = -1.46$ . This is 20 times brighter than our Sun would be at the same distance. Canopus is at a much greater distance of 96 pc (313 l.y.) and shines with an apparent magnitude of  $-0.72$ .

Of all visible celestial objects, only the Sun, the Moon, Venus, Jupiter and Mars appear brighter than Sirius; actually, Mars is brighter than Sirius only when it is close to opposition, approximately once every two years.

Sirius ( $\alpha$  CMa), Procyon ( $\alpha$  CMi, the brightest star in the constellation Canis Minor) and Betelgeuse ( $\alpha$  Ori, the brightest star in the constellation Orion) form a large triangle in the January-to-March sky, the so-called, 'Winter Triangle', which is almost equilateral. Today, Sirius first appears in the dawn skies several weeks later than it did in ancient times (10 August versus near the summer solstice). This is because of the precession of the equinoxes due to the 26,000-year wobble of the Earth's axis.

Sirius is in fact a triple star system. The companion star, Sirius B, is a white dwarf about the size of the Earth; most of its mass is compressed so much that a cubic cm of this material would weigh on Earth a few tons (and hundreds of tons on the surface of the white dwarf). Sirius B shines eighty times fainter than the naked-eye theoretical limit, but even if it reached that limit the intense glow from the adjacent Sirius A would render its companion invisible. This is the reason that Sirius B was only indirectly detected in 1844 from the perturbations it caused in the position of Sirius. The discovery was made by the German astronomer Friedrich Wilhelm Bessel. It was first optically observed in 1862 by the American astronomer and telescope-maker Alvan G. Clark during the testing of a refracting telescope of exquisite quality. In 1994 Daniel Benest and Jean-Louis Duvent (1995) from the O.C.A. Observatoire de Nice in France suggested the existence of a second companion to Sirius, Sirius C.

Because of its great brightness, Sirius occupied a prominent position in mythology, legends and traditions of most people, and especially of the ancient Greeks. Its very name, *Seirios*, in Greek means 'sparkling', 'fiery' or 'burning', 'flamboyant', 'scorching star' or 'scorcher' (Table 1); this epithet dates from at least the sixth century BC, as it was recorded in the Orphic *Argonautics* (Demetrakos, 1964: Volume 13).

Claudius Ptolemaeus (= Ptolemy, second century AD) mentions Sirius as "... the one in the mouth [of the dog], most bright, is called Dog and *hypokirros*." (Ptolemy, 1903: 142).<sup>1</sup> In a small differentiation, Johann Bayer in his *Uranometria* places the bright star on the greater dog's snout (see Bayer, 1603: Leaf 38).

Sirius can be seen from every inhabited region of the Earth's surface. The best time of the year to view it in our epoch is around 1 January, when it reaches the meridian at true midnight. In 500 BC this happened around 11 December.

### 3 SIRIUS IN GREEK AND ROMAN MYTHOLOGY

Canis Major probably depicts the faithful dog of Orion the Hunter, Laelaps. Orion is a nearby constellation. Indeed, Sirius can be located on the celestial sphere if we extend the line formed by the three stars of 'Orion's Belt' to the east.

In a tale of Greek mythology, Orion was in love with the goddess Artemis—the Greek equivalent of Diana. However, Apollo, in order to cancel the union of mortal Orion with his twin sister, sent a huge scorpion—represented now by the constellation Scorpius—that killed the unlucky hunter. After Orion's death, his beloved Artemis donated his exquisite hound to Procris, daughter of Erechtheus and one of Artemis' following nymphs. Procris later gave Laelaps to her husband Cephalus, who also was a famous hunter.

In early classical days it was simple Canis, represented the dog Laelaps, the hound of Actaeon, or that of Diana's nymph Procris, or the one given to Cephalus by Aurora and famed for the speed that so gratified Jove as to cause its transfer to the sky. (Allen, 1963: 117).

Table 1: Greek names for Sirius.

Greek Name	Transliteration	Latin spelling	Translation
Σείριος	Seirios	Sirius	Sparkling
Ἀστροκύων	Astrokyon	Aster Cyon	The Dog Star

According to Eratosthenes' *Catasterismoi* (1997; cf. Eratosthenis, 1897), Laelaps is the dog given as a gift by Zeus to Europa. Their son, Minos, King of Crete, gave it later on to Procris because she healed him of some illness. Procris again donated it to her husband Cephalus. After Cephalus accidentally killed Procris, Zeus placed his dog in the homonymous constellation.

Less known versions refer to Sirius in connection with Cerberus, the wild three-headed dog that guarded the gates of the underworld (Hades), or with one of the hunting dogs of Actaeon, a renowned hunter and hero from Thebes, who, had the misfortune of wandering onto Artemis' bathing site. After this dog saw Artemis naked, she turned him into a deer and made his own dogs kill him.

Seirios was variously identified in myth. Some say that it was Maira, a daughter of the Titan Atlas, or that, according to the Roman poet Ovid (43 BC–AD 17), it was Maira, the faithful dog of King Ikarios—represented by Boötes.

Sirius may also have been associated with Orthros (= the morning twilight), hound of Geryon,<sup>2</sup> the giant of the West. The dog-star was probably also associated with the dog-goddess Hecate, daughter of the Titans Perses and Asteria.

It was also considered to represent Orion's hunting dog, pursuing Lepus the Hare or helping Orion fight Taurus the Bull; and is referred to in this way by Aratus, Homer and Hesiod (Theodossiou and Danezis, 1990: 114).

The ancient Greeks refer only to one dog, but by Roman times, Canis Minor appears as Orion's second hound (Allen, 1963: 132). According to Richard H. Allen (1963: 118), in Rome two additional names of Canis Major were

Custos Europae [which] is in allusion to the story of the Bull who, notwithstanding the Dog's watchfulness, carried off that maiden; and Janitor Lethaeus, the Keeper of Hell, [who] makes him a southern Cerberus the watch-dog of the lower heavens, which in early mythology were regarded as the abode of demons.

### 4 SIRIUS IN ANCIENT GREEK AND ROMAN LITERATURE

#### 4.1 The Ancient Greek References

In the Orphic *Argonautica*, in the scene where Zeus mates with Alcmene (Hercules' mother) it states: "... when the Sun was losing his Sirius-like triple luminescence in his course and the black night was spreading from everywhere ..." (Apollonius Rhodius, 1962: verse 121); or: "... just when for three consecutive days lost its light the flamboyant Sun ('Seirios Sun') ..." (Petrides, 2005: 49).

Homer mentions Sirius in the *Iliad* (1924, V: 1-5, XXI: 25-32) and *Odyssey* (1919: v 4) as 'oporinós', the star of autumn, and as Orion's dog:

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. (Homer, 1924, V: 1-5).

The 'autumn star' is actually Sirius, and appears every year, for the geographical latitude of Greece, in the predawn sky in late July or early August. This is mentioned also by Allen, who writes:

Homer alluded to it in the *Iliad* as *Ἰστωρινός*, 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 5<sup>th</sup> 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 ..." (Allen, 1963: 120).

In *Iliad's* rhapsody XXII both Orion and Sirius are mentioned. The brightest star, Sirius, is referred to as Orion's dog. Homer presents Sirius as an ominous sign in the sky, as every summer it is connected with the so-called 'dog burnings':

... 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. (Homer, 1924: Ch. 22, v 25-31ff).

At about the same time, or slightly later, Hesiod (1914), in his famous book *Works and Days*, discusses 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 of these he gives some advice to his brother Perses about grape-gathering:

But when Orion and Sirius are come into mid-heaven, and rosy-fingered Eos [Dawn] sees Arcturus, then cut

off all the grape-clusters, Perses,<sup>3</sup> and bring them home. (Hesiod, 1914: v 609ff).

In the other two passages he speaks about the dog burnings: “For then the star Sirius passes over the heads of men, who are born to misery, only a little while by day and takes greater share of 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* (*The Shield of Hercules*), is to a certain extent an imitation of *Aspis Achilleos* (*The Shield of Achilles*) as it is described in the *Iliad* (Homer, 1924). In this work, too, Hesiod mentions Sirius twice:

Their souls passed beneath the earth and went down into the house of Hades; but their bones, when the skin is rotted about them, crumble away on the dark earth under parching Sirius. (Hesiod, 1914: v 139ff).

And when the dark-winged whirring grasshopper, perched on a green shoot, begins to sing of summer to men—his food and drink is the dainty dew—and all day long from dawn pours forth his voice in the deadliest heat, when Sirius scorches the flesh, then the beard grows upon the millet which men sow in summer. (ibid.: v 391).

The ancient Greek lyric poet Alcaeus (seventh-sixth century BC) states the following about Sirius:

Wet your lungs with wine: the dog star, Seirios, is coming round, the season is harsh, everything is thirsty under the heat, the cicada sings sweetly from the leaves ... the artichoke is in flower; now are women most pestilential, but men are feeble, since Seirios parches their heads and knees. (Alcaeus, 1982, 1993; cf. Alcaeus, 1922; Alcée, 1999).

Theognis (570–480 BC), a significant elegy poet from Megara, wrote several symposium poems, distinguished for their dignity and their respect for the gods. He even gave a rule for wine drinking, adding some information for the period around the rise of Sirius, calling it ‘astrokyon’ in Greek (Table 1): “Witless are those men, and foolish, who don’t drink wine even when the Dog Star is beginning ...” (Wender, 1984: 1039-1040).

The tragic poet Aeschylus (525–456 BC), in his tragedy *Agamemnon* (Aeschylus, 1955: v 966-968), also mentions Sirius, as ‘seirios dog’, while Euripides (480–406 BC) in both his tragedies *Hecuba* (2008) and *Iphigenia at Aulis* (1999; 2003; 2004) mentions it by its name, Seirios proper. Here are the relevant verses in their English translations:

For while the stock is firm the foliage climbs, Spreading a shade, what time the Dog-star (seirios kynos) glows; And thou, returning to thine hearth and home, Art as a genial warmth in winter hours. (Aeschylus, 1955: v 967).

Where Orion and Sirius dart from their eyes a flash as of fire ... (Euripides, 2008: v 1104).

Sirius, still shooting o’er the zenith on his way near the Pleiads’ sevenfold track ... (Euripides, 2004: 1A8).

The poet Lycophron of the Alexandrine ‘Pleias’<sup>4</sup> (third century BC), in his only surviving poem, wrote of Cassandra’s prophecy for the fall of Troy in which he referred to a ‘Seirian ray’, meaning more probably a solar ray (Scheer, 1958: Frag. 397).

The renowned Greek astronomical poem, *Phaenomena*, written by Aratus of Soloi in the Court of An-

tigonos Gonatas, the King of Macedonia (270 BC), refers to Seirios calling it ‘Star of the Dog’, ‘Poikilos’ (most probably meaning ‘changing in color’) and ‘Seirios’:

A star that keenest of all blazes with a searing flame and him men call Seirios. When he rises with Helios (the Sun), no longer do the trees deceive him by the feeble freshness of their leaves. For easily with his keen glance he pierces their ranks, and to some he gives strength but of others he blights the bark utterly. Of him too at his setting are we aware. (Aratus of Soloi, 1921: 326-340).

Aratus also appended an adjective to the name, calling Sirius μέγας (= big, great); according to Allen. With this adjective he wanted only to characterize the brilliancy of the star, and not to distinguish it from the Lesser Dog. The Greeks did not know of the two Dogs at that time, nor did the comparison appear until the latter days of Vitruvius (Allen, 1963: 117). However, Allen does not mention the use of the same adjective (big, great) for Sirius by Eratosthenes.

Eratosthenes (276–194 BC) in his work *Astrothesiai* or *Catasterismoi* (Eratosthenes, 1997a; 2001) writes about the Dog, which he calls both *Isis* and *Seirios*, describing it as “... great and bright.” However, he also uses the word *seirios* as an adjective, writing for example: “Such stars are called ‘seirioi’ by astronomers due to the quivering motions of their light.” (‘Seirioi’ is the plural of ‘seirios’).

Apollonius of Rhodes (third century BC) in his *Argonautica*, a major epic poem that remolds in poetic form the mythical expedition of the Argonauts from Thessaly to Colchis on the Black Sea, also mentions Sirius in connection to the unbearable summer heat:

But when from heaven Sirius scorched the Minoan Isles, and for long there was no respite for the inhabitants ... (Apollonius Rhodius, 1962, Book II: 517).

Also, in another passage:

But soon he appeared to her longing eyes, striding along loftily, like Sirius coming from ocean’s depths, which rises fair and clear to see, but brings unspeakable mischief to flocks ... (Apollonius Rhodius, 1962, Book III: 956-958).

Diodorus Siculus (ca. 80–20 BC), a Greek historian of Agyrium in Sicily, wrote forty books on world history, called *Library of History*, in three parts: mythical history of peoples (both non-Greek and Greek) up to the Trojan War; history up to Alexander’s death (323 BC); and history up to 54 BC. From his writings we have complete Books I-V (Egyptians, Assyrians, Ethiopians, Greeks) and Books XI-XX (Greek history 480-302 BC); and fragments of the rest. He was an uncritical compiler, but used good sources and reproduced them faithfully. He is valuable for details that are not recorded elsewhere, and as evidence for works now lost, especially the writings of Ephorus, Apollodorus, Agatharchides, Philistus and Timaeus. Diodorus Siculus writes in *The Library of History*:

A plague [i.e. a pestilence arising in a time of drought] prevailed throughout Greece ... [and] the sacrifice he offered there was on behalf of all the Greeks. And since the sacrifice was made at the time of the rising of the star Seirios, which is the period when the Etesian winds customarily blow, the pestilential diseases, we are told, came to an end. Now the man who ponders upon this event may reasonably marvel at the strange

turn which fortune took; for the same man [Aristaios] who saw his son [Aktaion] done to death by the dogs likewise put an end to the influence of the star which, of all the stars of heaven, bears the same name [i.e. Seirios, which was known as the dog-star] and is thought to bring destruction upon mankind, and by so doing was responsible for saving the lives of the rest. (Diodorus Siculus, 1939, IV: 81.1).

Satirical author Lucian of Samosata (AD 120–190) mentions Sirius in his fantasy novel *Trips to the Moon* (original title: *A True Story*), where he narrates the imaginary war between earthlings with the dog-faced inhabitants of Sirius, who are called Cynobalani:

Near them were placed the Cynobalani [88b] about five thousand, who were sent by the inhabitants of Sirius; these were men with dog's heads, and mounted upon winged acorns: some of their forces did not arrive in time; amongst whom there were to have been some slingers from the Milky Way, together with the Nephelocentauri; [88c] they indeed came when the first battle was over, and I wish [88d] they had never come at all: the slingers did not appear, which, they say, so enraged Phaëton that he set their city on fire. (Lucian, 2010).

Apart from this work, which probably could be considered as the first science fiction novel, Lucian mentions Sirius in other works, as 'the Dog of Orion': "For this reason the poet, in order to praise the Dog of Orion, called it lion-tamer." (Lucian, 1911: Volume 6).

In *The Almagest*, Ptolemy (1903: Books VII and VIII) called Sirius *Ἀστροκύνων* (*Astrokyon* = Dog star; see Table 1), writing that it was a red star like Antares (Alpha Scorpionis) and Aldebaran (Alpha Tauri). Ptolemy

... and his countrymen knew it by Homer's title, and often as *Ἀστροκύνων*, although it seems singular that the former never used the word *Σείριος*. (Allen 1963: 118).

Ptolemy used *Astrokyon* as the location for the celestial globe's central meridian.

In the same century, Plutarch writes in his work *De Iside et Osiride* that the constellation of the Dog was dedicated to goddess Athena-Isis:

And the ship that Greeks call 'Argo' was built in the form of the ship of Osiris; it was enlisted among the constellations as an honor and it moves not far from the constellations of Orion and of the Dog, from which the former is dedicated by the Egyptians to Horus, while the latter is dedicated to Isis. (Plutarch, 1932: 354c-359f).

According to Allen (1963: 120),

Plutarch called it *Προόπητης*, the Leader, which well agrees with its character and is an almost exact translation of its Euphratean, Persian, Phoenician, and Vedic titles; but *Κύων*, *Κύων σείριος*, *Κύων αστήρ*, *Σείριος αστήρ*, *Σείριον ἄστρον*, or simply *το ἄστρον*, were its names in early Greek astronomy and poetry.

According to the architect and author Nikolaos V. Litsas (2008: 40):

Plutarch in his opus *'De Iside et Osiride'* (354c and 366a) writes that Isis, which he identifies with Athena, is Sirius, the well-known star of the Dog. This is why Parthenon, the temple of Athena in the Acropolis of Athens is oriented in such a way that once per year, on July 2 [modern date], when the Sun passes above Sirius, the rays of the rising Sun penetrate in the sacrosanct of the sanctuary.

Quintus Smyrnaeus was a Greek epic poet who flourished in Smyrna in the late fourth century AD. His only surviving work is a fourteen-book epic entitled the *Fall of Troy* (or *Posthomerica*). This poem covers the period of the Trojan War from the end of Homer's *Iliad* to the final destruction of Troy. Quintus is believed to have drawn heavily from works of the poets of the Epic Cycle, including such now-lost works as the *Aethiopsis* and the *Little Iliad*:

From the ocean's verge upsprings Helios (the Sun) in glory, flashing fire far over earth - fire, when besides his radiant chariot-team races the red star Seirios, scatterer of woefullest diseases over men. (Quintus Smyrnaeus, 1913, 8: 30ff).

In the same period (fourth century AD) we have Anonymous, perhaps Pampreprius of Panopolis, referring to Seirios, as the dog-star (*kynos astraios*):

The snow-white brightness of blazing Phaethon [the Sun] is quenched by the liquid streams of rain clouds, and the fiery ... [lacuna]... of the dog-star [(kynos astraios)] is extinguished by the watery snowstorms. (Anonymous, 1950: No. 140).

Nonnus, a Greek epic poet of the fifth century AD from the Egyptian city of Panopolis, writes in his *Dionysiaka* twice about the dog burnings of Sirius:

He sent an opposite puff of winds to cut off the hot fever of Sirius. (Nonnus, 1940, 5: 275ff).

He [Aristaios] had not yet migrated to the island formerly called Meropis [Kos]: he had not yet brought there the life breathing wind of Zeus the Defender [the Etesian Winds], and checked the fiery vapour of the parched season; he had not stood steel clad to receive the glare of Seirios, and all night long repelled and clamed the star's fiery heat—and even now the winds cool him with light puffs, as he lances his hot parching fire through the air from glowing throat. (ibid. 13: 253 ff).

## 4.2 The Ancient Latin and Byzantine References

According to Allen (1963), the Romans adopted their *Canis* from the Greeks and kept that name forever, sometimes in its even diminutive form *Canicula* (with the adjective *candens*, meaning 'shining'). There are also the names 'Erigonaeus' and 'Icarius' from the fable of the dog 'Maera'—which by itself means 'Shining'. In the fable, the dog's mistress, Erigone, is transformed into Virgo, her master, Icarius, is transformed into Boötes, and Maera becomes Sirius. According to Allen (1963: 118), Ovid alluded to this in his *Icarii stella proterva canis* [*Amor.* II.16.4]; and Statius mentioned the *Icarium astrum*, although Hyginus [*Fab.* 130] had ascribed this to the Lesser Dog.

From the Latin authors and poets, Virgil in his *Georgics*, tragic poet Seneca (2003) in his *Oedipus*, epic poet Valerius Flaccus in his *Argonautica* (1934) and poet Statius in his *Silvae* (2003), all refer to Sirius mostly as the 'star of the dog'.

Virgil (first century BC) writes:

The time when the sultry Dog Star [Canis] splits the fields that gape with thirst ... (Virgil, 1916: *Georgics* 2, 353 ff).

And now Sirius (the Dog Star), fiercely parching the thirsty Indians, was ablaze in heaven, and the fiery Sun had consumed half his course; the grass was withering and the hollow streams, in their parched throats, were

scorched and baked by the rays down to the slime. (ibid. 2: 425 ff).

Virgil also writes in *Aeneid's* Books III and X about Sirius:

Just as when comets glow, blood-red and ominous in the clear night, or when fiery Sirius, bringer of drought and plague to frail mortals, rises and saddens the sky with sinister light. (Virgil, 2002: Book X: v 271-273).

They relinquished sweet life, or dragged their sick limbs around: then Sirius blazed over barren fields: the grass withered, and the sickly harvest denied its fruits (Virgil, 2002: Book III: v 140-142).

Seneca writes in his Roman tragedy *Oedipus* (first century BC):

[Thebes was plagued by drought and] ... No soft breeze with its cool breath relieves our breasts that pant with heat, no gentle Zephyrus blows; but Titan [Helios, the Sun] augments the scorching dog-star's [Seirios'] fires, close-pressing upon the Nemean Lion's [i.e. Leo, zodiac of mid-summer] back. Water has fled the streams, and from the herbage verdure. Dirce<sup>5</sup> is dry, scant flows Ismenus' stream, and with its meagre wave scarce wets the naked sands. (Seneca, 2004: *Oedipus*, 37 ff).

The Roman Valerius Flaccus writes in his epic *Argonautica* (first century BC):

When Sirius in autumn sharpens yet more his fires, and his angry gold gleams in the shining tresses of night, the Arcadian [planet Mercury] and great Jupiter [the planet] grow dim; fain are the fields that he would not blaze so fiercely in heaven, fain too the already heated waters of the streams. (Valerius Flaccus, 1934, 5: 370 ff).

Horace (Quintus Horatius Flaccus) mentions Sirius in his *Satires* (Horace, 1870: V). Finally, Statius in *Silvae* (Roman poetry, first century AD) refers to Sirius:

T'was the season when the vault of heaven bends its most scorching heat upon the earth, and Sirius the Dog-star smitten by Hyperion's [the Sun's] full might pitilessly burns the panting fields. (Statius, 2003: 3, 1, 5).

According to Allen (1963: 118), Sirion and Syrius occasionally appeared with the best Latin authors; and the *Alfonsine Tables* of 1521 had *Canis Syrius*.

Arab astronomers, influenced by Ptolemy and the other Greek astronomers, called Sirius 'Al Shi'rā', which means 'the shining one', because of its extreme brightness (Allen, 1963: 121).

The scholar and Byzantine Princess, Anna Comnena (Komnene), in her large work *Alexias* (1148) mentions the 'star of the Dog':

... 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 ... (Anna Comnena, 1928, 1969: I, Book 3, XII.4).

Finally, the Byzantine scholar, medical doctor and astronomer Georgios Chrysococca (fourteenth century) mentions Sirius as *Siaèr Jamanè* in his astronomical work *Synopsis tabularum persiacarum ex syntaxi Persarum Georgii medici Chrysococcae* (Chrysococca, 1645: 1347). Allen refers to this work as 'Chrysococca's *Tables*'. It was published by Ismael Bullialdus in Paris in 1645.

As a general observation, it can be noted that the ancient Greeks and Romans generally did not distinguish the constellation *Canis Major* from the star Sirius by

name, but often called both simply 'Dog' (Ceragioli, 1996: 121).

## 5 MAIRA

Sirius in the annual period from its heliacal rising to 22 August was also called 'Maira', a word coming from the ancient Greek verb *marmairo*, which means 'to shine' (*Palatine or Greek Anthology*, 1917, 9: 55). As a name, Maira (or Maera) therefore became the star-goddess of the scorching dog-star Seirios, whose rising in conjunction with the Sun brought on the scorching heat of midsummer. Like the Pleiades and Hyades, Maira was a starry daughter of the Titan Atlas. She married a mortal King, the Arcadian Tegeates, the son of King Lycaon and the eponymous founder of the Arcadian town of Tegea. The precise location of her tomb was not known, and both Tegea and Mantinea laid claim to it. Pausanias (1935, VIII: 12, §4; 48, §4; 53, §1) thinks that Maira was the same as the Maira whom Odysseus saw in Hades (Pausanias: "[Odysseus sees the ghosts of heroines in the Underworld:] I saw Maira too." (Homer, 1919: 11, 326 ff).

In his *Description of Greece*, the Greek traveller Pausanias (second century AD) writes about the story of the nymph Maira, and reports all the mythical and historical information associated with her:

There are also tombs [in Tegea, Arcadia] of Tegeates, the son of Lykaon, and of Maira, the wife of Tegeates. They say Maira was a daughter of Atlas, and Homer makes mention of her in the passage where Odysseus tells to Alkinous his journey to Hades, and of those whose ghosts he beheld there. (Pausanias, 1935: 8.48.6).

The ruins of a village called Maira, with the grave of Maira ... For probably the Tegeans, and not the Mantinians, are right when they say that Maira, the daughter of Atlas, was buried in their land. (ibid.: 8.12.7).

Apollon and Artemis, they say, throughout every land visited with punishment all the men of that time who, when Leto was with child and in the course of her wanderings, took no heed of her when she came to their land [Tegea in Arcadia]. So when the divinities came to the land of Tegea, Skephros, they say, the son of Tegeates, came to Apollon and had a private conversation with him. And Leimon [= water-rich meadow], who also was a son of Tegeates, suspecting that the conversation of Skephros contained a charge against him, rushed on his brother and killed him. Immediate punishment for the murder overtook Leimon, for he was shot by Artemis. At the time Tegeates and Maira sacrificed to Apollon and Artemis, but afterwards a severe famine fell on the land, and an oracle of Delphi ordered mourning for Skephros (ibid.: 8.53.2).

### 5.1 Maira/Maera as a Dog in Greek and Roman Mythology

Maera was the faithful hound of Icarus, an Athenian King, and follower of the wine-god Dionysus. Icarus was the father of the maiden Erigone.

This is the whole story, according to the Roman mythographer Hyginus (second century AD): Dionysus had taught Icarus how to make wine. One day, Icarus was travelling on the road in a wagon, when he met some shepherds. Icarus shared his wineskin. The shepherds fell into a drunken stupor and when they woke up they thought Icarus had tried to poison them, so they killed him and buried him under a tree.

Concerned for her father's whereabouts, Erigone set off with Maera to find him, and Maera led the maiden to the grave. The hound howled in its grief, before leaping off the cliff to its death. Erigone was also distraught over her father's death, and hanged herself from the tree above her father's grave.

Taking pity on his followers and the hound, Dionysus placed them in the sky as the constellations Boötes (Icarius), Virgo (Erigone), and Maera as the constellation with the star Sirius. So, Maira was closely identified with the *Kyon Ikarion*, the dog of Icarius, which along with her star formed the constellation Canis Major. Others say the constellation Canis Major or Canis Minor was Maera.

Dionysus did not let the shepherds escape for murdering Icarius. Dionysus caused madness in Athens, where all the maidens hanged themselves. The Athenians found out from the oracle what had caused this phenomenon so they captured the murderers and hanged them. From that time onwards, the Athenians held an annual festival in honour of Icarius and his daughter during the grape harvest, where the girls swung on trees in swings. In a different version, the shepherds found refuge in the land of the Keans (i.e. on the island of Kea).

## 5.2 Maira as the Star Seirios

Callimachus, the Hellenistic poet of the third century BC, writes:

The [Kean] priests of Zeus Aristaios Ikmaios (the Lord of Moisture): priests whose duty is upon the mountaintops to assuage stern Maira [Seirios] when she rises. (Callimachus, 1958: *Aetia Fragment* 3. 1).

The Greeks believed that the constellation Canis Minor and the Dog Star (Sirius) heralded the coming of a drought.

In the words of Hyginus:

Jupiter [Zeus], pitying their misfortune, represented their forms among the stars ... The dog, however, from its own name and likeness, they have called Canicula. It is called Procyon by the Greeks, because it rises before the greater Dog. Others say these were pictured among the stars by Father Liber [Dionysus].

[The constellation] ... Canicula rising with its heat, scorched the land of the Keans, and robbed their fields of produce, and caused the inhabitants, since they had welcomed the killers to be plagued by sickness, and to pay the penalty to Icarus with suffering. Their king, Aristaeus, son of Apollo and Cyrene, and father of Actaeon, asked his father by what means he could free the state from affliction. The god bade them expiate the death of Icarus with many victims, and asked from Jove that when Canicula rises he should send wind for forty days to temper the heat of Canicula. This command Aristaeus carried out, and obtained from Jove [Zeus] the favour that the Etesian winds should blow ... (Pseudo-Hyginus, 1960).

It should be noted that the brightest star in the constellation of Canis Minor, Alpha Canis Minoris, is called Procyon (from the Greek words *pro* = before and *kyon* = dog) because it rises just before Sirius (the Great Dog).

The epic poet Nonnus of Panopolis (previously mentioned in Section 3.1) also calls Sirius 'Maira's star' in his *Dionysiaka* (Nonnus, 1940, Book 5: v. 220-222).

## 6 'DOG BURNINGS' AND 'DOG DAYS'

In antiquity the heliacal rise of Sirius had been 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. The Romans also knew these days as *dies caniculariae*, the hottest days of the whole year, associated with the constellation of the Great Dog. 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 referred to the summer days after the heliacal rise of Sirius as 'dog burnings'. The term has no relation to the Dog-star or the constellation, but rather to dogs in general, thinking that only dogs were crazy enough to go outside when it was so hot. This idea persisted through the centuries and can be found in modern Greek folklore as the belief that during the hot days of July and August, and especially between 24 July and 6 August, dog bites are infectious (Theodossiou and Danezis, 1990: 115).

According to an ancient myth, the inhabitants of the island Kea were dying from a famine caused by a drought brought on by the dog burnings around 1600 BC. Then, the god Apollo made a prophecy that Phthia<sup>6</sup> Aristaeus, the god's son, could be summoned 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 Apollo the Dog.

Both gods listened to his pleas and they sent the Etesian Winds, northern winds that have blown ever since across the Aegean Sea during mid-summer, 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 the one side of their coins, while on the other side they depicted Sirius crowned with rays (Wendel, 1935: 168.8-12). Indeed, ancient coins retrieved from the island and dating to the third century BC feature dogs or stars with emanating rays, highlighting Sirius' importance (Holberg, 2005). From then on, the islanders of Kea used to predict from the first appearance of Sirius (its heliacal rising) whether the following year would be healthy or not: if it rose clear, it would portend good fortune; if it was misty or faint then it foretold (or emanated) pestilence.

According to Allen (1963: 126), even the 'father of Medicine', Hippocrates, writing *circa* 460 BC, stressed in his *Epidemics* and *Aphorisms* the influence of Sirius on the weather and on the physical aspect of humans; the same he believed for Arcturus. Some minor doctors in antiquity were arguing that the 'dog star' played some role in the appearance of cases of rabies (Ideler, 1841).

In ancient poetry Sirius is mentioned as a star with a particularly negative influence, a belief that is evident in the Homeric verse "... the most bright one, yet it bodes no good to us poor mortals." (Homer, 1924: XXII: 25-31).

Socrates appears to swear to Apollo, the Dog, in his *Apology* (and not to curse, as some have argued): "...

and, by the Dog, oh men of Athens – for I must tell you the truth.” (Plato, 2002: 22a-22b). Similarly, Plato (*Platonis opera*, 1900-1907) in *Gorgias* swears to the god Kyna (Dog) that what he writes is true: “By the Dog, Gorgias, a lengthy conversation is needed about how these things are, so that we can analyze them in extent.” [461b].

It should be noted that Kynas (Sirius) is one of the numerous appellations of Apollo, the god of solar and spiritual light, and of music.

Professor Pericles Theochaes (1995) writes about the Kea island myth:

This myth alludes to the relation of Sirius with the Earth. The sacrifices were made to Zeus Meilichius,<sup>7</sup> 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.

Also, for Manilius (1977: 5.208) the Dog-star is, in effect, a fiery mad dog that “... raves with its own fire.”

On the influence of Sirius on ‘dog burnings’ Geminus (1898: 17.26) writes in *Isagoge*:

For everyone assumes that the star has a peculiar power and is the cause of the intensification of summertime heat, when it rises with the sun.

## 7 THE RED COLOR OF SIRIUS

It is an interesting fact that the star’s color is mentioned by most ancient authors as red, while today, we know it is a star of spectral type A1 V, and is white.

In essence, there is a series of ancient references about Sirius from different civilizations that describe it as a red star (Allen 1963: 128). In the fourth century AD epic poet Quintus Smyrnaeus (1913: 8. 30ff) mentions the ‘red star’ Sirius in the *Fall of Troy*.

From the Roman literary figures, Horace (1870) refers to Sirius as a red star (*rubra*), while Seneca (2004) writes (ca. AD 35) that: “... when the air is clear, then Sirius appears more red than planet Mars.” (Whittet, 1999: 335).

In 1927, T.J.J. See reported on references to the color of Sirius from the second century AD to the tenth century AD:

Many classical literature artists – Cicero, Horatius and Seneca to name a few – mention Sirius as a red star. Ptolemy goes even further in his description and claims that Sirius is fire-red in color. On the other hand, the Arabian Astronomer Abd-al Rahman Al-Sufi contradicts them and classifies Sirius as a white star in his catalogue dating around 925 BC, 850 years after Ptolemy. Also in *Carmina Burana*, based on the pastoral songs of the 13<sup>th</sup> century, the whiteness of Sirius is compared to that of ivory. Geoffrey Chaucer, in 1391, relates that the Arabians call Sirius Al-Habur, the beautiful white star. Chinese Astronomer and Historian Sima-quian (91 BC), Roman artists Hyginus, Manilius and Avienus, (360 BC), and Archbishop Saint Isidore of Seville all support the opinion that Sirius is a white star.

According to Holberg (2007: 157),

One of the most contentious and long-running mysteries regarding Sirius originated in the 2<sup>nd</sup> century AD with

what appears to be a casual comment made by the Alexandrine astronomer/astrologer Claudius Ptolemy (Chapter 3). Books VII and VIII of Ptolemy’s *Almagest* contain one of the earliest and most famous of the ancient star catalogues, in which Ptolemy lists the positions and brightness of some 1022 stars. He comments on the color of only six of these stars – Betelgeuse, Aldebaran, Pollux, Arcturus, Antares, and Sirius – and assigns the color red to each. In particular, for Sirius in the constellation Canis Major, he states its location, on the dog’s mouth, as well as its relative brightness and color: bright and red.

Besides the references already mentioned, Horace (first century BC), Seneca (first century AD) and Aratus (third century BC) also described Sirius as being red in color. Various early translations of their works, including those by Cicero and Germanicus, drew no concern from anyone about Sirius’ redness. In fact, it was not until 1760 (after a translation by Samuel Johnson) that anyone voiced skepticism about the observations.

There is a quote from Hephaestion of Thebes (Cragioli, 1996) describing how the star’s color upon rising was inspected as an omen. Curiously, he mentions that the star is ‘white’ (*lefkòs*). This agrees with Hyginus’ description of Sirius as being remarkable for its ‘candor’, which is usually—from the context—interpreted as ‘brightness’, but almost certainly implies a white color. Add to these Manilius and Avienus, who explicitly describe the star Sirius as blue or perhaps blue-white.

Since we can see that there was an awareness and assumed meaning in the color of Sirius, perhaps Ptolemy’s (1903) characterization of the star as ‘hypokirros’ is a guess at the star’s ‘actual’ color, since we do not know if he shared an assumption with Seneca that celestial bodies have no inherent color. There is very little context to make a guess, although several astronomers (most notably See) took up the task and piled up dubious citations leading ultimately to the conclusion that the ancients saw Sirius as a ‘fiery red’ star all the time. So probably the correct question to ask here is not really ‘Was Sirius red in antiquity?’, but rather ‘Did Sirius sometimes appear to be red, or was it sometimes described as red (or other colors) in antiquity, and if so what did this mean?’.

The certain thing is that the impression Sirius currently gives to a visual observer is of a ‘cold white’ star (i.e. with a lightly bluish tint) when it is high enough above the horizon, an impression which agrees with its modern spectral classification as an A1 star.

Another explanation involves the modern finding that Sirius is part of a binary star system. The fainter star of the pair (the companion), Sirius B, is a white dwarf. This means that it started with the larger mass of the two stars of the system, as it evolved faster and became a stellar remnant after it first passed from the evolutionary stage of the red giant. In that stage the fiery red light of Sirius B would dominate over the cold white light of Sirius A, thus causing all the ancient color descriptions mentioned in the previous paragraphs. Of course, the main weakness of this explanation scheme is that the time needed for a star to pass from the stage of a bright red giant to that of a clear white dwarf is, according to theoretical astrophysics, much longer than a few thousand years, so this can not be the reason for the ancient ‘red color’ of Sirius.

A more plausible explanation is that perhaps some interstellar cloud in the space between the Solar System and Sirius was absorbing the shorter wavelengths of the Sirian light, thus causing its ancient red appearance. This is not so probable, though, due to the relatively small distance of Sirius, only 2.64 parsecs. A much more feasible explanation is that the ancient tradition was created by the color of Sirius when it was very low in the sky, near the horizon. In this position Sirius—like other stars—appeared to twinkle, to move rapidly around a mean position and to change its color in tenths of a second, exhibiting a variety of very intense nuances more intense than its true color. All three phenomena are caused by the Earth's atmosphere. Moreover, Sirius is only a few times fainter than Venus in the terrestrial sky, and it is known that Rayleigh scattering of Venus' light—which is a function of the light's wavelength—reddens it considerably when the planet is near the horizon (the phenomenon of course is much better known and is more impressive in the case of the Sun and the Moon). Now Sirius, as we saw earlier, was intensely observed by the ancient Greeks when it first appeared in its heliacal rising, that is, when it was just above the eastern horizon during the last hour of the night. So, unlike today, the most frequently-observed image of Sirius in antiquity was when it was very close to the horizon. Hence, this explanation is by far the most probable.

## 8 CONCLUSIONS

In this paper we have only studied ancient Greek, Roman and Byzantine references to Sirius.

The name *seirios*, which means sparking, fiery or burning, flamboyant, scorching star or scorcher, turned out to be very ancient in the form of an adjective, as it occurred in the Orphic *Argonautics*, even though it did not relate to a specific star. Homer, also, did not use *seirios* for the star, preferring to call it the 'autumnal star' and 'Orion's Dog'. Hesiod, writing at about the same time (circa 800 BC) in two different works, calls this particular bright star *Seirios*, which is a most important turning point in the star's lore. Additional references to Sirius and its various names were in the works of Aratus and Eratosthenes.

After the two great epic poets (Homer and Hesiod), the Greek lyrical poet Alcaeus (seventh to sixth centuries BC) also mentioned the star as *Seirios* and the 'Dog's star'. Theognis of Megara (570–480 BC) refers to it in a single-word form (*Astrokyon*).

Next came the tragic poets Aeschylus and Euripides; the former with his 'seirios dog', while the latter used just *Seirios* as a proper name.

Lykophron of Alexandria (third century BC), a well-known poet of that period, wrote of a 'seirian ray' (most probably meaning sunray). Eratosthenes (third century BC) in his famous *Catasterismoi*, calls the star both *Isis* and *Seirios*, still using, however, the word *seirios* as an adjective; the use of the word as a name for the specific star had nevertheless been widespread by then, as is evident by the *Argonautics* of Apollonius of Rhodes during the same years (two different passages), and by Diodorus Siculus in *The Library of History*.

Passing to the AD years, Lucian of Samosata mentioned Sirius by that name in his *True Story* or *Trips to*

*the Moon*. The leading astronomer of the time, Ptolemy, followed the older tradition by calling the star *Astrokyon*. Plutarch called it *Προόπητις*, the Leader; but *Κύων*, *Κύων σείριος*, *Κύων αστήρ*, *Σείριος αστήρ*, *Σείριον άστρον*, or simply *το άστρον* ('the star') were its names in early Greek astronomy and poetry.

Also considered were works from the fourth century AD, of epic poet Quintus Smyrnaeus and Pamprepicus of Panopolis. One century later, epic poet Nonnus of Panopolis, in his main work *Dionysiaka*, wrote twice about Sirius and the 'dog burnings'.

The Latin authors and poets who mentioned the star are Virgil in his *Georgics* and the *Aeneid* (Books III and X), Seneca in his *Oedipus*, and Valerius Flaccus in his *Argonautica*, and the poet Statius in his *Silvae* (3.1.5).

According to Allen (1963: 118): "*Sirion* and *Syrius* occasionally appeared with the best Latin authors; and the *Alfonsine Tables* of 1521 had *Canis Syrius*."

In the mid-twelfth century, Byzantine Princess Anna Comnena (Komnene) in her opus *The Alexiad* (1148) also mentioned Sirius as the 'Dog's star'. Finally, the Byzantine scholar, medical doctor and astronomer Georgios Chrysococca, two centuries later, in his astronomical work *Synopsis tabularum ...*, mentioned Sirius as *Siaër Jamanè*.

An important additional element is that Sirius from its heliacal rising up to 22 August bore the special appellation Maira, both a Greek word stemming from the verb *marmairo*, which means 'to shine', and the name of a dog from Greco-Roman mythology. The name Maira appears for Sirius in poems by Callimachus in the third century BC and Nonnus (as 'Maira's star') eight centuries(!) later.

Mythology associated with the star and its constellation is also plentiful, a fact that indicates their significance. Thus, according to Eratosthenes, Sirius is Laelaps, the faithful dog of Orion the Hunter. Another legend puts in its place Cerberus, the horrid three-headed dog that guarded the World of the Dead, or with one of the hunting dogs of Actaeon, a renowned hunter and hero from Thebes.

The myths about Sirius also involve Orthrus (the dog of Geryon the giant), Maira (the faithful dog of Icarus, placed in the sky by the god Dionysus according to Ovid and Hyginus), and Hecate, the goddess protecting dogs, who was the daughter of the Titans Perses and Asteria.

A Roman myth refers to Canis Major as Custos Europae, the dog guarding Europa; and as Janitor Lethaeus, the watch-dog of the 'lower heavens', i.e. the Keeper of Hell.

The significance of the brightest star in the sky which emerges from all of these references is evident. As for the traditional ancient characterization of Sirius as 'red', this most likely arose from the custom of watching the star on the nights of its heliacal rising, when it was very low in the sky.

## 10 NOTES

1. All translations into English in this paper were made by the authors.
2. Geryon, son of Chrysaor and Callirrhoe and grand-



- son of Medusa, was a giant on the island of Erytheia (Hesiod, 1914: 979 ff) in the far west of the Mediterranean. According to Hesiod (1914: 287 ff), Geryon had one body and three heads, whereas the tradition followed by Aeschylus (1955: 869 ff) gave him three bodies. He owned a herd of magnificent red cattle, guarded by a two-headed hound named Orthrus, which was the brother of Cerberus. In the *Bibliothèque* of Pseudo-Apollodorus (1913: 2. 5. 10) the tenth labour of Heracles was to obtain the Cattle of Geryon.
3. Perses was the brother of Hesiod. He is mentioned several times in the *Works and Days*.
  4. Pleias is a 'group of seven stars' and refers to the seven tragic poets who wrote at Alexandria under Ptolemy Philadelphus in the third century BC: Alexander Aetolus, Philiscus, Sosithus, Homerus, Aeantides, Sosiphanes and Lycophron.
  5. In Greek Mythology, Dirce was the wife of the Theban King, Lycus. She was devoted to the god Dionysus, who caused a spring to flow where she died, near Thebes (Tripp, 1970: ctp. 213).
  6. Phthia (Greek: Φθία or Φθῆ; transliterations: Fthii (modern), Phthīē (ancient)) in ancient Greece was the southernmost region of ancient Thessaly, on both sides of the Othrys Mountain. It was the homeland of the Myrmidones tribe, who took part in the Trojan War under Achilles (Hornblower, 2004).
  7. Meilichius is the surname of Zeus, the protector of those who honored him with propitiatory sacrifices.

## 11 ACKNOWLEDGEMENTS

This study forms part of the research at the University of Athens, Department of Astrophysics, Astronomy and Mechanics, and we are grateful to the University for financial support through the Special Account for Research Grants. This research is also supported by the Ministry of Science and Technological Development of Serbia through the project 146022 "History and Epistemology of Science".

## 12 REFERENCES

- Aeschylus, 1955. *Agamemnon*. Edited by G. Murray. *Aeschyli Tragoediae, Second Edition*. Oxford, Clarendon Press (reprinted 1960).
- Alcée, 1999. *Fragments* (Collection des Universités de France publiée sous le patronage de l'Association Guillaume Budé). Edited and translated by G. Liberman. Paris, Les Belles Lettres [in French].
- Alcaeus, 1922. *Lyra Graeca, Volume I*. Translated by J.M. Edmonds. The Loeb Classical Library, Harvard University Press. London, Heinemann.
- Alcaeus, 1982. *Greek Lyric I. Fragment 347*. Translated D.A. Campbell. The Loeb Classical Library No. 142, Harvard University Press. London, Heinemann.
- Allen, R.H., 1963. *Star Names - Their Lore and Meaning*. London, Constable & Co. (Dover edition).
- Anna Comnena (Komnene), 1928. *The Alexiad*. Edited and translated by E.A. Dawes. London, Routledge, Kegan, Paul.
- Anna Comnena (Komnene), 1969. *The Alexiad*. Edited and translated by E.R.A. Sewter. Harmondsworth. Penguin Books.
- Anonymous, 1950. *Two Poems - Fragments. Volume 3, Select Papyri III, Greek Poetry 4<sup>th</sup> Century AD. Literary Papyri, Poetry (LCL 1950)*. Text, translation and notes by D.L. Page. The Loeb Classical Library, No. 140. London, Heinemann.
- Apollonius Rhodius, 1962. *Argonautica*. Translated by R.C. Seaton. The Loeb Classical Library, Harvard University Press. London, Heinemann.
- Aratus of Soloi, 1921. *The Fall of Troy*. In *Callimachus: Hymns and Epigrams, Lycophron: Alexandra, Aratus of Soloi: Phaenomena*. Translated by A.W. Mair. The Loeb Classical Library No. 129. London, Heinemann.
- Bayer, Johann, 1603. *Uranometria*. Augsburg, Christoph Mang (Linda Hall Library of Science, Engineering & Technology e-edition, 2005).
- Benest, D., and Duvent, J.-L., 1995. Is Sirius a triple star? *Astronomy & Astrophysics*, 299, 621-628.
- Callimachus, 1958. *Aetia, Iambi, Hecale, and Other Fragments, Fragment 3.1, from Oxyrhynchus Papyri 7*. Translated by C.A. Trypanis. The Loeb Classical Library. London, Heinemann.
- Campbell, D.A., 1991. *Greek Lyric Poetry*. London, Bristol Classical Press.
- Ceragioli, R.C., 1996. Solving the puzzle of 'red' Sirius. *Journal for the History of Astronomy*, 27, 93-128.
- Chrysococca, G., 1645. *Synopsis Tabularum Persiacarum ex Syntaxi Persarum Georgii Medici Chrysococcae*. Edited by Ismael Bullialdus. Paris, Astronomia Philolaica [in Latin].
- Demetrakos, D.B., 1964. *Mega Lexicon of the Whole Greek Language*. Edited by Tegopoulos, X., and Asimakopoulos, B. Athens, Dome [in Greek].
- Diodorus Siculus, 1939. *The Library of History*. Translated by C.H. Oldfather. The Loeb Classical Library. London, Heinemann.
- Eratosthenes, 1878. *Catasterismorum Reliquiae*. Edited by Karl Robert. Berlin, Weidmann [in Latin].
- Eratosthenes, 1997. *Catasterismoi*. Translated by Theony Contos. In *Star Myths of the Greeks and Romans: A Sourcebook*. Grand Rapids, Phanes Press.
- Eratosthenes, 2001. *Le Ciel: Mythes et Histoire des Constellations; les Catastérismes d'Eratosthènes*. Text Traduit, Présenté et Commenté par Pascal Charvet et Arnaud Zucker. Paris, NIL éditions [in French].
- Eratosthenis, 1897. *Pseudo-Eratosthenis Catasterismoi = Mythografi Graeci Vol. 3, fasc. 1*. Edited by A. Olivieri. Leipzig, Teubner [in Greek].
- Euripides, 1999. *Iphigenia at Aulis - Iphigenia at Tauris*. Translation and supervision by D. Goudis. Athens, Papatimas Publications [in Greek].
- Euripides, 2003. *Bacche, Iphigenia at Aulis, Rhesus*. Edited and translated by D. Kovacs. The Loeb Classical Library No. 495. London, Heinemann.
- Euripides, 2004. *Iphigenia at Aulis*. Translated by E.P. Coleridge. eBooks@Adelaide.
- Euripides, 2008. *Hecuba*. Series: *Ancient Greek Dramatic Poetry*. Thessaloniki, Zetos Publications [in Greek].
- Geminus, 1898. *Isagoge*. In C. Manitius (ed.). *Gemini Elementa Astronomiae*. Leipzig, B.G. Teubner [in Latin].
- Hesiod, 1914. *The Homeric Hymns and Homeric (Theogony)*. Translated by H.G. Evelyn-White. The Loeb Classical Library. London, Heinemann (reprinted 1954).
- Hesiod and Apollonius of Rhodes, 2005. *Theogony, Works and Days, Shield of Hercules, Argonautica*. Thessaloniki, Zetos Publications [in Greek].
- Holberg, J.B., 2005. How degenerate stars came to be known as white dwarfs. *Bulletin of the American Astronomical Society*, 37, 1503.
- Holberg, J.B., 2007. *Sirius - Brightest Diamond in the Night Sky*. New York, Springer Praxis.
- Homer, 1919. *The Odyssey*. Translated by A.T. Murray; revised by G.E. Dimock. The Loeb Classical Library. London, Heinemann (reprinted 1995).
- Homer, 1924. *The Iliad*. Translated by A.T. Murray. The Loeb Classical Library. London, Heinemann (reprinted 1954).
- Homer, 1950. *The Iliad*. Translated by E.V. Rieu. London,

- Penguin Classics.
- Homer, 1998. *The Odyssey*. Translated by W. Shewring. Oxford, Oxford University Press.
- Horace, 1870. *The Satires, Epistles and Art of Poetry of Horace*. Translated by J. Conington. London, Bell and Daldy.
- Hornblower, Simon, 2004. *Thucydides and Pindar: Historical Narrative and the World of Epinikian Poetry*. Oxford, Oxford University Press.
- Hyginus, 1993. *Fabulae. Editio Altera*. Edited by P.K. Marshall. Munich, K.G. Saur (corrected edition 2002) [in Latin].
- Ideler, L. (ed.), 1841. *Physici e Medici Graeci Minores*. Berlin, Reimer (Amsterdam, reprint 1963) [in Latin].
- Litsas, N.B. (ed.), 2008. The alchemists from the Pre-Socratic philosophers to Plato. *Archeology and Arts*, 106, (March), 38-51 [in Greek].
- Lucian, 1911. *The Complete Works*. Translated by Ioannis Kondylakis. Athens, Fexis [in Greek].
- Lucian, 2010. *Trips to the Moon*. Edited by H. Morley; translated by Th. Francklin. On-line version at: <http://pospappendix.blogspot.com/2010/06/lucians-trips-to-moon.html>
- Manilius, 1977. *Astronomica*. Edited and translated by G.P. Goold. The Loeb Classical Library No. 469. Cambridge (Mass.), Harvard University Press.
- Nonnus, 1940. *Dionysiaca. Volume I, Books 1-15*. Translated by W.H.D. Rouse. The Loeb Classical Library No. 344. London, Heinemann.
- Palatine or Greek Anthology. Volume III, Book 9* (1917). Translated by W.R. Paton. The Loeb Classical Library No. 84, Harvard University Press. London, Heinemann.
- Pausanias, 1935. *Description of Greece. Volume IV: Arcadia, Boeotia, Phocis and Ozolian Locri, Books 8.22-10*. Translated by W.H.S. Jones. The Loeb Classical Library No. 297. London, Heinemann.
- Petrides, S., 2005. *Orpheus' Argonautica – A Dissertation on Seafaring of the Late Pleistocene*. Athens, published by the author.
- Plato, 2002. *The Apology of Socrates. Introduction*. Translation and comments by N.E. Tzirakis. Athens, Patakis Publications [in Greek].
- Platonis Opera. I-V* (1900-1907). Edited by J. Burnet. Oxford, Clarendon Press (republished 1967-1968).
- Plutarch, 1932. *Moralia Vol. 2, Fasc. 3: De Iside et Osiride*. Edited by W. Sieveking. Leipzig, B.G. Teubner [in Latin].
- Pseudo-Apollodorus, 1913. *Bibliothèque (Library)*. Edited by J.G. Frazer. The Loeb Classical Library No. 121. Harvard University Press. London, Heinemann.
- Pseudo-Hyginus, 1960. *Astronomica 2. 4*. In *The Myths of Hyginus*. Edited and translated by Mary Grant. Lawrence, University of Kansas Press (University of Kansas Publications in Humanistic Studies, No. 34).
- Ptolemy, 1903. *Claudi Ptolemaei Opera quae Extant Omnia. Syntaxis Mathematica*. Leipzig, J.L. Heiberg [in Latin].
- Quintus Smyrnaeus, 1913. *The Fall of Troy*. Translated by A.S. Way. The Loeb Classical Library Volume 19. London, Heinemann.
- Scheer, E. (ed.), 1958. *Lycophronis Alexandra. Vol 2 Scholia Continens*. Berlin, Weidmann [in Latin].
- See, T.J.J., 1927. Historical researches indicating a change in the color of Sirius between the epochs of Ptolemy, 138, and of Al Sîfi, 980, A.D. *Astronomische Nachrichten*, 229, 245-272.
- Seneca, 2004. *Tragedies II: Oedipus, Agamemnon, Thyestes, Hercules on Oeta, Octavia*. Edited and translated by J.G. Fitch. The Loeb Classical Library. London, Cambridge University Press.
- Statius, 2003. *Silvae*. English and Latin edition, translated by D.R. Shackleton Bailey. The Loeb Classical Library No. 206. Harvard University Press. London, Heinemann.
- Theocharas, P., 1995. *The Pyramids of Argolis and their Dating*. 11<sup>th</sup> Panhellenic Conference, May 12-13. Nafplio, Foundation of the Peloponnesian Studies [in Greek].
- Theodossiou, E., and Danezis, E., 1990. *The Stars and Their Myths – Introduction to Uranography*. Athens, Diavlos Publications [in Greek].
- Theognis, 1997. *Lyrical Poems III*. Athens, Epikairoitita Publications [in Greek].
- Tripp, Edward, 1970. *Crowell's Handbook of Classical Mythology*. New York, Thomas Crowell Press.
- Valerius Flaccus, 1934. *Argonautica*. Translated by J.H. Mozley. The Loeb Classical Library No. 286. Harvard University Press. London, Heinemann.
- Virgil, 1916. *Eclogues, Georgics, Aeneid, I-VI*. Edited and translated by H.R. Fairclough; revised by G.P. Goold. The Loeb Classical Library No. 63. Harvard University Press. London, Heinemann.
- Virgil, 2002. *Aeneid. Book III & X*. Translated by A.S. Kline. Online: <http://www.poetryintranslation.com/index.html>
- Wendel, C. (ed.), 1935. *Scholia in Apollonium Rhodium Vetera*. Berlin, Weidmann [in Latin].
- Wender, D., 1984. *Hesiod and Theognis*. New York, Penguin Books.
- Whittet, D.C.B., 1999. A physical interpretation of the 'red Sirius' anomaly. *Monthly Notices of the Royal Astronomical Society*, 310, 335-359.

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.

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.

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.