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PLOVIDBA PO GEOGRAFSKOJ ŠIRINI NA MEDITERANU

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"Kormilar, kada plovi preko širokog mora, sjedi visoko iznad kormila i vodi brod pomoću njegove drške, ali su mu oči i um napeti izravno prema nebu, gledajući stvari visoke, jer njegov kurs prolazi preko neba iznad, dok on plovi po moru ispod." (Numenije apud Eus. PE XI.18)

Interpretira se poznati grčki mit o Alfeju i Aretuzi. Smatra se da je taj mit nastao kao opis plovidbe po geografskoj širini između Peloponeza i Sicilije. Raspravlja se o zvijezdama koje su na tom putu mogle poslužiti kao pomoć u navigaciji. Objašnjava se antička praksa određivanja geografske širine mjesta pomoću promatranja visine donje kulminacije zadnje cirkumpolarne zvijezde. Donose se i neki prijedlozi za pomorske putove koji su se mogli prelaziti koristeći tehniku plovidbe po geografskoj širini. Raspravlja se i o zvijezdama koje su mogle poslužiti kao navigacijsko pomagalo na takvim putovanjima.

Ključne riječi: zvijezde, navigacija, geografska širina, Alfej, Aretuza, Kreta, Sicilija

"A pilot when driven along in mid-ocean, sits high above the helm, and steers the ship by the tillers, but his eyes and mind are strained directly at the sky, looking at things aloft, as his course passes across the heaven above, while he sails upon the sea below". (Numenius apud Eus. PE XI.18)

An interpretation of the well-known Greek myth of Alpheus and Arethusa is provided. It is believed that this myth emerged as a description of latitude sailing between the Peloponnese and Sicily. There is a discussion of the stars on this route which could have served to assist navigation. There is an explanation of the ancient practice of determining latitude by observing the altitude of the lower culmination of the last circumpolar star. Some suggested maritime routes are also provided which could have been traversed using the latitude sailing technique. There is a also a discussion of the stars that could have been used as navigation aids on such voyages.

Key words: stars, navigation, latitude, Alpheus/Alfeios, Arethusa, Crete, Sicily

U antici je postojalo zanimljivo mišljenje vezano uz peloponešku rijeku Alfej i izvor Aretuzu na Ortigiji, malenom otočiću ispred obale Sicilije koji je već u antičko doba bio sastavni dio grada Sirakuze. Ovi-

In Antiquity, there was an interesting view associated with the Alfeios River in the Peloponnese and

dije u *Metamorfozama* opisuje mit o nimfi Aretuzi i riječnome bogu Alfeju (Ov. Met. V.572–641; također V.487–508). Nimfa se, umorna od lova, jednom prigodom odlučila okupati u rijeci. Spazivši lijepu nimfu, riječni bog Alfej poželi je obljubiti. Čedna Aretuza bježala je od njega po cijelome Peloponezu, no zaljubljeni Alfej nije ju prestajao progoniti. Na kraju je, izmorena, zatražila pomoć Artemide. Boginja ju je zaklonila oblakom, ali je Alfej, iznenađen njezinim naglim nestankom, nastavio svoju potragu. Tada se nimfa pretvorila u vodu; spazivši tu promjenu i riječni se bog pretvorio u svoj vodeni oblik. Nakon toga, kako kaže sama Aretuza, "Delija [Artemida] probije zemlju, te padnuvši u spilje tamne dođoh k Ortigiji…"[1] Također: "Meni se zemlja otvara i put mi daje te prošavši najdonje spilje ovdje podižem glavu i druge motrim zvijezde."[2]

Sličnu priču donosi i Pauzanija. On piše da je Alfej bio lovac zaljubljen u Aretuzu, koja je također voljela lov. Ne želeći se udati za njega, pobjegla je s Peloponeza na Ortigiju i tamo se pretvorila u izvor. Alfej se također pretvorio u rijeku. I to vrlo neobičnu rijeku – Alfej naime prolazi ispod mora i miješa svoje vode s Aretuzom: "Ja ne mogu a da ne vjerujem u to da je on išao kroz more i da je tamo sjedinio svoju vodu s izvorom..."[3] Pauzanija potkrepljuje ovu priču činjenicom da je Delfsko proročište poslalo Arhiju Korinćanina da osnuje Sirakuzu sljedećim riječima: "Neki Ortigija otok na sinjoj je pučini morskoj, naspram Trinakriji onoj gdje ušće Alfeja vrije, mješajuć sebe s vrelom ljepoteke Aretuze."[4] O Alfeju na drugome mjestu još piše: "Ni Jadran ga nije mogao spriječiti da ide naprijed. Prolazeći kroz to veliko i olujno more pojavljuje se u Ortigiji pred Sirakuzom kao rijeka Alfej i onda spaja svoju vodu s Aretuzom."[5]

Legendu spominje i Vergilije. On opisuje priču o Alfeju, elejskoj rijeci, za kojeg "kazuju, pod morem da je ovuda... potajno teći okrenuo, te sad se lije, o Aretuza, iz ušća tvog u Sikulsko more".[6] Da Alfej prolazi ispod mora od Elide do Ortigije spominju i Plinije (H. N. XXXI.30 i II.106), Lukan (Luc. III.176–177), Valerije Flak (Val. Fl. Argon. VIII.91) i Seneka (Sen. Q. N. III.26.5–6 i VI.8.2). To se uvjerenje održalo sve do 10. st., kad bizantsko enciklopedijsko djelo *Leksikon Suda* opisuje Jadran kao "…sicilijansko more ispod kojeg arkadska rijeka Alfej roni te se miješa u vrlo čistom obliku s sicilskim izvorom Aretuzom"

the Spring of Arethusa on Ortygia, a small island just off the coast of Sicily, which was already a component of the city of Syracuse in the ancient times. Ovid, in his *Metamorphoses*, described the myth of the nymph Arethusa and the river god Alpheus (Ov. Met. V.572–641; also V.487–508). The nymph, tired after hunting, at one point decided to bathe in a river. Spying the beautiful nymph, the river god Alpheus was overwhelmed with the desire to seize her. The chaste Arethusa fled from him throughout the Peloponnese, but the enamoured Alpheus would not stop pursuing her. Ultimately, exhausted, she sought the help of Artemis. The goddess veiled her with a cloud, but Alpheus, startled by her sudden disappearance, continued his pursuit. Then the nymph turned into water; seeing this transformation, the river god also assumed his liquid form. Thereafter, as Arethusa herself recounts, "Diana [Artemis], therefore, opened up the ground, in which I plunged, and thence through gloomy caves was carried to Ortygia …"[1] Also: "Through the porous earth by deepest caverns, I uplift my head and see unwonted stars".[2]

Pausanias recounted a similar story. He wrote that Alpheus was a hunter in love with Arethusa, who also enjoyed the chase. Not wanting to marry him, she fled from the Peloponnese to Ortygia and there turned into a spring. Alpheus transformed himself into a river, but a very unusual river indeed, for he flowed under the sea and intermingled his waters with Arethusa: "But that the Alpheius passes through the sea and mingles his waters with the spring at this place I cannot disbelieve...".[3] Pausanias backs this story with the fact that the Delphic oracle sent Archias of Corinth to found Syracuse with the following words: "An isle, Ortygia, lies on the misty ocean over against Trinacria, where the mouth of Alpheius bubbles mingling with the springs of broad Arethusa".[4] At another place, he wrote more about the Alfeios: "Not even the Adriatic could check its flowing onwards, but passing through it, so large and stormy a sea, it shows in Ortygia, before Syracuse, that it is the Alpheius, and unites its water with Arethusa".[5]

This legend is also mentioned by Virgil. He describes the story of Alfeios, the Elean river, which "...from Elis flowed by secret sluice, they say, beneath the sea, and mingles at thy mouth, fair Arethusa! with Sicilian waves".[6] That the Alfeios flows under the sea

[1] Ov. Met. V.639–640.
[2] Ov. Met. V.501–503.
[3] Paus. V.7.
[4] Paus. V.7.
[5] Paus. VIII.54.
[6] Verg. Aen. III.692-696. Također Verg. Ecl. X.4–5.

[1] Ov. Met. V.639–640.
[2] Ov. Met. V.501–503.
[3] Paus. V.7.
[4] Paus. V.7.
[5] Paus. VIII.54.
[6] Verg. Aen. III.692-696; also Verg. Ecl. X.4–5.

(s. v. *Adrias*). Na zapadu to se uvjerenje održalo još duže, sve do 12. st., kad Bernard Silvestris piše kako "Sicilija, čija je sudbina da pati pod okrutnim tiranima, gleda rijeku Alfej i tok Aretuze" (*Cosmographia*, I.3). Još u 15. st. piše Lodovico Ariosto o "…Siciliji, gdje potok Alfej za nimfom Aretuzom pođe, kad pretvorena u vrelo svoj protok kroz morske tmine pronađe i ode, a on je stiže, da s njom smiješa vode."[7] U novijem razdoblju Percy Bysshe Shelley u Pisi je 1820. godine u pjesmi *Arethusa* vrlo živo opisao samu potjeru, dok je prikaz nimfe na sirakuškome novcu (vidi dolje) možda nadahnuo idealizirani prikaz *La République* (*Marianne*) na prvim francuskim poštanskim markama iz 1849. godine (Seltman 1955: 104). U *Leksikonu Suda* Alfej se još opisuje kao peloponeška rijeka "koja prolazi preko Jadranskog mora ne miješajući se ni na koji način s njim, te izvire na Siciliji kod vrela Aretuze" (s. v. *Alpheios, Arethousa*). Sličan motiv nemiješanja Alfeja s morskom vodom iznosi i Non: "Sicilska Aretuza, gdje Alfej nakon svojih lutanja dolazi ponosan na svoj pisanski vijenac – on prelazi bezdan kao da ide cestom, i donosi svoju vodu, roba ljubavi, suhu, preko površine mora, jer nosi goruću vatru vruću kroz hladnu vodu" (Nonn. D. XIII.323–327); te na drugome mjestu: "Zemlja nimfe voljene od nesretnog Alfeja, koji donosi Aretuzi kao zalog ljubavi svoju ukrašenu vodu neokaljanu morem" (Nonn. D. XXXVII.171–173). Isti motiv nalazimo i kod Lukijana. U dijalogu između Posejdona i Alfeja saznajemo da se Alfej nakon ulijevanja u more "jedini ne pomiješa sa slanom vodom poput svih drugih rijeka. Ne zaustavlja se i ne razlijeva, već cjelovit srlja kroz valove i zadržava slatku tekućinu, stalno nepomiješan i čist: zaroni nekamo u dubinu, poput galebova i čaplji! I čini se da negdje opet izranja i iznova izlazi na vidjelo".[8] Dakle čini se da su u antici zaista smatrali da peloponeška rijeka Alfej protječe ispod mora, koje redovno nazivaju Jadranskim, a zapravo je to Jonsko more, te izvire ponovo na otočiću Ortigiji kod Sicilije. To potkrepljuje i Strabon. On navodi, između ostalog, dva starija autoriteta, povjesničara Timeja i pjesnika Pindara, te spominje kako "ljudi kazuju mitološku priču po kojoj je rječica Aretuza zapravo Alfej koji, kako oni kažu, izvire na Peloponezu, teče podzemno kroz more sve do Aretuze i tada se ponovo izlijeva u more. A dokazi koje predočuju su sljedeći: neki vrč je, kako oni misle, bačen u rijeku [Alfej] kod Olimpije, a izbačen je u izvoru [Aretuzi]; također, izvoru se promijenila boja kao posljedica volovskih žrtvovanja u Olimpiji. Pindar slijedi ove

from Elis to Ortygia is also mentioned by Pliny (H. N. XXXI.30 and II.106), Lucan (Luc. III.176–177), Valerius Flaccus (Val. Fl. Argon. VIII.91) and Seneca (Sen. Q. N. III.26.5–6 and VI.8.2). This belief persisted until the tenth century, when the Byzantine encyclopaedic work *Suda* describes the Adriatic as "…a Sicilian sea, which the [river] Alpheios dives under from Arcadia and mingles in very pure form with the Sicilian spring Arethusa" (s.v. *Adrias*). In the west this conviction endured even longer, until the twelfth century, when Bernardus Silvestris wrote that "Sicily, fated to suffer under cruel tyrants, beholds the river Alpheus, and the stream of Arethusa". (*Cosmographia*, I.3). Even in the fifteenth century Lodovico Ariosto wrote "…like that fair region, whither, long unspied of him, her wayward mood did long offend, whilom in vain, through strange and secret sluice, passed under sea the Virgin Arethuse".[7] In more recent times, Percy Bysshe Shelley vividly described the chase itself in a poem *Arethusa* (Pisa, 1820), while the depiction of the nymph on Syracuse coins (see below) perhaps inspired the idealised portrayal of *La République* (*Marianne*) on the first French postal stamps in 1849 (Seltman 1955: 104). In the *Suda* lexicon, the Alfeios is also described as the Peloponnesian river "reaching open water through the Adriatic Sea, and mixing in no way with the brine, it surges up by the island of Sicily around the spring called Arethusa" (s.v. *Alpheios, Arethousa*). A similar motif of the Alfeios not mixing with seawater is also provided by Nonnos: "Sicilian Arethusa, where after his wandering travels Alpheios creeps proud of his Pisan chaplet – he crosses the deep like a highway, and draws his water, the slave of love, unwetted, over the surface of the sea, for he carries a burning fire warm through the cold water" (Nonn. D. XIII.323–327); and at another place: "…land of the nymph loved by hapless Alpheios, who brings to Arethusa as a gift of love his garlanded waters untainted by the brine" (Nonn. D. XXXVII.171–173). The same motif can be found in Lucian. In a dialogue between Poseidon and Alpheus (where Poseidon addresses Alpheus), we learn that Alpheus, after flowing into the sea is described as following: "unlike others, when you take your plunge you do not mingle with the brine as a river should; you do not put an end to your labours by dispersing; you hold together through the sea, keep your current fresh, and hurry along in all your original purity; you dive down to strange depths like a gull or a heron; I suppose you will come to the top again and show yourself somewhere or other".[8] So

[7] Lodovico Ariosto, *Bijesni Orlando*, VI.19.
[8] DMar. III; također Mosch. Id. VII.

[7] Lodovico Ariosto, *Orlando Furioso*, VI.19.
[8] DMar. III; also Mosch. Id. VII.

izvještaje kada kaže: 'O uzvišeno odmorište[9] Alfeja, Ortigijo, mladico slavne Sirakuze.' I povjesničar Timej iznosi isto slažući se s Pindarom"[10] (Str. VI.2.4). A što Strabon o toj teoriji misli, dolazi odmah u nastavku teksta: "Kada bi Alfej propao u neku jamu prije utoka u more, bilo bi neke osnove teoriji da se njegov tok produžuje podzemno od Olimpije sve do Sicilije, tako čuvajući njegovu pitku vodu nepomiješanu s morem; ali pošto se ušće rijeke lako vidljivo prazni u more, i pošto u blizini tog ušća, na prelasku, nema vidljivog ušća koje bi progutalo tok rijeke (iako ni na ovaj način voda ne bi mogla ostati slatka; ali bi mogla, barem većim dijelom, ako bi potonula u podzemni kanal), stvar je potpuno nemoguća. Jer sama voda Aretuze donosi svjedočenje protiv toga, budući da je slatka; i da bi tok rijeke mogao tako dugo izdržati prelazak a da se ne pomiješa s morskom vodom, odnosno, dok ne upadne u zamišljeni podzemni prolaz, je izrazito mitološko objašnjenje" (Str. VI.2.4). Dakle Strabon teoriju o podzemnom prolasku Alfeja ispod mora smatra posve nemogućom, štoviše naziva to objašnjenje "izrazito mitološkim". Tu je itekako bio u pravu, kako ćemo kasnije vidjeti. On dopušta da bi bilo osnove za takav prolazak kada bi Alfej prije svog utoka u more negdje uranjao u zemlju, ali kako to nije slučaj – naprotiv, rijeka ima vrlo vidljivo ušće – teorija o podzemnu prolasku nije održiva. I što nam ostaje od tog mita?

Dodajmo da o popularnosti koju je mit o Aretuzinu bijegu stekao u Sirakuzi dovoljno govori činjenica da se na novcu toga sicilskog grada u pravilu pojavljuje prikaz Aretuzine glave okružene dupinima. Taj prizor možemo pronaći već na najstarijem sirakuškom novcu te je upravo dominantan na novcu tog najmoćnijeg

Slika 1. Glava nimfe Aretuze okružena dupinima; tetradrahma, Sirakuza, Gelonova vladavina (485–478. pr. Kr.) ili ranije razdoblje (530–485. pr. Kr.) (iz B. V. Head, P. Gardner & R. S. Poole: "Sicily", in R. S. Poole (ed.), A Catalogue of the Greek Coins in the British Museum, London, 1876, 146).

Figure 1. Head of the nymph Arethusa surrounded by dolphins; tetradrachm, Syracuse, Gelo's reign (485–478 BC) or earlier (530–485 BC) (from B. V. Head, P. Gardner & R. S. Poole: "Sicily", in R. S. Poole (ed.), A Catalogue of the Greek Coins in the British Museum, London, 1876, 146).

[9] Ampneuma, "mjesto gdje se [Alfej] ponovno pojavljuje", doslovno "mjesto gdje [Alfej] ponovno diše"; citat je iz Pi. N. I.1–2. Pindar je živio i djelovao krajem VI. i početkom V. st. pr. Kr.

[10] Dugovječni sicilijanski povjesničar Timej živio je od sredine IV. do sredine III. st. pr. Kr.

it seems that in Antiquity they truly believed that the Peloponnesian Alfeios River flowed under the sea, which they constantly refer to as the Adriatic—even though it was actually the Ionian—and then emerged on the small island of Ortygia off the Sicilian coast. Strabo confirmed the existence of this belief. Among others, he cites two older authorities, the historian Timaeus and the poet Pindar, and notes how "...they say that it is the river Alpheus which rises in the Peloponnese, and that it flows through the land beneath the sea to the place where the Arethusa rises and flows into the sea. Some such proofs as these are given in support of the fact. A certain chalice having fallen into the river at Olympia was cast up by the springs of Arethusa; the fountain too is troubled by the sacrifices of oxen at Olympia. And Pindar, following such reports, thus sings: 'Ortygia, revered place of reappearing[9] of the Alpheus, the offset of renowned Syracuse'. Timaeus the historian advances these accounts in like manner with Pindar"[10] (Str. VI.2.4). Strabo's own opinion of this theory immediately follows: "Undoubtedly if before reaching the sea the Alpheus were to fall into some chasm, there would be a probability that it continued its course from thence to Sicily, preserving its potable water unmixed with the sea; but since the mouth of the river manifestly falls into the sea, and there does not appear any opening in the bed of the sea there, which would be capable of imbibing the waters of the river, (although even if there were they could not remain perfectly fresh, still it might be possible to retain much of the character of fresh water, if they were presently to be swallowed down into a passage running below the earth which forms the bed of the sea,) it is altogether impossible; and this the water of Arethusa clearly proves, being perfectly fit for beverage; but that the flow of the river should remain compact through so long a course, not mixing with the sea until it should fall into the fancied channel, is entirely visionary" (Str. VI.2.4). So Strabo considers the theory of the subterranean passage of the Alfeios under the sea entirely impossible, and he moreover refers to this explanation as "distinctly mythological". He was certainly right here, as we shall see later. He allows that there would be basis for such passage insofar as the Alfeios plunged into an opening in the ground prior to its confluence at the sea, but since this is not the

[9] Ampneuma, "place of reappearing [of Alpheus]", literally "place where [Alpheus] breathes once more"; citation from Pi. N. I.1–2. Pindar lived and worked at the end of the sixth and beginning of the fifth century BC.

[10] The long-lived historian Timaeus lived from the mid-fourth to the mid-third century BC.

sicilskog grada (sl. 1). Najraniji sirakuški novac kovan je u razdoblju od 530. do 485. god. pr. Kr. (Seltman 1955: 73–74), pa su ti prikazi otprilike istovremeni Pindaru. Mit je dakle mogao nastati najkasnije krajem VI. st. pr. Kr., ali činjenica da ga Sirakužani prikazuju od samoga početka kovanja svoga novca govori u prilog mnogo ranijoj dataciji. Prikazi Aretuze dominantni su sve do četrdesetih godina IV. st. pr. Kr. i "ponovnog osnivanja" grada. Nakon toga Aretuza se na sirakuškome novcu gotovo uopće više ne pojavljuje (*ibid.*: 191–192).

Promotrimo sada geografske širine dviju glavnih geografsko-mitoloških odrednica. Otočić Ortigija – danas, kao i u antici, dio grada Sirakuze (koju su 734. god. pr. Kr. osnovali Korinćani) – nalazi se na geografskoj širini od 37°05' sjeverno od ekvatora. Rijeka Alfej izvire u Arkadiji na Peloponezu na 37°25' sjeverne geografske širine, na planini Boreju kod grada Asee, u blizini Megalopola, a u more utječe nedaleko od slavne Olimpije u Elidi na 37°35' sjeverne geografske širine.[11] Dakle može se reći da su ove dvije geografske odrednice – ušće Alfeja i Ortigija – na gotovo jednakoj geografskoj širini. To znači da Alfej produžuje svoj put "ispod" ili "preko" Jonskoga (Jadranskoga) mora gotovo po paraleli. U čemu je važnost tog podatka?

Visina nebeskoga pola na određenoj geografskoj širini jednaka je geografskoj širini mjesta s kojega promatramo pol. Nadalje, visina kulminacije pojedinih zvijezda jednaka je ako se promatra s mjesta jednake geografske širine. To znači da ako netko iz Sirakuze promatra određenu zvijezdu u, recimo, donjoj kulminaciji, visina te zvijezde u tom položaju jednaka je visini te iste zvijezde u istome položaju promatrane s neke točke na Peloponezu koja je na istoj geografskoj širini. Taj podatak od velika je značenja za noćnu plovidbu i orijentaciju prema zvijezdama.

Brod koji je s Peloponeza kretao prema Siciliji mogao je kao polaznu točku imati nekoliko elejskih luka. U neposrednoj blizini ušća Alfeja u antici se nalazilo nekoliko gradova. Primjerice luka Fija (37°40' SGŠ) za koju Strabon kaže: "Nakon Helonate, dolazi duga obala Pisatinaca; i tad, rt Fija. Tamo je bio također mali grad Fija: 'uz zide Fijskog grada uz valove Jardan rijeke',[12] jer u blizini je i rječica istog imena. Po nekima, Fija je početak Pizide. Kod Fije se nalazi otočić i luka, od koje je najmanja udaljenost od mora do Olimpije..." (Str. VIII.3.12). Pauzanija piše

[11] Napominjemo da je već u antici bilo kontradiktornih podataka o izvoru, toku i ušću Alfeja; vidi Paus. VI.22, VIII.44, 54; Str. VIII.3.12; Plb. XVI.17; Suda, s. v. *Alpheios*.

[12] Il. VII.135.

case—on the contrary, the river has a quite visible mouth—the theory of subterranean passage cannot be sustained. And so what do we have left of this myth?

It should be added that the popularity of the myth of Arethusa's flight to Syracuse is sufficiently reflected in the fact that the coins from this Sicilian city generally depict Arethusa's head surrounded by dolphins. This scene can be found in the oldest Syracusan coins and it is actually a dominant motif on the coins of this most powerful Sicilian city (Fig. 1). The earliest Syracusan coins were minted in the period from 530 to 485 BC (Seltman 1955: 73–74), so these depictions are roughly contemporaneous with Pindar. The myth could thus have appeared at the end of the sixth century BC at the latest, but the fact that the Syracusans use it at the very beginning of minting of their coins would indicate a much earlier dating. Depictions of Arethusa were dominant until the 340s BC and the "re-establishment" of the city. Thereafter Arethusa almost never appears on Syracusan coins any more (*Ibid.*: 191–192).

Let us now turn to the latitudes of the two principal geographic/mythical sites. The islet of Ortygia—today, as in Antiquity, a part of the city of Syracuse (founded by the Corinthians in 734 BC)—lies at 37°05' north latitude. The spring of the Alfeios River is in Arcadia on the Peloponnese, at 37°25' north latitude on Mt. Boreios near the city of Asea, near Megalopolis, and it flows into the sea near the famed Olympia in Elis at 37°35' north latitude.[11] So one can say that these two geographic sites, the mouth of the Alfeios and Ortygia, lie at almost the same latitude. This means that the Alfeios continues its course "beneath" or "across" the Ionian (Adriatic) Sea almost along the parallel. Why is this fact so important?

The altitude of a celestial pole at a given latitude is equal to the latitude of the site from the point of observation of the pole. Furthermore, the altitude of the culmination of individual stars is equal if observed from points on the same latitude. This means that if someone in Syracuse observes a given star at, say, its lower culmination, the altitude of this star at this position is equal to the height of this same star in the same position observed from some point in Peloponnese at the same latitude. This information is extremely important in night-sailing and in celestial navigation.

[11] It should be noted that already in Antiquity there was contradictory data on the source, course and mouth of the Alpheus; see Paus. VI.22, VIII.44, 54; Str. VIII.3.12; Plb. XVI.17; Suda s.v. *Alpheios*.

da Alfej "ulazi u more poviše elejske luke Kilene",[13] no ta je luka nešto sjevernije (na 38°05' SGŠ), blizu ušća rijeke Laris, na granici Elide i Ahaje. Tamo je smješta, na drugome mjestu, i sam Pauzanija te dodaje da je "okrenuta prema Siciliji i pruža zgodno pristanište lađama".[14] Istu luku tamo smješta i Strabon (Str. VIII.3.4). Kao treći kandidat nameće se ahajska luka Egij. Za njezino korištenje imamo i izravniju mitološku potvrdu. Pauzanija spominje da svećenici u Egiju (38°15' SGŠ) "uzimaju iz okolnog područja kolače od božice [Demetre] i bacaju ih u more izjavljujući da ih šalju Aretuzi u Sirakuzu".[15] Ova tradicija opisuje možda putovanja na trasi Egij – Sirakuza. U obzir dolaze i mesenske luke Kiparisija (37°15' SGŠ) i Pil (37° SGŠ). Između njih i Sirakuze moglo se ploviti ravno po 37. paraleli.

Ako bi neki brod prema Sirakuzi isplovio s ušća rijeke Alfeja, odnosno iz neke od obližnjih elejskih luka koje smo upravo naveli, putovanje uz obalu bilo bi dugo oko 500 NM. Naime brod bi prvo trebao ploviti prema sjeverozapadu uz Jonske otoke i Krf pa zatim prijeći Otrantska vrata. Plovidba bi se dalje nastavljala preko Tarentskoga zaljeva i dalje Kalabrije i Sicilije prema jugozapadu. No ako bi se s Peloponeza krenulo prema zapadu, preko otvorenoga mora, do Sirakuze bi trebalo prijeći svega oko 300 NM, što je znatno smanjenje puta (za oko 40 %). No takvo je putovanje gotovo od samoga početka vodilo preko prostranstava otvorenoga mora bez ijednog orijentira na cijelome putu. Za takvo se putovanje dakle bilo potrebno orijentirati prema zvijezdama.

Najlakši i najjednostavniji način bio bi pratiti visinu pola. U promatranome razdoblju, uzmimo kao referentnu godinu 700. pr. Kr., nijedna svjetlija zvijezda nije označavala sjeverni nebeski pol. U toj godini zvijezda Kochab bila je udaljena od pola 6°46', a κ *Draconis*, magnitude 3.85, 5°57'. Godine 1300. pr. Kr. najbliža polu bila je zvijezda κ *Draconis*, udaljena 4°40', dok je Kochab bila udaljena 6°38'. Fresa smatra da su Grci plovili između otoka Kefalonije i Velike Grčke prateći visinu zvijezde Kochab (Fresa 1969: 253, 254), iako je ona, kako smo naveli, dosta udaljena od pola. Takva situacija trajala je sve do znatno kasnijega razdoblja, kada se zvijezda Polaris približila polu. U vrijeme Piteja iz Masalije (kraj 4. st. pr. Kr.) pol je bio pozicioniran tako da je zajedno s trima cirkumpolarnim zvijezdama (Kochab, mag. 2.07, Thuban, mag. 3.67, κ *Draconis*, mag. 3.85) činio dosta pravilan četverokut. O tome piše Hiparh u *Tumačenju uz Aratove i Eudoksove 'Pojave'*: "Eudoks

[13] Paus. VIII.54.
[14] Paus. VI.26.
[15] Paus. VII.24.

A ship setting off from the Peloponnese toward Sicily could have used several Elean ports as points of reference. There were several towns in the immediate vicinity of the Alfeios' mouth. For example, the port of Pheia (37°40' north lat.), about which Strabo said: "After Chelonatas comes the long seashore of the Pisatans; and then Cape Pheia. And there was also a small town called Pheia: 'beside the walls of Pheia, about the streams of Iardanus',[12] for there is also a small river nearby. According to some, Pheia is the beginning of Pisatis. Off Pheia lie a little island and a harbor, from which is the nearest distance from the sea to Olympia…" (Str. VIII.3.12). Pausanias writes that the Alpheus "…falls into the sea above Cyllene, the port of Elis",[13] although this port was somewhat farther north (at 38°05' north lat.), near the mouth of the Laris River, at the boundary between Elis and Achaia. It was located there, at another place, by Pausanias himself, who added that "it faces Sicily and affords ships a suitable anchorage".[14] The same port is placed there by Strabo (Str. VIII.3.4). A third candidate is the Achaian port of Aegium. There is also a more direct mythological confirmation for its use. Pausanias observes of the priests in Aegium (38°15' north lat.) that "they take cakes of the district from the goddess [Demeter] and throw them into the sea, saying that they send them to Arethusa at Syracuse".[15] This tradition perhaps describes voyages on the Aegium-Syracuse route. Also worth considering are the Messinian ports of Kyparisia (37°15' north lat.) and Pylos (37° north lat.). Between them and Syracuse, one could navigate exactly along the 37th parallel.

If a ship set off for Syracuse from the mouth of the Alfeios River, or from one of the nearby Elean ports mentioned above, a voyage along the coast would be approximately 500 NM. The ship would, namely, have to sail toward the north-west by the Ionian islands and Corfu and then cross the Strait of Otranto. The voyage would continue across the Gulf of Taranto and further south-west to Calabria and Sicily. But if one travelled from the Peloponnese by setting off west over the open sea, the voyage to Syracuse would only encompass approximately 300 NM, which is much shorter (approximately 40% less). But from its very beginning, such a voyage traverses expanses of open sea with no points of reference anywhere. Such a voyage requires celestial navigation.

[12] Il. VII.135.
[13] Paus. VIII.54.
[14] Paus. VI.26.
[15] Paus. VII.24.

griješi o sjevernom polu, jer kaže: 'Postoji određena zvijezda koja uvijek ostaje na istom mjestu; ova zvijezda je pol svemira.'; ustvari, na polu nema nijedne zvijezde, nego prazan prostor, međutim, sa tri zvijezde u blizini, s kojima točka pola čini četverokut, kako tvrdi i Piteja iz Masalije" (Hipparch. I.4.1). Hiparh ne spominje izravno na koje tri zvijezde misli, ali gore spomenuto objašnjenje čini se realnim. No u promatranome razdoblju taj je četverokut bio krajnje nepravilan.

Ali postoji i drugi način kojim su Grci mogli iz Elide ploviti u Sirakuzu: pomoću promatranja donje kulminacije cirkumpolarnih zvijezda. Cirkumpolarne zvijezde, dakle one koje nikad ne zapadaju za horizont, dvaput prelaze preko lokalnoga meridijana – jednom "iznad" nebeskoga pola (gornja kulminacija), a drugi put "ispod" (donja kulminacija). Znamo da je Piteja iz Masalije, da bi potvrdio geografsku širinu zemalja koje je posjetio, promatrao donju kulminaciju onih cirkumpolarnih zvijezda čija je točka te kulminacije bila najbliže horizontu (Duboković-Nadalini 1998: 47). Strabon tako prenosi Pitejevu tvrdnju kako je "najudaljenija zemlja sjeverno od Britanskog otočja Thule; tamo su ljetna obratnica i arktički krug jednaki" (Piteja *apud* Str. II.5.8). Grci su, naravno, pod pojmom arktičkoga kruga shvaćali različite krugove za različite geografske širine. Kako Strabon, a vjerojatno i Piteja, ljetnu obratnicu smješta na 24° SGŠ, geografska širina Pitejeve Thule iznoslila bi 66°. Zadnja cirkumpolarna zvijezda označava onu cirkumpolarnu zvijezdu koja u donjoj kulminaciji dodiruje horizont. Ako je određena zvijezda od pola udaljena za iznos φ (dakle iznos jednak geografskoj širini na kojoj je motritelj; polarna udaljenost $p = 90 - \delta = \phi$, gdje je φ = geografska širina, a δ = deklinacija određene zvijezde, dakle njezina udaljenost od nebeskog ekvatora), ona će u donjoj kulminaciji doticati horizont. Prema takvim su zvijezdama Grci određivali mjesta jednake geografske širine ako su te zvijezde za motritelja tih mjesta u donjoj kulminaciji dodirivale horizont (Hekman 1995: 55). Evo što o određivanju arktičkoga kruga pomoću zadnje cirkumpolarne zvijezde kaže Marcijan Kapela: "Ponovo ću početi s uzvišenim arktičkim krugom. Ovdje sam [govori nam sama Astronomija], slijedeći geometrijski postupak, odredila dvije točke pomoću kojih ću iscrtati krug: jedna točka označava središte, druga promjer. Na samom polu univerzuma postavila sam svijetlu zvijezdu te sam od nje do glave Zmaja, koja se, kako sam već navela, proteže do ruba horizonta, povukla liniju. Oko te linije, a s utvrđenim središtem, povukla sam, u svom umu, krug koji obuhvaća jednaku površinu prostora u svakom smjeru. Opseg se proteže do sljedećih konstelacija: započinje kod glave Zmaja, ide do desnog stopala Herkula, zatim kroz središte Kefejevih grudi, kroz prednje šape Velikog medvjeda te natrag do glave Zmaja" (Mart. Cap. VIII.827). Zanimljivo je da Marcijan (odnosno Astronomija)

The easiest and simplest method is to follow the elevation of the pole. In the period in question, if we take 700 BC as a reference, not a single brighter star designated the north celestial pole. In that year, the star Kochab was 6°46' from the pole, while κ *Draconis,* mag. 3.85, was at 5°57'. In 1300 BC, the star κ *Draconis* was closest to the pole, at a distance of 4°40', while Kochab was at a distance of 6°38'. Fresa believes that the Greeks sailed between the island of Kefallonia and Magna Grecia by following the altitude of the star Kochab (Fresa 1969: 253, 254), even though it was, as stated, quite distant from the pole. Such as situation persisted until a much later period, when the star Polaris approached the pole. During the time of Pytheas of Massalia (end of 4th cent. BC), the pole was positioned so that together with three circumpolar stars (Kochab, mag. 2.07, Thuban, mag. 3.67, and κ *Draconis*, mag. 3.85), it formed a truly regular rectangle. Hipparchus wrote about this in the *Commentary on the Phaenomena of Eudoxus and Aratus*: "About the north pole Eudox is in error, for he says: 'There is a certain star which remains always in the same spot; this star is the pole of the universe', the fact being that at the pole there is no star at all, but there is an empty space, with, however, three stars close to it, with which the point at the pole forms a square, as Pytheas of Massalia also states" (Hipparch. I.4.1). Hipparchus does not directly state which three stars he means, but the aforementioned explanation seems realistic. However, during the period under observation this rectangle was quite irregular.

But there is another manner in which the Greeks could have sailed from Elis to Syracuse: by observing the lower culmination of the circumpolar stars. The circumpolar stars, meaning those that never sink below the horizon, pass over local meridian twice: once "above" the celestial pole (upper culmination) and once "below" (lower culmination). We know that Pytheas of Massalia, when measuring the latitudes of the countries he visited, observed the lower culmination of those circumpolar stars whose position at that point was closest to the horizon (Duboković-Nadalini 1998: 47). Strabo thus cites Pytheas' assertion that "...the farthest country north of the British islands is Thule; for which place he says the summer tropic and the arctic circle is all one" (Pytheas *apud*, Str. II.5.8). To be sure, the Greeks understood the arctic circle as different circles for different latitudes. Since Strabo, and probably Pytheas, placed the Tropic of Cancer at 24° north latitude, the latitude of Pytheas' Thule would be 66°. The last circumpolar star is that circumpolar star that touches the horizon in its lower culmination. If a given star is at a distance of φ from the

kao oznaku arktičkoga kruga uzima baš glavu Zmaja. U stvarnosti, zbog raznih astronomskih pojava (atmosferske refrakcije, ekstinkcije svjetlosti i elevacije horizonta), nije moguće promatrati zvijezde dok nisu barem nekoliko stupnjeva iznad horizonta. "Za svaku se važniju luku Mediterana znala visina jedne cirkumpolarne zvijezde u donjoj kulminaciji, a po njoj i geografska širina te luke. Pomorci su, ploveći s otvorenog mora, mjerili visinu te zvijezde u donjoj kulminaciji i tako procjenjivali svoj položaj" (Franušić 1981: 188–189; 1994: 20; također Hekman 1995: 57).

Metode mjerenja visina zvijezda opisali smo u ranijim člancima (Bilić 2004; 2005). Ako su zaista postojale zvijezde koje su određivale geografsku širinu pojedine luke, one zbog precesije nisu mogle ostati u funkciji duže vremensko razdoblje. Da su antički pomorci procjenjivali visinu pojedinih asterizama – npr. Velikoga i Maloga medvjeda, nebeskoga pola te Kanopa – jasno je iz Plinijeva *Prirodoslovlja* (H. N. II.71). On navodi različitu vidljivost Kanopa u Italiji, Aleksandriji, Rodu i na Crnome moru, zatim različitu vidljivost Velikoga i Maloga medvjeda (*septentriones*) u Egiptu i na Crnome moru itd. Donosi i podatak o nevidljivosti Prijestolja Cezara, odnosno zviježđa Južni križ (Allen 1963: 185), u Italiji, ali i neke krive podatke, primjerice da se zviježđe Berenikine kose iz Italije ne vidi. Također spominje da Veliki medvjed počinje zalaziti između Roda i Aleksandrije, što je dosta neprecizan podatak koji se može shvatiti kao uopćeno svjedočenje o spuštanju tog zviježđa prema horizontu s promatračkoga mjesta na južnome Mediteranu u vremenskome razmaku koji je protekao između Plinija te Eratostena i Hiparha (Medas 2000: 245). Plinije tvrdi da se do gore navedenih podataka došlo uglavnom iz pomorskih ekspedicija. Zaključno iznosi da su cirkumpolarne zvijezde više na mjestima bližima nebeskomu polu, odnosno da se spuštaju bliže moru što se mornari udaljuju od pola te da je Zemlja u obliku "lopte". Zato se čini da su iste zvijezde, promatrane s jedne točke zemaljske kugle, visoko iznad horizonta, a promatrane s drugoga mjesta čine se bliže horizontu. Strabon prenosi Eratostena (Eratosten *apud* Str. II.1.19) i Hiparha (Hiparh *apud* Str. II.5.36), koji donose kako šape i kraj repa Velikoga medvjeda u nekim dijelovima Egipta (Sijene i Berenike kod Crvenoga mora, na geografskoj širini od oko 24° sjeverno, blizu Rakove obratnice) zapadaju za horizont; dakle na toj geografskoj širini ovo zviježđe nije cirkumpolarno (Medas 2000: 245).[16] Lukan

[16] Strabon prenosi Megastena, koji je tvrdio da je u južnim krajevima Indije moguće vidjeti Velikoga i Maloga medvjeda kako zalaze, dok je Deimah tvrdio suprotno; sam Eratosten tvrdi kako je

pole (a distance equal to the latitude at which the observer is; polar distance $p = 90 - \delta = \phi$, where ϕ = latitude, δ = declination of the star, i.e. its distance from the celestial equator) it will touch the horizon at its lower culmination. Based on these stars, the Greeks determined the points of equal latitude if these stars touched the horizon at their lower culmination from the observer's position (Hekman 1995: 55). This is what Martianus Capella said about the determination of arctic circle using the last circumpolar star: "I shall again begin with the sublime arctic circle. Here, following a geometrical procedure, I have set two points for drawing a circle: the one to mark the center, and the other the circumference. At the very pole of the universe I have set a brilliant star, and from it to the head of Draco, which I had previously noted stretches to the circle of the horizon, I have drawn a line. About this line, with the center fixed, I have drawn, in my mind, a circle encompassing an equal space on every side. The circumference extends through the following constellations: beginning at the head of Draco, to the right foot of Engonasis, through the middle of the breast of Cepheus, through the front feet of Ursa Maior, and back to the head of Draco" (Mart. Cap. VIII.827). It is interesting that Martianus (i.e. *Astronomy*) takes the head of Draco as the mark of the arctic circle. Actually, due to various astronomical phenomena (atmospheric refraction, extinction of light and elevation of the horizon), it is impossible to observe the stars unless they are a few degrees above the horizon. "The altitude of one circumpolar star at its lower culmination, and based on it the latitude, was known for each major Mediterranean port. Sailors navigating on the open seas measured the altitude of these stars at their lower culmination and thus estimated their position" (Franušić 1981: 188–189; 1994: 20; also Hekman 1995: 57).

This author has described the methods for measuring the altitude of stars in earlier articles (Bilić 2004; 2005). If there truly were stars that determined the latitude of individual ports, due to precession they could not maintain that function for a longer period. That the ancient seafarers calculated the altitude of individual asterisms, e.g. Ursa Maior and Minor, the celestial pole and Canopus is apparent from Pliny's *Naturalis Historia* (H. N. II.71). He noted the different visibility of Canopus in Italy, Alexandia, Rhodes and on the Black Sea, as well as the different visibility of Ursa Maior and Minor (*septentriones*) in Egypt and on the Black Sea, and so forth. He also stated that the Caesar's Throne, i.e. the Southern Cross (Allen 1963: 185) was invisible in Italy, but he also recounted some incorrect information – for example, that the constellation Coma Berenices

donosi kako se u Karmaniji, središnjoj iranskoj pokrajini, može vidjeti Veliki medvjed kako zalazi, ali ne potpuno (Luc. III.250–251). Iz toga je jasno da su antički pomorci geografsku širinu određivali pomoću cirkumpolarnih zvijezda, jer su bili svjesni da se udaljavanjem od sjevernoga pola visina sjevernih cirkumpolarnih zvijezda, smanjuje. To potvrđuje i Klaudije Ptolemej, koji u *Geografskoj uputi* prenosi i komentira neke navode Marina iz Tira, a koji se i sam služi Hiparhovim podacima: "'Mali medvjed postaje potpuno vidljiv iznad horizonta promatran sa sjeverne obale Ocele... Iz Hiparha znamo da je najjužnija zvijezda u konstelaciji Malog medvjeda, ona na kraju repa, od pola udaljena 12 i 2/5°...' On [Marin] kaže da oni koji plove iz Indije u Limiriku... izvještavaju da je Bik u višem položaju na središnjem dijelu neba nego što je u stvarnosti te da se Plejade vide u sredini jarbola i nastavlja, 'oni koji plove iz Arabisa u Azaniju plove pravo prema jugu, prema zvijezdi Kanop, koju tamo nazivaju Hippos, tj. Konj, a koja je daleko na jugu. Tamo se vide zvijezde koje mi ne poznajemo po imenu, a Sirius izlazi prije Procyona i Oriona'... neke od tih zvijezda, nama nikad vidljive, mogu se vidjeti iznad horizonta s mjesta južnije od nas, u mjestima bližim ekvatorijalnom području od onih na sjeveru, kao oko Meroe. One mogu biti vidljive kao što je vidljiv Kanop, koji nije vidljiv iznad horizonta onima koji su sjevernije od nas. Oni koji žive prema jugu zovu ovu zvijezdu Hippos, tj. Konj, a niti jedna od zvijezda koje mi poznajemo ne nosi to ime itd." (Ptol. Geog. I.7). Dodajmo ovomu da Diodor Sicilski (D. S. II.35, III.48) opisuje (ne)vidljivost Velikoga i Maloga medvjeda te Arktura u Indiji, kao i nevidljivost Velikoga medvjeda u Sretnoj Arabiji (D. S. II.35, III.48). I Diodor te podatke povezuje s pomorstvom.

Vratimo se tehnici određivanja geografske širine pomoću promatranja zadnje cirkumpolarne zvijezde u donjoj kulminaciji. Pogledajmo kako bi ona mogla pomoći pomorcima na putu otvorenim morem između Elide ili Mesenije i Sirakuze. Vidjeli smo već da su geografske točke određene rijekom Alfej i otočićem Ortigijom na sličnoj geografskoj širini, što nam potvrđuje ispravnost mitološkoga povezivanja tih dviju točaka navodnim Alfejevim podzemnim tokom. Ako povežemo taj podatak s gore opisanom

moguće vidjeti kako Medvjedi zalaze u krajevima 5000 stadija južno od Aleksandrije (Megasten, Deimah, Eratosten *apud* Str. II.1.19). Hiparh donosi da je u "Zemlji koja proizvodi cimet" Polaris zadnja cirkumpolarna zvijezda, a da se iz Sijene, Berenike i Zemlje Troglodita gotovo cijeli Veliki medvjed vidi unutar arktičkoga kruga, osim bedara, vrška repa i jedne od zvijezda u četverokutu koji tvori njegovo tijelo (Hiparh *apud* Str. II.5.35–36). Dalje Strabon prenosi slične Hiparhove navode o Arkturu, Kasiopeji i Perzeju (Hiparh *apud* Str. II.5.38, 41, 42).

could not be seen from Italy. He also mentioned that Ursa Maior began to set between Rhodes and Alexandria, which is truly imprecise, and this can be seen as general testimony on the movement of this constellation toward the horizon when observed in the southern Mediterranean during the period that passed between Pliny and Eratosthenes and Hipparchus (Medas 2000: 245). Pliny asserts that these data were generally gathered during maritime expeditions. He concluded that circumpolar stars are higher at points closer to the celestial pole, and that they come closer to the sea as seafarers move farther away from the pole and that the Earth is shaped like a "ball". This is why the same stars, viewed from one point on the globe, are high above the horizon, while when observed from another point they seem closer to the horizon. Strabo cited Eratosthenes (Eratosthenes *apud* Str. II.1.19) and Hipparchus (Hipparchus *apud* Str. II.5.36), who stated that the paws and end of the tail of Ursa Maior in parts of Egypt (Syene and Berenice on the Red Sea, at a latitude of approximately 24° north, near the Tropic of Cancer) fall below the horizon; so at this latitude this constellation is not circumpolar (Medas 2000: 245).[16] Lucan stated that in Carmania, a central Iranian province, Ursa Maior can be seen setting, but not completely (Luc. III.250–251). From this is it apparent that ancient seafarers determined latitudes using circumpolar stars, because they were aware that the altitude of these stars declined as they moved away from the north pole. This is also confirmed by Claudius Ptolemey who, in *The Geography*, cites and comments the statements of Marinus of Tyre, who used Hipparchus' information himself: " 'Ursa Minor begins to be entirely above the horizon from the north shore of Ocele... We learn from Hipparchus that the star in Ursa Minor which is the most southerly or which marks the end of the tail, is distant from the pole twelve and two-fifths degrees...' He [Marinus] says that those who sail from India to Limyrica... tell us that Taurus is in a higher position in the mid-heavens than in reality it is and that the

[16] Strabo also cites Megasthenes, who claimed that in the southern regions of India it was possible to see Ursa Maior and Minor setting, while Deimachus claimed the opposite; Eratosthenes himself claimed that it was possible to see the both Ursas set in regions 5000 stadia south of Alexandria (Megasthenes, Deimachus, Eratosthenes *apud* Str. II.1.19). Hipparchus stated that in "The Cinnamon-bearing country" Polaris is the last circumpolar star, and that from Syene, Berenice and the Troglodytic almost the entire Ursa Maior can be seen within the arctic circle, except its thighs, tip of its tail and one of the stars in the rectangle that forms its body (Hipparchus *apud* Str. II.5.35–36). Strabo further cites similar statements by Hipparchus about Arcturus, Cassiopeia and Perseus (Hipparchus *apud* Str. II.5.38, 41, 42).

tehnikom plovidbe pomoću promatranja donje kulminacije zadnje cirkumpolarne zvijezde, vidjet ćemo da je sve što su pomorci za uspješnu navigaciju na trasi Elida/Mesenija – Sirakuza trebali učiniti bilo pronaći zadnju cirkumpolarnu zvijezdu na geografskoj širini od nešto više od 37°, izmjeriti njezinu visinu i pratiti je tijekom puta. Dakle samo je trebalo pratiti visinu takve zvijezde u donjoj kulminaciji na horizontu i održavati brod na toj geografskoj širini. To je jednostavna navigacijska tehnika, a njezinu uspješnost moglo je povećati kombiniranje izmjerene visine ciljane zvijezde s visinom pola, koja je morala iznositi 37°. Koja je zvijezda u navedenome razdoblju mogla poslužiti kao navigacijsko pomagalo?

Promatrana s geografske širine φ = 37°10' zvijezda Rastaban (β *Draconis*, mag. 2.79; δ 700. pr. Kr. = 56°07') imala je visinu donje kulminacije 3°18'; to znači da je bila zadnja cirkumpolarna zvijezda vidljiva na toj geografskoj širini.[17] Heleni su, dakle, oko 700. g. pr. Kr. između ušća rijeke Alfej na Peloponezu i otočića Ortigije pred Sirakuzom mogli navigirati pomoću zvijezde Rastaban (godine 1300. pr. Kr., u mikensko vrijeme, ista zvijezda imala je δ = 57°26', odnosno visinu donje kulminacije od 4°37', tako da je i tada mogla služiti istoj svrsi, možda i bolje nego u kasnijem razdoblju).[18] Nemamo puno podataka iz antičkoga doba koji bi nam sugerirali upotrebu zviježđa Zmaj (*Draco*) u navigaciji. Tu je navod iz Vergilijevih *Georgika*, u kojem se ratarima savjetuje sljedeće: "Osim toga nam tako Arkturove pazit zvijezde valja i Jarića dane i sjajnu Zmiju ko onim, koji po valima se vjetrovitim vraćaju Pontom kući i morskom uzinom Abida školjaka punog."[19] Dakle, pjesnik nam donosi svjedočenje po kojem su mornari na povratku s Crnoga mora (Abid je grad na Helespontu) navigirali uz pomoć Zmije, dakle zviježđa Zmaja.[20] Ti su mornari, baš kao i oni koji su plovili između Peloponeza i Sirakuze, plovili sa zapada prema istoku, vjerojatno uz sjevernu obalu Male Azije, dakle

[17] Uzeli smo u obzir sljedeće pravilo: zbog ekstinkcije najmanja visina zvijezde koja omogućava njezinu vidljivost u stupnjevima mora iznositi vrijednost jednaku njezinoj magnitudi; dakle, ako je zvijezda magnitude 3, ona ne može biti vidljiva ako nije barem 3° iznad horizonta (Aveni 2001: 106; Šprajc 1991: 49).

[18] S geografske širine od 37°30' visina donje kulminacije zvijezde Rastaban iznosila je godine 700. pr. Kr. 3°38', a godine 1300. pr. Kr. 4°57'.

[19] Verg. Georg. I.204–207.

[20] Da je Vergilije pod Zmijom mislio na zviježđe Zmaja, a ne npr. Hidru ili neko drugo "zmijsko" zviježđe, svjedoči nam sljedeći stih: "Golema Zmija se mota, vijuga kod prvog vrha oko Medvjeda oba i med njima kao rijeka..." (Verg. Georg. I.244–245). Iz ovoga se jasno vidi da je Zmija zviježđe Zmaja "omotano" oko sjevernoga pola ekliptike u neposrednoj blizini sjevernoga nebeskog pola i zviježđa Velikoga i Maloga medvjeda.

Pleiades are seen in the middle of the masts, and he continues, 'those who sail from Arabis to Azania sail straight to the south, and towards the star Canopus, which there is called Hippos, that is the Horse, and which is far south. Stars are seen there which are not known to us by name, and the Dog-star rises before Procyon and Orion... several of the fixed stars, never seen by us, can be seen above the horizon in places south of us, and in places more toward the equatorial region than those in the north, as around Meroe. They can be seen as is Canopus itself, which, when appearing above the horizon is never visible to those who dwell north of us. Those who dwell toward the south call this star Hippos, that is the Horse, nor is any other star of those known to us called by that name." (Ptol. Geog. I.7). We should add here that Diodorus Sicilus (D. S. II.35, III.48) describes the (in)visibility of Ursa Maior and Minor and Arcturus in India, and the invisibility of Ursa Maior in Arabia Felix (D. S. II.35, III.48). Diodorus also associated these data with seafaring.

We now return to the technique of determining latitudes by observing the last circumpolar star at the lower culmination. Let us look at how it could help seafarers on an open-sea voyage between Elis or Messinia and Syracuse. We have seen that the geographic points determined by the Alfeios River and the islet of Ortygia are at similar latitudes, which confirms that the mythical links between these two points by the alleged subterranean course of the Alfeios were correct. If this fact is associated with the navigation technique described above using the lower culmination of the last circumpolar star, we will see everything that seafarers needed to do to successfully navigate the route from Elis/Messinia to Syracuse was find the last circumpolar star at the latitude of a little over 37°, measure its altitude and follow it during the voyage. Thus, all that was needed was to follow the altitude of such stars at their lower culmination on the horizon and maintain the ship at that latitude. This is a simple navigational technique, and the combination of measured altitudes of the targeted stars with the elevation of the pole, which had to be 37°, may have enhanced its success. Which star could have served as a navigational aid during this period?

Observed from latitude φ = 37°10', the star Rastaban (β *Draconis*, mag. 2.79; δ 700 BC = 56°07') had an altitude at is lower culmination of 3°18'; this means that it was the last circumpolar star visible at this latitude.[17] So at about 700 BC, the ancient Greeks could have

[17] The following rule was taken into consideration: due to extinction the lowest altitude of stars that enables their visibility must be a value in degrees that is equal to their magnitude; thus, if a star is magnitude 3, it cannot be visible if it is not at least 3° above the horizon (Aveni 2001: 106; Šprajc 1991: 49).

na geografskoj širini od oko 42° sjeverno. Još jednu potvrdu korištenja zviježđa Zmaja u navigaciji nalazimo u *Argonautici* Valerija Flaka. Kormilar Arga Tifis obraća se Argonautima umirujućim riječima; objašnjava kako ga je Palada Atena naučila da tijekom plovidbe ne slijedi one zvijezde koje zapadaju za horizont (kao primjere navodi zviježđa Oriona i Perzeja), već mu kao vodič treba poslužiti "on koji se nikada ne skriva ispod zabranjenih voda dok sjaji oko pola, zmija koja okružuje sedam zvijezda" (Val. Fl. Argon. II.61–65). Ovaj je navod vjerojatno opet vezan uz crnomorsku navigaciju (plovidba Argonauta mahom se vezuje uz Pont), no ne nužno – Tifis opisuje svoje općenito naučavanje u astronavigaciji – on je naime *prvi* mornar na *prvome* brodu koji je ikad zaplovio. Našli smo, dakle, izravne potvrde o korištenju zviježđa Zmaja za navigaciju u antici. Na tablici 1 prikazane su vrijednosti visina zvijezda "kandidata" za zadnju cirkumpolarnu zvijezdu na danim geografskim širinama, u trima različitim vremenskim razdobljima.

Rastaban je zvijezda koja predstavlja desnu sljepoočnicu Zmaja. Arat piše da "njegova [Zmajeva] usta i desna [prema Hiparhu lijeva; Hipparch. I.4.4] sljepoočnica leže ravno nasuprot kraju repa Velikog medvjeda" (Arat. 59–60). Arat (Arat. 54–62) i Ciceron (Cic. ND II.107) opisuju Zmajevu glavu koja se sastoji od pet zvijezda: očiju (ξ i ν *Draconis*), dviju obrva ili sljepoočnica (β i γ *Draconis*) te brade (μ *Draconis*). Arat dalje piše da Zmajeva "glava kruži u blizini mjesta gdje se stapaju granice zalaska i izlaska" (Arat. 61–62). Slično donosi i Ciceron, koji nakon opisa Zmajeve glave, piše: "Ostatak Zmajevog tijela vidimo svakog sata tijekom noći. 'Ovdje se iznenada glava malo sakrije, gdje se svi njezini dijelovi ujedinjuju na istom mjestu, oni koji su vidljivi i oni koji su nevidljivi'" (Cic. ND II.108). Što to znači? To znači da su Arat (oko 270. pr. Kr.), Hiparh (oko 135. pr. Kr.) i Ciceron (1. st. pr. Kr.) smatrali da Zmajeva glava dotiče horizont u donjoj kulminaciji promatrana s geografskih širina na kojima su oni živjeli, odnosno da je tomu bilo tako u vremenu kad je netko tko je Aratu prenio podatke vršio astronomska promatranja. To je vjerojatno bio Eudoks s Knida, koji je djelovao oko stotinjak godina prije Arata (Knid se nalazi na 36°50' SGŠ, prema Ptolemeju na 36°, V.2). Strabon (Str. II.5.14) prenosi da je Eudoks promatrao zvijezdu Kanop s Knida te da je njegova promatračnica bila nešto viša od stambenih kuća (visina gornje kulminacije Kanopa 370. g. pr. Kr. bila je svega 19' promatrana s Knida, odnosno s 36°50' SGŠ). Hiparh (Hipparch. I.4.8) donosi da se Zmajeva glava proteže od 34 i 3/5° do 37° (!) te bi tako na geografskoj širini od 37° zvijezda Etamin (γ *Draconis*) bila zadnja cirkumpolarna zvijezda. U Hiparhovo je vrijeme ta zvijezda bila udaljena 37°03'

navigated between the mouth of the Alfeios River on the Peloponnese and the island of Ortygia at Syracuse with the help of Rastaban (in 1300 BC, during the Mycenaean era, the same star was at δ = 57°26', with a lower culmination of 4°37', so that it could have served the same purpose, perhaps even better than in subsequent periods).[18] There are no complete data from Classical Antiquity that would suggest the use of the constellation Draco in navigation. Here is a citation from Virgil's *Georgics*, in which he shares the following advice: "Us too behoves Arcturus' sign observe, and the Kids' seasons and the shining Snake, no less than those who o'er the windy main borne homeward tempt the Pontic, and the jaws of oyster-rife Abydos".[19] Thus, the poet testifies to the fact that seafarers returning from the Black Sea (Abydos was a city on the Hellespont) navigated with the help of the Snake, i.e. the constellation of Draco.[20] These seafarers, just as those who sailed between the Peloponnese and Syracuse, travelled west to east, probably along the northern coast of Asia Minor, at a latitude of approximately 42° north. Another confirmation of the use of Draco in navigation can be found in the *Argonautica* by Valerius Flaccus. The Argo's pilot Tiphys pacified the Argonauts by explaining that Pallas Athena taught him not to follow those stars which fall below the horizon during navigation (he mentions the examples of the constellations Orion and Perseus), but rather to use as a guide "he that never hides beneath the forbidden waters as he shines about the pole, the serpent that enfolds the seven stars" (Val. Fl. Argon. II.61–65). This citation is again tied to Black Sea navigation (navigation of the Argonauts is largely associated with Pontus), but not necessarily – Tiphys described his general learning about celestial navigation; he is, in fact, the *first* seafarer on the *first* ship that ever sailed. So we have therefore found confirmation of the use of the constellation Draco in navigation during the Antiquity. Table 1 shows the values of the altitudes of "candidate" stars for the last circumpolar star at given latitudes during three different periods.

Rastaban is a star that forms Draco's right temple. Aratus wrote that "his [Draco's] mouth and right

[18] From a latitude of 37°30', the altitude of the lower culmination of Rastaban at 700 BC was 3°38', while in 1300 BC it was 4°57'.

[19] Verg. Georg. I.204–207.

[20] That Virgil meant the constellation Draco when referring to the Snake, and not the Hydra or some other "serpentine" constellation, is demonstrated by the following verse: "Here glides the huge Snake forth with sinuous coils 'twixt the two Bears and round them river-wise…" (Verg. Georg. I.244-245). From this it is clear that the Snake is the constellation Draco "coiled" around the north pole of the ecliptic in the immediate vicinity of the north celestial pole and Ursa Maior and Minor.

od pola: "Opet, u odnosu na poziciju Zmajeve glave, Eudoksovi i Aratovi podaci odgovaraju činjenicama, dok Atalovi ne odgovaraju. Jer Arat, slijedeći Eudoksa, kaže da se ona kreće na uvijek vidljivom krugu, koristeći ove riječi: 'Njegova se glava kreće gdje su granice izlaska i zalaska pomiješane.' Ali Atal kaže da je ona malo južnije od uvijek vidljivog kruga, tako da malo zapada za horizont za kratko vrijeme. Da je Atal ovdje u sukobu s činjenicama dobivenim promatranjem može se zaključiti iz sljedeće rasprave. Zvijezda na vrhu Zmajevih usta udaljena je 34 i 3/5° od pola, njegovo južnije oko 35°, a južnija sljepoočnica 37°. Uvijek vidljivi krug u okolici Atene, gdje je pokazatelj sunčanog sata 1 i 1/3 puta duži od njegove ekvinocijalne sjene, je udaljen 37° od pola. Iz toga je jasno da se Zmajeva glava kreće unutar uvijek vidljivog dijela neba, i da je samo lijeva sljepoočnica na samom krugu, a ne, kako kaže Atal, dalje na jugu, da bi bila ispod horizonta kratko vrijeme i tada izašla" (Hipparch. I.4.8).

Visinu zvijezda stari su Heleni mogli mjeriti na više načina: "Poznato je da debljina srednjeg prsta ispružene ruke predstavlja oko 2° na nebeskoj sferi. Isto tako širina pesnice oko 8°, razmak između raširenog palca i kažiprsta oko 15°, a razmak između vrhova raširenog palca i malog prsta oko 22°" (Franušić 2000: 172). U Oceaniji su visinu polarne zvijezde također mjerili prstima: raširenи prsti ispružene ruke činili su jedan *ey-ass* (oko 15°; *ey-ass* je inače kukasti štap za branje kruhovca). Navigatori sa Satawala utvrdili su visinu polarne zvijezde od ½ *ey-assa* (oko 7°30'), a na Saipanu 1 *ey-ass*, što su približno točne vrijednosti. Navigator je u Honoluluu prstima odredio visinu polarne zvijezde od 1½ *ey-assa* (22°30'), što je opet vrlo precizno (Lewis 1994: 277–278).

Dakle, da zaključimo: iznijeli smo jednu, na prvi pogled bajkovitu, mitološku priču o nesretnoj ljubavi i njezinu sretnu završetku. Posljedica te ljubavi, čini se i povod za sam nastanak priče, jest navodna podzemna povezanost peloponeške rijeke Alfeja i otočića Ortigije pred Sirakuzom. Priču ponavljaju brojni antički autori. I dok je neki (Pauzanija) bezrezervno prihvaćaju, potkrepljujući je neospornim autoritetom Delfskoga proročišta, drugi je (Strabon) odbacuju kao nemoguću. Racionalnom argumentacijom Strabon prihvaća mogućnost podzemnih kanala dugih i po 500 km, ali smatra da to u ovom slučaju ne vrijedi. Čini se da navedeni antički autori (Strabon iz 1. st. pr. Kr., Pauzanija iz 2. st. n. e.), odmaknuti stotinama godina od izvora priče, nisu shvatili njezinu bit. A ključ zagonetke jest činjenica da su te dvije lokacije, kako smo vidjeli, na sličnoj geografskoj širini. Ta činjenica omogućila je skraćivanje plovidbe uz upotrebu relativno jednostavnih astronavigacijskih tehnika. S vremenom je čvrsta znanstvena činjenica "prebačena" u mit, pa je ili prihvaćana kao religijska

temple [left according to Hipparchus; Hipparch. I.4.4] straight confront the end of her [Helice's] tail" (Aratus 59–60). Aratus (Aratus 54–62) and Cicero (Cic. ND II.107) described Draco's head as consisting of five stars: the eyes (ξ and ν *Draconis*), two brows or temples (β and γ *Draconis*) and a chin (μ *Draconis*). Aratus further wrote that Draco's "head wheels near where the limits of setting and rising blend" (Aratus 61–62). Cicero made a similar observation. After describing Draco's head, he wrote: "The whole body of the Dragon is visible throughout the night, but 'the head dips almost down below the ocean rising and setting in a mazy motion" (Cic. ND II.108). What does this mean? It means that Aratus (ca 270 BC), Hipparchus (ca 135 BC) and Cicero (first century BC) believed that Draco's head touched the horizon at the lower culmination observed from the latitudes at which they lived, or that it was this way when somebody from whom Aratus obtained his data conducted astronomical observations. This was probably Eudoxus of Cnidus, who flourished approximately a century prior to Aratus (Cnidus is on 36°50' north latitude, according to Ptolemy at 36°, V.2). Strabo (Str. II.5.14) stated that Eudoxus observed the star Canopus from Cnidus and that his observatory was only a little higher than a house (the altitude of Canopus' upper culmination in 370 BC was only 19' observed from Cnidus, or 36°50' north latitude). Hipparchus (Hipparch. I.4.8) stated that Draco's head extended from 34 and 3/5° to 37° (!) so that at a latitude of 37° the star Etamin (γ *Draconis*) would be the last circumpolar star. In Hipparchus' time that star would have been 37°03' from the pole: "Again, with reference to the position of the Dragon's head, Eudoxus' and Aratus' statements agree with the facts, while Attalus' does not. For Aratus, following Eudoxus, says that it moves on the always-visible circle, using these words: 'Its head moves where the limits of rising and setting are confounded.' But Attalus says that it is slightly more southerly than the always-visible circle, so that it goes below the horizon for a short time. That Attalus is here at variance with the observed fact may be inferred from the following considerations. The star at the front of the Dragon's mouth is distant 34 3/5° from the pole, his southerly eye is 35°, and his southerly temple 36° from the pole. Now the always-visible circle in the neighbourhood of Athens, where the pointer of the sundial is in length 1 1/3 times its equinoctial shadow, is distant 37° from the pole. Hence, it is clear that the head of the Dragon moves in the always visible part of the heaven, and has only the left temple on the circle itself, and is not, as Attalus says, further to the south, so as to be below the horizon for a short time and then to rise." (Hipparch. I.4.8).

dogma ili odbacivana kao znanstvena nelogičnost. Naravno da Alfej ne teče ispod Jonskoga mora: to je mitološkim jezikom dano objašnjenje za nautičku trasu između istoka i zapada grčkoga svijeta.

Postoji još jedna slična priča o Alfeju. Ona je gotovo identična priči o Aretuzi, ali je ovoga puta predmet Alfejeve pohlepe boginja Artemida. Pri opisu hrama Artemide Alfeje u Letrinima (u neposrednoj blizini ušća Alfeja, na 37°40' SGŠ), Pauzanija donosi priču o tome na koji je način boginja dobila taj pridjev. Opisuje želju riječnoga boga da je obljubi. Budući da njegove molbe i uvjeravanja nisu ništa postigli, odlučio se poslužiti silom. Došao je u Letrine na noćnu svečanost koju je božica održavala te ušao u društvo nimfa, Artemidinih drugarica u igri. Kako je boginja naslućivala Alfejevu namjeru, namazala je svoje lice i lica prisutnih nimfa bijelim muljem. Kada je stigao, Alfej nije mogao razlikovati Artemidu od drugih nimfa pa je otišao neobavljena posla. Zbog Alfejeve su ljubavi Letrinjani boginji dali nadimak (Paus. VI.22).[21] Čini se da je to izvorna priča, u kojoj je junakinja bila boginja Artemida, a ne nimfa Aretuza. Sama Ortigija, otočić pred Sirakuzom, posvećena je Artemidi, kako kaže Pindar u već citiranoj himni: "Ortigijo, mladico slavne Sirakuze, stolico Artemide, sestro Dela!" (Pi. N. I.2–4). To potvrđuje i Kalimah: "jer sada je luk kretskog Ehemasa položen u Ortigiji, u Artemidinom hramu..." (Call. Epigr. LXIII). Pindar spominje i otok Del, jedan od Kiklada u Egejskome moru. Taj otok čvrsto je vezan uz Artemidu. Postoje razni izvještaji o starom imenu otoka: prema jednome to ime bilo je Asterija (Call. Del. 37; Nonn. D. XXXIII.336–340),[22] prema kćeri titana Koja (sestri Artemidine majke Leto) u koju se zaljubio Zeus. Nakon što ga je odbila, "pretvorena je u pticu *ortyx*, koju mi nazivamo jarebica, te je bačena u more. Od nje je izrastao otok koji nazivamo Ortigija. On je bio plutajući otok. Kasnije je vjetar *Aquilo* tamo odnio Latonu, kada ju je progonio Piton, te je tamo, držeći se za maslinu, rodila Apolona i Dijanu. Otok je kasnije nazvan Del." (Hyg. F. 53).[23] Da se otok Del prvotno zvao Ortigija, tvrde i Vergilije (Verg. Aen. III.124), Likofron (Lyc. Alex. 401–402), Homer (Od. V.123–124), kao i isti onaj

[21] Strabon spominje da se u blizini Alfejeva ušća nalazi svetište Artemide Alfejonije ili Alfejuze. U čast te boginje u Olimpiji se održava godišnja svetkovina (Str. VIII.3.12).

[22] Također: "Od Kojevih kćeri, Asterija se u obličju jarebice bacila u more bježeći od Zeusa. Grad se prvo nazvao po njoj Asterija: kasnije je postao Del." (Apollod. Bibl. I.4).

[23] Da je Del bio plutajući otok, slažu se i Kalimah (Call. Del. 35–36), Ovidije (Ov. Met. VI.186–191; XV.336–337) te Non (Nonn. D. XXXIII.336–340).

The ancient Greeks could have measured the altitude of stars in several ways: "It is known that the width of the middle finger of an extended arm constitutes approximately 2° in the celestial sphere. By the same token, the fist is approximately 8°, and the distance between the extended thumb and index finger approximately 15°, while the distance between the tips of the extended thumb and little finger is approximately 22°" (Franušić 2000: 172). In Oceania the altitude of the polar star was also measured using fingers: the span of the fingers loosely extended at arms length formed one *ey-ass* (approximately 15°; an *ey-ass* is otherwise a hooked breadfruit-picking pole). The Satawal navigators estimated that the pole-star was half an *ey-ass* above the horizon (approximately 7°30'), and one *ey-ass* at Saipan, values that are almost exactly right. A navigator in Honolulu used his fingers to determine the altitude of the polar star as 1½ *ey-ass* (22°30'), which is again very precise (Lewis 1994: 277–278).

So, to sum up: an apparently fanciful, mythological story about an unfortunate love with a happy ending has been presented. The consequence of this love and, it would appear, the cause of this story's origin, is the alleged connection between the Peloponnesian Alfeios River and the island of Ortygia in front of Syracuse. This story is repeated by numerous Classical authors. And while some (Pausanias) unquestioningly accept it, backing it with the undisputed authority of the oracle of Delphi, others (Strabo) reject it as impossible. Strabo used rational arguments to concede the possibility of a subterranean channel as much as 500 km long, but he believed that this was not the case here. It seems that these ancient authors (Strabo in the first century BC, Pausanias in the second century AD), centuries removed from the source of this story, did not comprehend its essence. The key to this enigma is the fact that these two locations, as we have seen, lie on a similar latitude. This fact made it possible to reduce the time of a voyage by using relatively simple celestial navigation techniques. With time this solid scientific fact was "transcribed" into myth, and it was accepted as religious dogma or rejected as scientifically illogical. Of course, the Alfeios River does not flow beneath the Ionian Sea: this is an explanation of the nautical route between the eastern and western Greek worlds rendered in the language of mythology.

There is another, similar story about Alpheus. It is almost identical to the story involving Arethusa, but this time the object of Alpheus' desire is the goddess Artemis. When describing the temple of Artemis Alpheiaea/Alpheian in Letrini (near the mouth of the Alpheus, at 37°40' north latitude), Pausanias re-

Kalimah koji na drugome mjestu daje drugačiji podatak (Call. Apoll. 58–59).[24] Otok Del svugdje se spominje u kontekstu rođenja Apolona i Artemide. Tu također postoje dvije tradicije. Prema jednoj je Artemida rođena na otočiću Ortigiji kraj Dela. Tako se tvrdi u homerskoj Himni Apolonu: "Raduj se, blagoslovljena Leto, jer si rodila slavnu djecu, gospodina Apolona i Artemidu, koja se raduje strijelama; nju na Ortigiji, a njega na kamenitom Delu..." (h. Apoll. 15–16) te u 34. orfičkoj himni posvećenoj Leto (Orph. Hymn. ad Lat. 5–8).[25] Zato se Artemida ponekad naziva Ortigijskom.[26] Ostali izvori spominju da su oboje rođeni na Delu, npr. Higin (vidi gore, Hyg. F. 53) i Apolodor.[27] Nakon što je Leto porodila svoju djecu, otok Asterija/Ortigija/Del prestao je biti lutajući otok te se učvrstio u Kikladima (Call. Del. 260; Str. X.5.2).[28] Lukijan ističe da se lutajući otok Del "otkinuo od Sicilije", povezujući time ta dva udaljena otoka; Posejdon je učvrstio Del kako bi se Leto mogla poroditi (DMar. IX.1). Nakon Letina poroda proglašeno je da se na otoku ne smiju pokapati ni spaljivati mrtvaci; oni se prevoze na otočić u neposrednoj blizini Dela, Reneju, "koja se u ranija vremena nazivala Ortigija" (Str. X.5.5). Iz ovoga je citata očito da je Strabon smatrao da je Ortigija, koja se spominje kao mjesto rođenja Artemide, različita od samog Dela. On Ortigiju identificira kao Reneju, nenaseljen otok u neposrednoj blizini Dela, na kojem se nalazila nekropola Deljana. Na Delu je također bilo zabranjeno roditi se ili umrijeti; umirući i rodilje bili su prevoženi na Reneju (Paus. II.27; Th. III.104; Graves 1992: 56).

[24] Cjelovitu priču donosi Higin. Hera je, saznavši da je Leto trudna sa Zeusom, odredila da djecu mora poroditi tamo gdje sunce ne sja. Također, nesretnu Leto progonio je i Piton, neman s gore Parnas (prema Kalimahu Hera je odredila Aresa da motri kopno, a Iridu more; Call. Del. 61–69). Posejdon je primio Leto te ju je smjestio na otok Ortigiju, koji je prekrio morem. Kasnije je izdigao otok iz mora, pa je na njemu Leto, držeći se za maslinu, rodila Artemidu i Apolona (Hyg. F. 140).

[25] Također Graves 1992: 55–56.

[26] Npr. Ov. Met. I.694–696; V.639–641.

[27] "Druga kćer [titana Koja] Leto imala je odnos s Zeusom, zbog čega ju je Hera progonila po cijeloj zemlji. Konačno je stigla na Del i rodila Artemidu, koja joj je nakon toga pomogla da porodi Apolona" (Apollod. Bibl. I.4).

[28] Strabon prenosi Pindara: "jer odavna je, kaže Pindar, bio [Del] bacan po moru, udarcima svih vjetrova, ali kada je Kojova kćerka [Leto] stupila na njega u mukama porodiljstva, tada su četiri stupa, oslonjena na adamant, uzdignuta okomito iz korijena zemlje, te na svojim kapitelima pridržavaju stijenu" (Pindar *apud* Str. X.5.2). Euzebije prenosi Porfirija: "Ali kad su bolovi svetog poroda zaokupili lijepu Leto cijelim njezinim tijelom, a u utrobi njezinoj se komešahu blizanci, Zemlja zastane, i zastane zrak, otok [Del] se učvrsti, valovi se utišaše; u život uskoči Likorej, bog luka, kralj-prorok, ustoličen na božanskom tronoščU" (Porfirije *apud* Eus. PE III.14).

counted the story about how the goddess acquired this appellation. He described the river god's desire to embrace her. Since his pleas and supplications produced no result, he decided to resort to force. He arrived at Letrini during a nocturnal ceremony that the goddess was holding and he joined the ranks of her nymphs, her companions in the festivities. Since the goddess perceived Alpheus' intentions, she smeared her face and the faces of her nymphs with white mud. When Alpheus came, he could not distinguish between the goddess and her nymphs so he left, his work unfinished. Because of Alpheus' love, the natives of Letrinoi gave the goddess her appellation (Paus. VI.22).[21] This would appear to be the original story, in which the heroine was the goddess Artemis, and not the nymph Arethusa. Ortygia itself, the island in front of Syracuse, is dedicated to Artemis, as Pindar said in his already cited poem: "Ortygia, scion of renowned Syracuse, bed of Artemis, sister of Delos!" (Pi. N. I.2–4). This was confirmed by Callimachus: "...for now the bow of Cretan Echemmas is laid up in Ortygia in the temple of Artemis..." (Call. Epigr. LXIII). Pindar also mentions the island of Delos, one of the Cyclades in the Aegean Sea. This island is very closely associated with Artemis. There are differing accounts of the island's ancient name: according to one it was Asteria (Call. Del. 37; Nonn. D. XXXIII.336–340),[22] after the daughter of the titan Coeus (the sister of Artemis' mother Leto) with whom Zeus fell in love. After she spurned him, "...she was transformed into the bird *ortyks*, which we call a quail, and he cast her into the sea. From her an island sprang up, which was named Ortygia. This was floating. Later Latona was borne there at Jove's command by the wind *Aquilo*, at the time when the Python was pursuing her, and there, clinging to an olive, she gave birth to Apollo and Diana. This island later was called Delos" (Hyg. F. 53).[23] That the island of Delos was originally called Ortygia was also claimed by Virgil (Verg. Aen. III.124), Lycophron (Lyc. Alex. 401–402), Homer (Od. V.123–124), and that same Callimachus who said differently in another instance (Call. Apoll. 58–59).[24] The island of Delos is everywhere mentioned

[21] Strabo mentions that near the mouth of the Alpheus there is a shrine to Artemis Alpheionia or Alpheiusa. An annual feast in honour of this goddess was held in Olympia (Str. VIII.3.12).

[22] Also: "Of the daughters of Coeus, Asteria in the likeness of a quail flung herself into the sea in order to escape the amorous advances of Zeus, and a city was formerly called after her Asteria, but afterwards it was named Delos." (Apollod. Bibl. I.4).

[23] Callimachus (Call. Del. 35–36), Ovid (Ov. Met. VI.186–191; XV.336–337) and Nonnos (Nonn. D. XXXIII.336–340) all agreed that Delos was a floating island.

[24] The entire story was recounted by Hyginus. Hera, learning that Leto was pregnant by Zeus, ordained the children were to be

Imamo, dakle, otok Ortigiju posvećen Artemidi, ispred Sirakuze na Siciliji. Imamo i otok Ortigiju, bilo da je to otočić neposredno kraj Dela ili sam otok Del, također čvrsto vezan uz Artemidu. Osim boginje i Lukijanova navoda – njegove mitološke navode nikada ne treba zanemarivati – što ih još povezuje? Povezuje ih vrlo slična geografska širina: naime Del se nalazi na 37°25' SGŠ,[29] dakle nešto sjevernije od same Sirakuze, ali i dalje na vrlo bliskoj geografskoj širini. Također, to je geografska širina identična onoj izvora rijeke Alfeja te opet vrlo blizu geografske širine ušća te rijeke. Je li slučajnost da su dva otočića na istoj geografskoj širini, udaljena gotovo 900 km zračnom linijom, nazvana istim imenom i posvećena istoj boginji? Vjerojatnije je da je u svim gore navedenim pričama mitološkim rječnikom opisana geografska veza između Dela, Alfeja i Sirakuze.

Postoji još jedna Ortigija. Tacit spominje da su Efežani iz Male Azije tvrdili "da se Dijana i Apolon nisu rodili na Delu, kako to vjeruje prosti narod; da ima kod njih rijeka Kenhrej i gaj Ortigija, gdje je Latona, pri kraju svoje trudnoće, i naslonivši se na maslinu koja još sada postoji, dala na svijet ta božanstva..."[30] Isti gaj kraj Efeza spominje i Strabon: "(...) i tada [dolazi] grad Efez. Na istoj obali, malo iznad mora, je Ortigija, veličanstveni gaj prepun raznih vrsta drveća, najviše čempresa. Kroz njega prolazi rijeka Kenhrej, gdje se kaže da se Leto oprala nakon poroda. Jer ovdje je mitološko mjesto rođenja, i dadilje Ortigije, i svetog mjesta gdje se zbio porod, i masline u blizini, za koju se kaže da se tamo boginja prvo odmorila nakon poroda" (Str. XIV.1.20). Kod te, azijske, Ortigije postojala su razna svetišta, "neka drevna, a neka izgrađena u kasnija vremena; u onima drevnima se nalaze brojni drevni drveni kipovi, a u onima kasnijima su Skopasova djela; npr. Leto koja drži žezlo i Ortigija koja stoji kraj nje, s po jednim djetetom u svakoj ruci. Tamo se jednom godišnje održavaju opće svetkovine..." (Str. XIV.1.20). Pretpostavljamo da su opisana svetišta, ili barem jedno od njih, bila posvećena Artemidi. Efez se nalazi na 37°55' SGŠ, čini se malo previše sjeverno da bi se uspoređivao s ostalim dvjema Ortigijama, iako ne treba isključiti ni tu mogućnost (posebno stoga što Klaudije Ptolemej navodi geografsku širinu za Efez 37°40' sjeverno; Ptol. Geog. V.2). Činjenica je da se nazire osovina Efez–Del–Alfej–Sirakuza. Uvjerljivost toj osovini dodaje činjenica da je Efez bio najveće središte štovanja Artemide u starome vijeku, a u njemu se nalazio i poznati hram Artemide Efeške.

[29] Prema Ptolemeju 37°20' SGŠ (Ptol. Geog. III.14).

[30] Tac. A. III.61.

in context of the birth of Apollo and Artemis. There are also two traditions here. According to one, Artemis was born on the islet of Ortygia next to Delos. This is the claim made in Homeric Hymn to Apollo: "Rejoice, blessed Leto, for you bare glorious children, the lord Apollo and Artemis who delights in arrows; her in Ortygia, and him in rocky Delos..." (h. Apoll. 15–16), and in the 34th Orphic hymn dedicated to Leto (Orph. Hymn. ad Lat. 5–8).[25] This is why Artemis is sometimes called Ortygian.[26] Other sources mention that both were born on Delos, e.g. Hyginus (see above, Hyg. F. 53) and Apollodorus.[27] After Leto gave birth to her children, the island Asteria/Ortygia/Delos stopped being a floating island and took firm ground in the Cyclades (Call. Del. 260; Str. X.5.2).[28] Lucian stressed that the wandering island Delos "was torn from Sicily", thus linking two distant islands; Poseidon fastened Delos to the seafloor so that Leto could give birth (DMar. IX.1). After Leto's delivery, it was decreed that no deceased could be interred or cremated on the island; they were taken to a small island in the immediate vicinity of Delos, Rhenea, which "in earlier times was called Ortygia" (Str. X.5.5). From this citation it is apparent that Strabo believed that Ortygia, which was mentioned as the birthplace of Artemis, was different from Delos itself. He identifies Ortygia as Rhenea, an uninhabited island close to Delos, on which there was a Delian necropolis. Giving birth or dying were also prohibited on Delos; those who were near death and expectant women were taken to Rhenea (Paus. II.27; Th. III.104; Graves 1992: 56).

born where the sun does not shine. Also, the ill-fated Leto was pursued by the Python, the monster from Mt. Parnassus (according to Callimachus, Hera ordered Ares to monitor the land, and Iris the sea; Call. Del. 61–69). Poseidon received Leto and placed her on the island of Ortygia, which he covered with the sea. Later he raised the island from the sea, while Leto, holding on to an olive tree, gave birth to Artemis and Apollo (Hyg. F. 140).

[25] Also Graves 1992: 55–56.

[26] E.g. Ov. Met. I.694–696; V.639–641.

[27] "But Latona for her intrigue with Zeus was hunted by Hera over the whole earth, till she came to Delos and brought forth first Artemis, by the help of whose midwifery she afterwards gave birth to Apollo." (Apollod. Bibl. I.4).

[28] Strabo cites Pindar: "for aforetime, says Pindar, it [Delos] was tossed by the billows, by the blasts of all manner of winds, but when the daughter of Coeus [Leto] in the frenzied pangs of childbirth set foot upon it, then did four pillars, resting on adamant, rise perpendicular from the roots of the earth, and on their capitals sustain the rock. (Pindar apud Str. X.5.2) Eusebius cites Porphyry: "But when the pangs of holy birth through all her frame fair Leto seized, and in her womb twin children stirr'd, still stood the earth, the air stood still, the isle grew fix'd, the wave was hush'd; forth into life Lycoreus sprang, God of the bow, the prophet-king on the divining tripod thron'd". (Porphyry *apud* Eus. PE III.14).

Udaljenost od Efeza do Sirakuze, izravnim morskim putom preko Dela, Korinta i ušća Alfeja iznosi oko 630 NM, a zračnom linijom gotovo 1100 km.

Dodajmo ovomu još jednu zanimljivu vezu između otoka Dela (37°25' SGŠ) i otoka Kalaurije blizu Trezena u Argolidi (37°30' SGŠ). Pauzanija tvrdi da su Apolon i Posejdon zamijenili Kalauriju i Delfe (Paus. II.33); Strabon pak kaže da je Posejdon Del dao Leto u zamjenu za Kalauriju, a Apolonu Delfe u zamjenu za Tenar (Str. VIII.6.14). Oba antička autora navode proročanstvo nekog Efora: "Jednako imat' je Del i Kalauriju otok, presvetu Pitiju [Delfe] i vjetroviti Tenar."[31] Možda je ovo odjek plovidbene rute Del – Kalaurija i dalje prema Korintu.

Iz gore navedenih podataka možemo doći do zaključka o pomorskoj ruti na liniji Kikladi (ili čak Mala Azija) – Korint[32] – dalje Korintskim zaljevom prema Jonskome moru – Sicilija. Fresa smatra da su navigatori iz Jonije koristeći iskustva plovidbe Egejskim morem, koje je na jednakim geografskim širinama kao i Jonsko, preplovljavali otvoreno more i po 38. paraleli plovili između otoka Kefalonije i Mesinskoga tjesnaca (Fresa 1969: 253–254).[33] U tome su imali i pomoć prirodnih orijentira. Naime udaljenost na ruti Kefalenija – Mesinski tjesnac iznosi 237 morskih milja. No planina Enos na Kefaloniji visoka je 1620 m, pa prema formuli $D = 2.06(\sqrt{e} + \sqrt{H})$[34] možemo izračunati da su planinu navigatori mogli vidjeti s udaljenosti od 82 milje. Isto su tako planinu Aspromonte, na samome dnu južne Italije kod Reggija, visoku 1958 m, mogli vidjeti s udaljenosti od 91 milje.[35] Tako su im, po toj ruti, ostajale svega 164 milje otvorenoga mora (*ibid.*: 254). Zbog prevladavajućih sjevernih i južnih vjetrova u Otrantskome kanalu znalo se dogoditi, u slučaju da brod na putovanju prati sjeverni vjetar, da bude odbačen nešto

[31] Paus. II.33.

[32] Iako u to vrijeme nije bio prokopan Korintski kanal, Grci su brodove znali prevlačiti preko Istamske prevlake, između dviju korintskih luka, Leheje i Kenhreje (Fresa 1969: 253). Korint je na 37°55' SGŠ, jednako kao i Efez.

[33] Messina je na 38°10' SGŠ (prema Ptolemeju, 38°30'; Ptol. Geog. III.1).

[34] Gdje je *D* udaljenost s koje se objekt vidi u nautičkim miljama, *e* visina promatrača (u ovom slučaju zanemariva), a *H* visina samoga objekta.

[35] Planina Aspromonte kod Reggija je na 38°10' SGŠ (prema Ptolemeju čak 39°15'; iznos je dan za grad Reggio, koji je inače na 38°05' SGŠ; Ptol. Geog. III.4), isto kao i planina Enos na Kefaleniji (38°10' sjeverno). Najjužnija točka Kefalonije je na 38°05' SGŠ, a najjužnija točka Italije, rt Spartivento, na 37°55' SGŠ. Prema Ptolemeju najjužnija je točka Kefalonije na 36°40' SGŠ (Ptol. Geog. III.13), što je veliko odstupanje od stvarne geografske širine. Ptolemejevi podaci za Peloponez pogrešni su za više od 1° u prosjeku. No za rt Leucopetru (uz rt Spartivento krajnja južna točka talijanskoga kopna) daje iznos od 38° SGŠ (Ptol. Geog. III.1), što u potpunosti odgovara stvarnosti.

There is, therefore, the island of Ortygia dedicated to Artemis, which lies just off the shore of Syracuse, on Sicily. There is also Ortygia, a small island very close to Delos, and Delos itself, also closely tied to Artemis. Besides the goddess and Lucian's assertions—his mythology-related statements should never be neglected—what else connects them? They are connected by a very similar latitude: Delos is at 37°25' north latitude,[29] a little farther north than Syracuse, but still at a very close latitude. Also, this latitude is identical to that of the source of the Alpheus River, and again very close to the latitude of the river's mouth. Is it coincidental that these two small island on the same latitude, almost 900 km apart, have the same name and are dedicated to the same goddess? It is more probable that in all of the aforementioned stories, the language of mythology was used to describe the geographic link between Delos, Alpheus and Syracuse.

There is yet another Ortygia. Tacitus mentions that the Ephesians from Asia Minor claimed "that Diana and Apollo were not born at Delos, as was the vulgar belief. They had in their own country a river Cenchrius, a grove Ortygia, where Latona, as she leaned in the pangs of labour on an olive still standing, gave birth to those two deities..."[30] The same grove in Ephesus is also mentioned by Strabo: "...and then the city Ephesus. On the same coast, slightly above the sea, is also Ortygia, which is a magnificent grove of all kinds of trees, of the cypress most of all. It is traversed by the Cenchrius River, where Leto is said to have bathed herself after her travail. For here is the mythical scene of the birth, and of the nurse Ortygia, and of the holy place where the birth took place, and of the olive tree near by, where the goddess is said first to have taken a rest after she was relieved from her travail" (Str. XIV.1.20). At this, Asian, Ortygia there were various shrines, "some ancient and others built in later times; and in the ancient temples are many ancient wooden images, but in those of later times there are works of Scopas; for example, Leto holding a sceptre and Ortygia standing beside her with a child in each arm. A general festival is held there annually..." (Str. XIV.1.20). It is assumed that the shrines so described, or at least one of them, was dedicated to Artemis. Ephesus lies at 37°55' north latitude, which seems a little too far north to be compared with the other two Ortygias, although this possibility cannot be entirely discarded (particularly since Claudius Ptolemy stated that the latitude of Ephesus was 37°40' north; Ptol. Geog.

[29] According to Ptolemy, 37°20' north latitude (Ptol. Geog. III.14).

[30] Tac. A. III.61.

južnije od svoga kursa, odnosno da se "progresivno smanjuje geografska širina broda" (*ibid.*: 255). Ako smo u pravu u tome da su Grci navigirali pomoću zvijezde Rastaban, onda su mogli primijetiti da se njezina visina smanjuje u slučaju kad brod lagano "zastranjuje" prema jugu, a isto se događalo i sa sjevernim polom.[36] Fresa tvrdi da su navigatori mogli korigirati svoj položaj i pomoću svjetlijih zvijezda južnoga neba koje su promatrali u gornjoj kulminaciji. S odmakom broda od kursa u smjeru juga povećavala bi se visina gornje kulminacije tih zvijezda (*ibid.*: 255–256). U tablici 2 dajemo primjer zvijezda koje su mogli promatrati. Deklinacije su iznesene s negativnim predznakom jer se navedene zvijezde nalaze južno od nebeskog ekvatora. Potvrdu o korištenju zvijezda južnoga neba u navigaciji nalazimo kod Lukana, koji spominje Kanop (Luc. VIII. 181–184). Istu zvijezdu spominje i Kludije Ptolemej, koji prenosi pisanje Marina iz Tira (Ptol. Geog. I.7). Apolonije Rođanin (A. R. III.744–745), Vergilije (Verg. Aen. III.517), i Arat (Arat. 728–731) u kontekstu navigacije spominju Orion. Ako bismo tražili pandan zadnjoj cirkumpolarnoj zvijezdi, onda bi to na jugu bila zvijezda koja se nad južnim horizontom pojavljuje samo u trenutku svoje gornje kulminacije. Uzevši u obzir sve navedene astronomske efekte koji onemogućavaju da se zvijezde vide baš u trenutku kad dodiruju horizont, najizgledniji je kandidat zvijezda Turais (ι *Carinae*). Tako bi se plovidba na liniji Peloponez – Sicilija mogla odvijati, astronomskim rječnikom, između donje kulminacije zvijezde Rastaban i gornje kulminacije zvijezde Turais.

Put između Kefalonije i Mesinskoga tjesnaca mogli su Grci prijeći za dva dana i dvije noći, ako uzmemo da su plovili prosječnom brzinom od 5 milja na sat. Od toga su oko 24 sata bili na otvorenome moru (Fresa 1969: 254). Čini se da je noćna plovidba bila jednako brza kao i dnevna. Tako Herodot piše da "u vrijeme kada su dani najdulji lađa prevali prosječno 70000 hvati [oko 5,6 nautičkih milja po satu] danju, a 60000 [oko 4,8 NM po satu] noću".[37] Kako Herodot eksplicitno navodi da se ovo odnosi na vrijeme ljetnih mjeseci, kada dan traje znatno duže od noći, možemo zaključiti da se po noći nije plovilo ništa sporije, možda čak i nešto brže.

Uz prethodno navedene astronavigacijske tehnike kojima su mornari mogli navigirati između 37. i 38. paralele postoji još jedna tehnika kojom su se mogli služiti. Ta je tehnika promatranje zenitnih zvijezda. Naime deklinacija zvijezde koja nad nekim mjestom

[36] Visina donje kulminacije zvijezde Rastaban promatrane s geografske širine od 38° bila je godine 700. pr. Kr. 4°08', a 1300. pr. Kr. 5°27'.

[37] Hdt. IV.86.

V.2). It is a fact that an Ephesus-Delos-Alpheus-Syracuse axis can be perceived. The axis gains in credibility if one considers that Ephesus was the largest hub of reverence to Artemis in ancient times, and the well-known temple of Artemis of Ephesus was located there. The distance from Ephesus to Syracuse, by direct maritime route via Delos, Corinth and the mouth of the Alpheus is approximately 630 NM, and 1,100 km in a straight line.

To this one should add the interesting link between the island of Delos (37°25' north) and the island of Calauria near Troezen in Argolis (37°30' north). Pausanias claimed that Apollo and Poseidon exchanged Calauria and Delphi (Paus. II.33); Strabo said that Poseidon gave Delos to Leto in exchange for Calauria, while Apollo received Delphi in exchange for Taenarus (Str. VIII.6.14). Both ancient authors cite the prophecy of a certain Ephorus: "Delos and Calaurea alike thou lovest to dwell in, Pytho, too, the holy, and Taenarum swept by the high winds".[31] Perhaps this is an echo of the navigation route from Delos to Calauria and further on to Corinth.

From the aforementioned data we can draw a conclusion about the maritime route from the Cyclades (or even Asia Minor) via Corinth[32] – and beyond the Gulf of Cornith toward the Ionian Sea – to Sicily. Fresa believes that navigators from Ionia, utilising the experience of sailing on the Aegean Sea, which lies at the same latitudes as the Ionian Sea, navigated over the open sea and sailed along the 38th parallel between the island of Kefallonia and the Straits of Messina (Fresa 1969: 253–254).[33] They were aided in this by natural points of orientation. The length of the Kefallonia-Straits of Messina route is 237 nautical miles. But Mt. Ainos on Kefallonia is 1,620 m high, so based on the equation $D = 2.06(\sqrt{e} + \sqrt{H})$[34] we can compute that navigators could have seen it at a distance of 82 miles. By the same token, the mountain of Aspromonte, at the very southern tip of Italy at Reggio, 1,958 m high, could be seen at a distance of 91 miles.[35] Thus, along that same route,

[31] Paus. II.33.

[32] Even though the Corinth Canal had not been dug at that time, the Greeks were known to carry ships over the Isthmus of Corinth between Corinth's two ports, Lechaion and Kenchreai (Fresa 1969: 253). Corinth is at 37°55' north, same as Ephesus.

[33] Messina is at 38°10' north (according to Ptolemy, 38°30'; Ptol. Geog. III.1).

[34] Where *D* is the distance from which the object is seen in nautical miles, *e* the height of the observer (in this case negligible), and *H* the height of the object itself.

[35] The mountain Aspromonte near Rhegium lies at 38°10' north (according to Ptolemy as far as 39°15'; the figure is given for the city of Reggio, which otherwise lies at 38°05' north; Ptol. Geog. III.4), the same as the Mt. Ainos on Kefallonia (38°10' north).

prolazi kroz zenit (dakle kada prelazi mjesni meridijan izravno iznad glave promatrača) jednaka je geografskoj širini toga mjesta. Visina gornje kulminacije te zvijezde slijedom toga iznosi 90°. Drugim riječima, ako neka zvijezda u određenoj epohi ima deklinaciju koja odgovara geografskoj širini mjesta promatrača, ona će se u trenutku svoje gornje kulminacije nalaziti u zenitu promatrača. Tako se geografska širina može odrediti pomoću zenitnih zvijezda. U tablici 3 donosimo neke zvijezde koje su mogle poslužiti kao zenitne zvijezde za geografske širine između 35. i 38. paralele. Vidimo da je npr. vrlo svijetla zvijezda Deneb godine 1300. pr. Kr. izvrsno mogla poslužiti kao zenitna zvijezda za geografsku širinu od 37° sjeverno, a godine 700. pr. Kr. za 38° sjeverno. Isto tako, zvijezde konstelacije Sjeverne krune godine 700. pr. Kr. mogle su u zenitu označavati raspon geografskih širina između 37. i 38. paralele.

Potvrdu da su navigatori u antici koristili tehniku zenitnih zvijezda u antičkih pisaca ne nalazimo. Klaudije Ptolemej u VIII. knjizi *Geografske upute* prilikom opisa karata koje namjerava načiniti navodi kako će odrediti "u kojem zviježđu nebeske kružnice se nalazi geografska dužina mjesta, zatim u kojem je zviježđu sunce jednom ili dvaput direktno iznad glave [tj. u zenitu] te položaje konstelacija u odnosu na same obratnice". Zatim dodaje kako će "pokazati koje zvijezde netko može imati iznad glave, ako bi se pri promatranju geografska širina pričinila na istoj ekvinocijskoj točki, tj. ako bi geografska širina uvijek bila mjerena na istoj paraleli". No zbog kruženja sfere nepomičnih zvijezda oko pola ekliptike "iste zvijezde nisu uvijek direktno iznad glave na istom mjestu, već su neke od njih ponekad nužno sjevernije, a druge južnije" (Ptol. Geog. VIII.2). Čini se da ovdje Ptolemej možda spominje zenitne zvijezde, iako je zbog kompliciranosti njegova jezika ponekad teško dokučiti o čemu točno piše. On ispravno primjećuje da pojedina zvijezda ne ostaje vječno "zenitna zvijezda" za neku geografsku širinu, već da se, zbog precesije, zvijezde pomiču prema jugu ili sjeveru. No navod se može protumačiti i na druge načine. Zbog navedenog razloga ostavit ćemo interpretaciju ovoga Ptolemejeva odlomka otvorenom. Spomenimo i Plinijev navod o "krajevima na istoku, od Indijskog mora, koji se nalaze na istoj geografskoj širini, i koji se zakreću prema Kaspijskom moru, koje je istražila makedonska vojska..." (H. N. II.67). Termin koji Plinije koristi za krajeve na istoj geografskoj širini je *sub eodem sidere*, tj. "oni koji leže ispod iste zvijezde". No opet smo ovdje u ne posve razjašnjenoj situaciji – Plinije ne govori nužno o zenitnim zvijezdama, već je moguće da govori o zvijezdama karakterističnima za neko područje

there remained only 164 miles of open sea (*Ibid.*: 254). Due to the prevailing northern and southern winds in the Strait of Otranto, it did occur—if a ship was following the northern wind on its voyage—that ships were blown somewhat farther south from their course, or "a progressive reduction of the ship's latitude" (*Ibid.*: 255). If we are correct in believing that the Greeks navigated using the star Rastaban, then they could have noticed that its altitude decreased if the ship slightly "veered" to the south, and the same happened to the north pole.[36] Fresa claims that navigators could have adjusted their course with the help of brighter stars of the southern skies observed at their upper culmination. If a ship moved south of its course, the altitude of the upper culmination of these stars increased (*Ibid.*: 255–256). Table 2 contains an example of the stars that could have been observed. The declinations are expressed in negative values because these stars are south of the celestial equator. Confirmation of use of southern-sky stars in navigation can be found in Lucan, who mentions Canopus (Luc. VIII.181–184). The same star is mentioned by Claudius Ptolemy, who cites the writings of Marinus of Tyre (Ptol. Geog. I.7). Apollonius of Rhodes (A. R. III.744–745), Virgil (Verg. Aen. III.517), and Aratus (Arat. 728–731) mention Orion in the context of navigation. If we were to seek a counterpart of the last circumpolar star, then in the south this would be the star that appears on the southern horizon only at the moment of its upper culmination. Taking into account all of the astronomical effects that prevent observation of stars precisely at the moment of their touching the horizon, then the most prospective candidate is Turais (ι *Carinae*). Thus navigation along the Peloponnese–Sicily route could proceed, in astronomical terms, between the lower culmination of Rastaban and the upper culmination of Turais.

The Greeks could have made the voyage between Kefallonia and the Straits of Messina in two days and two nights travelling at an average speed of 5 miles per hour. Out of this, roughly 24 hours were on the open sea (Fresa 1969: 254). It would appear

The southernmost point of Kefallonia lies at 38°05' north, while the southernmost point of Italy, Cape Spartivento, lies at 37°55' north. According to Ptolemy, the southernmost point of Kefallonia lies at 36°40' north (Ptol. Geog. III.13), which varies considerably from its actual latitude. Ptolemy's data for the Peloponnese are off by over 1° on average. However, for Cape Leucopetra (together with Cape Spartivento the southernmost point of the Italian mainland) he cites the measurement of 38° north (Ptol. Geog. III.1), which is entirely accurate.

[36] The altitude of the lower culmination of the star Rastaban observed from a latitude of 38° was 4°08' in 700 BC, and 5°27' in 1300 BC.

općenito. No Aristotel navodi da se Sjeverna kruna, promatrana iz sjeverne umjerene zone, kada prelazi meridijan, nalazi u zenitu (Arist. Mete. II.5). Godine 340. pr. Kr. najsjajnija je zvijezda konstelacije Sjeverne krune, Alphekka (α *Coronae Borealis*), imala deklinaciju oko 36°30', pa je za tu geografsku širinu zaista bila zenitna zvijezda, dok je stotinu godina ranije njezina deklinacija bila oko 37°, pa je mogla biti zenitna zvijezda za tu geografsku širinu. Dakle, moguće je da je u antici bila poznata metoda korištenja zenitnih zvijezda za određivanje geografske širine, iako nemamo izravnih potvrda da je ona korištena i u navigaciji.[38]

Dakle, sada smo uspjeli odrediti položaj pri navigaciji s barem četirima parametrima. Primjerice, ako bi neki mikenski navigator 1300. godine pr. Kr. plovio po 37. paraleli od, recimo, Pila do Sirakuze, preko otvorenoga mora, morao bi bio obratiti pozornost na sljedeće (vidi sl. 2):

1. Morao bi bio držati sjeverni nebeski pol na svojoj desnoj strani na visini od 37° (ako pretpostavimo da je mogao odrediti pol, što vjerojatno jest).

2. Mogao bi bio pratiti visinu donje kulminacije zvijezde Rastaban, koja je iznosila 4°27', također na desnoj strani broda, na sjevernome horizontu. Napominjemo da su se u antici povoljnima za plovidbu smatrali samo lipanj, srpanj, kolovoz i rujan (točnije, sezona plovidbe trajala je od 27. svibnja do 14. rujna). Ožujak, travanj i listopad smatrani su opasnim mjesecima, a tijekom studenoga, prosinca, siječnja i veljače (od 10. studenoga do 10. ožujka) mora su bila "zatvorena". No to ne znači da se u tom razdoblju godine uopće nije plovilo. To spominjemo zato što je zvijezda Rastaban u navedeno me razdoblju bila vidljiva u donjoj kulminaciji samo od rujna do siječnja, pa je većim dijelom razdoblja plovidbe bila nepogodna za navigaciju. No zvijezda ψ *Ursae Maioris* bila je vidljiva u donjoj kulminaciji ($v_{dk1300.\ pr.\ Kr.}$ = 5°17') od travnja do rujna, pa je ona mogla poslužiti kao zadnja cirkumpolarna zvijezda u tom razdoblju godine (zvijezda θ *Ursae Maioris* također je mogla poslužiti u tu svrhu jer je u donjoj kulminaciji bila vidljiva od ožujka do kolovoza; $v_{dk1300.\ pr.\ Kr.}$ = 5°50').

3. Mogao bi bio pratiti visinu gornje kulminacije zvijezde Turais, koja je iznosila 5°01', na lijevoj strani broda prema južnome horizontu. Iz istoga razloga kao i u prethodnoj točki bolje od zvijezde Turais (vidljiva u gornjoj kulminaciji od studenoga do travnja) u ljetnim mjesecima mogle su poslužiti neke druge južne zvijezde, npr. Fomalhaut (vidljiva u gornjoj kulminaciji od lipnja do listopada, $v_{gk1300.\ pr.\ Kr.}$ = 9°55') ili β *Piscis Austrini* (vidljiva od svibnja do listopada, $v_{gk1300.\ pr.\ Kr.}$ = 8°40').

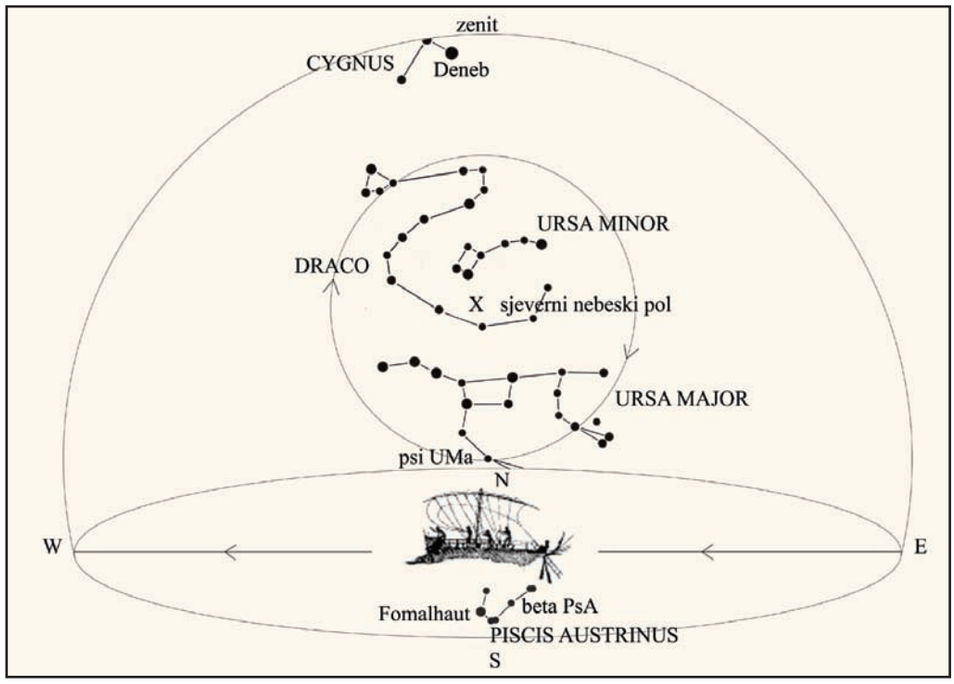
that navigation at night was just as fast as during the day. Thus Herodotus wrote that "a ship will generally accomplish seventy thousand orguiae [approximately 5.6 nautical miles per hour] in a long day's voyage, and sixty thousand [approximately 4.8 NM per hour] by night".[37] Since Herodotus explicitly stated that this pertains to the summer months, when days are much longer than nights, one can conclude that travel by night was no slower, and perhaps even slightly faster.

Besides the preceding celestial navigation techniques that seafarers may have used to navigate between the 37th and 38th parallels, there is another that they could have used. This involves observation of zenith stars. The declination of a star that passes through the zenith above a certain location (i.e., when it passes the local meridian directly above the head of the observer) is equal to the latitude of that location. The altitude of the upper culmination of that star is 90° as a result. In other words, if a star in a given epoch has a declination that corresponds to the latitude of the observer's location, it will be at the observer's zenith at the moment of its upper culmination. Thus the latitude can be determined using the zenith-stars. Table 3 provides some stars that may have served as zenith stars at latitudes between the 35th and 38th parallels. For example, the very bright star Deneb could have served very well as a zenith star in 1300 BC at a latitude of 37° north, while in 700 BC at 38° north. Similarly, the stars of the constellation Corona Borealis in 700 BC could have marked the range of latitudes between the 37th and 38th parallels.

There is no confirmation that navigators in Antiquity used the zenith star technique in the writings of authors of the time. Claudius Ptolemy, in Book VIII of *The Geography*, when describing the maps he intended to make, stated that he will determine "…in which of the constellations of the celestial circle is the longitude of the places, and in which of the constellations the sun is once or twice directly overhead, and the constellation's position with regard to the tropics themselves". He then adds that he will show "what stars each may have overhead, if by observation the latitude should appear at the same equinoctial point, that is if the latitude were always measured on the same parallel". But due to the rotation of the sphere of fixed stars around the pole of the ecliptic "the same stars are not at all times directly overhead in the same place, but of necessity are more northward at one time than at another, and others are more southward" (Ptol.

[38] O korištenju zenitnih zvijezda u navigaciji vidi Bilić 2005: 93.

[37] Hdt. IV.86.



Slika 2. Rekonstrukcija putovanja 1. srpnja 1300. godine pr. Krista (1:00h); brod se nalazi na sjecištu 18. meridijana i 37. paralele (autor: Tomislav Bilić, 2005).

Figure 2. Reconstruction of a voyage on 1 J uly 1300 BC (1:00h); the ship is at the intersection of the 18th meridian and the 37th parallel (by Tomislav Bilić, 2005).

4. Naposljetku, mogao bi bio pratiti zvijezdu Deneb u gornjoj kulminaciji, koja je na 37° sjeverno prolazila točno kroz zenit promatrača. Gornja kulminacija zvijezde Deneb bila je u navedenome razdoblju vidljiva od svibnja do listopada, pa je u godini 1300. pr. Kr. izvrsno mogla poslužiti kao zenitna zvijezda za geografsku širinu od 37° sjeverno. Svi podaci iz ove i prethodnih dviju točaka mogu se provjeriti u tablici 4a.

U opisu ovoga hipotetskog puta navodimo kako je polazna točka bio grad Pil. Pod tim mislimo na Pil u Meseniji, koji se nalazi na 37° SGŠ. Vratimo se na raniju raspravu o Alfeju, odnosno različitim izvještajima o izvoru, toku i ušću te rijeke. Dodatnu zabunu o tome u antici je izazvao stih u kojem Homer spominje rijeku "Alfeja, koji teče široko kroz zemlju Pilsku".[39] Na Peloponezu postoje čak tri Pila, poimence Mesenijski, Elejski i Trifilijski, odnosno Leprejski ili Arkadijski (Str. VIII.3.7), pa se postavlja pitanje na koji je Pil pjesnik mislio? Uvriježeno je mišljenje povjesničara i arheologa da je slavni Nestorov Pil ovaj u Meseniji, koji smo mi uzeli za primjer; to mišljenje prevladavalo je i u antici: "većina suvremenih autora, povjesničara i pjesnika, kažu da je Nestor bio Mesenjanin" (Str. VIII.3.7). No Pauza-

[39] Il. V.545.

Geog. VIII.2). It seems that here Ptolemy is perhaps referring to zenith stars, although the complexity of his language sometimes makes it difficult to comprehend exactly what he is writing about. He correctly noticed that individual stars do not remain "zenith stars" eternally at a given latitude, but rather, due to precession, move toward south or north. But this statement can be interpreted in other ways, as well. For this reason, interpretation of this passage by Ptolemy will be left open. Also notable is Pliny's statement: "…towards the east, from the Indian sea, all that part which lies in the same latitude, and which bends round towards the Caspian, has been explored by the Macedonian arms..." (H. N. II.67). The term used by Pliny for regions on the same latitude is *sub eodem sidere*, i.e., "those which lie under the same star". But here we are once more at a not entirely clear situation: Pliny was not necessarily talking about zenith stars, rather it is possible that he is speaking of stars characteristic of a given region in general. Aristotle stated that the Corona Borealis, observed from the northern temperate zone, is at zenith when it passes the meridian (Arist. Mete. II.5). In 340 BC, the brightest star in Corona Borealis, Alphekka (α *Coronae Borealis*), had a declination of approximately 36°30', so at this latitude it was truly a zenith star, while one hundred years earlier its declination was approximately 37°, so it may have been the zenith star for this latitude. Thus, it

nija smatra da je Nestorov Pil mjesto u Elidi (Paus. VI.22). Strabon kaže da to "…nije Nestorov grad, nego jedan drugi Pil koji nema ništa zajedničko s Alfejem..." (Str. VIII.3.7), s čime se moramo složiti. No Strabon smatra da je Pil koji spominje Homer grad u Trifiliji u blizini same rijeke koja se danas naziva Alfej (Str. VIII.3.14). Ostatak trećega poglavlja VIII. knjige (24–29) Strabon posvećuje dokazivanju, geografskom interpretacijom nekih mitoloških priča, da je Nestorov Pil baš onaj Trifilijski, a nikako Mesenijski ili Elejski Pil. Činjenica da je Mesenijski Pil na identičnoj geografskoj širini kao Ortigija na Siciliji navodi nas na pomisao da je baš taj grad onaj koji spominje Homer. Uistinu kod tog Pila nema neke važnije rijeke, osobito ne neke koja bi se zvala Alfej, ali to ne govori mnogo jer se u Homerovo vrijeme tako mogla zvati neka lokalna rječica. Aretuza na Ortigiji također je zanemarive duljine.

Nakon što smo opisali dva pomorska puta preko otvorenoga mora (onaj po 37. paraleli od Pila do Sirakuze i drugi po 38. paraleli od Kefalenije do Mesinskoga tjesnaca – vidi kartu 1), pogledajmo postoje li i neki drugi putovi koje su pomorci staroga vijeka mogli koristiti, ponajprije služeći se tehnikom navigacije pomoću zvijezda, koju možemo nazvati "plovidba po geografskoj širini". Prva točka prema kojoj ćemo baciti pogled jest otok Kreta, središte velike pomorske civilizacije koja je cvjetala u prvoj polovici drugoga milenija pr. Kr., a koju Homer opisuje poznatim stihovima: "Zemlja Kreta imade u iskričavome moru, zemlja lijepa i rodna, oko nje voda, a na njoj mnogi bezbrojni ljudi, gradova tu je devedeset..."[40]

Kreta je smještena između 34°55' i 35°40' SGŠ. Na prvi pogled dva su pomorska puta koji vode s otoka prema bilo kojem odredištu: sjeverozapadni put preko otočića Antikitere i otoka Kitere[41] prema Peloponezu te sjeveroistočni put preko otoka Karpata do Roda i dalje prema Aziji. Oba ova puta ne zahtijevaju da se kopno u bilo kojem trenutku izgubi iz vida. Tako bi, primjerice, minojski (ili mikenski) pomorci koji su plovili na Cipar, koristili sljedeći pravac: Kreta – Karpat – Rod – obala Male Azije – Cipar.[42] No postoji i drugi način. Jugoistočni rt Krete

[40] Od. XIX.172–174.

[41] "Bogovi i ljudi nju nazivaju Afrodita... i Kiteranka, jer je dospjela do Kitere..." (Hes. Th. 196–197; vidi također h. Ven. (V) 5, 175 i dr).

[42] "[Afroditu nazivaju i] Ciprogenetka, jer je rođena na ustalasanom Cipru" (Hes. Th. 200); "O Kiteranki, rođenoj na Cipru, ja ću pjevati" (h. Ven X.1). Glavno mjesto štovanja Afrodite u antici bio je Paf na Cipru. Zanimljivo, iako su u stvarnosti Paf i Kitera dosta udaljeni po geografskoj širini (Kitera 36°10'–36°25' SGŠ, Paf 34°45' SGŠ, Ptolemej ih smješta na gotovo identičnu geografsku širinu (Kitera 34°40' SGŠ, Paf 35° SGŠ; Ptol. Geog. III.14, V.13).

is possible that during the Antiquity the zenith star method to determine latitude was known, although there is no direct confirmation that it was used in navigation.[38]

At this point, the position in navigation has been determined with at least four parameters. For example, if a Mycenaean navigator sailed along the 37th parallel from, say, Pylos to Syracuse in 1300 BC over the open sea, he would have had accord due attention to the following (see Fig. 2):

1. He would have had to keep the northern celestial pole to his right at an altitude of 37° (assuming that he could determine the pole, which he probably could).

2. He could have monitored the altitude of the lower culmination of Rastaban, which was 4°27', also on the right side of the ship, on the northern horizon. Worth noting is that in the Antiquity only June, July, August and September were deemed suitable for navigation (more precisely, the sailing season lasted from 27 May to 14 September). March, April and October were deemed perilous months, while the seas were "closed" during November, December, January and February (from 10 November to 10 March). This does not mean that there was no sailing at all during these months. This is mentioned here because during this period Rastaban was visible in its lower culmination from September to January, so that during most of the sailing season it was unusable for navigation. But the star ψ *Ursae Maioris* was visible in its lower culmination ($alt_{lc1300\ BC}$ = 5°17') from April to September, so it may have served as the last circumpolar star during this time of the year (star θ *Ursae Maioris* may also have served this purpose because in its lower culmination it was visible from March to August; $alt_{lc1300\ BC}$ = 5°50').

3. He could have monitored the altitude of the upper culmination of Turais, which was 5°01' from the left side of the ship toward the southern horizon. As in the preceding point, in the summer months some other southern stars could have served better than Turais (visible in its upper culmination from November to April), e.g. Fomalhaut (visible in its upper culmination from June to October, $alt_{uc1300\ BC}$ = 9°55') or β *Piscis Austrini* (visible from May to October, $alt_{uc1300\ BC}$ = 8°40').

4. Finally, he could have monitored Deneb in its upper culmination, which passed exactly over the observer's zenith at 37°. Deneb's upper culmination was visible during this period from May to October, so it could have served quite well as a zenith star at a latitude of 37° north in 1300 BC. All data from

[38] On the use of zenith stars in navigation, see Bilić 2005: 93.

Gudura nalazi se na točno 35° SGŠ, a rt Arnauti na sjeverozapadnome rubu Cipra na 35°05' SGŠ. Dakle, pomorci su tehnikom "plovidbe po geografskoj širini" bez većih poteškoća s Krete na Cipar mogli stići navigirajući prema zvijezdama. Drugi mogući put bio bi onaj između sjeveroistočnoga rta Krete Sidera (35°20' SGŠ) i najistaknutije točke na sjevernoj obali Cipra okrenute prema istoku, u blizini grada Kirenije (na 35°25' SGŠ). To su dva moguća puta s Krete na Cipar. Od Cipra se dalje moglo ploviti prema obali Sirije (i obrnuto), točnije prema Ugaritu, velikoj brončanodobnoj luci koja je održavala kontakte s Ciprom i Kretom već u 18. st. pr. Kr., a osobito od 1400. do 1200. pr. Kr. I ovdje je moguća plovidba po geografskoj širini. Naime Ugarit se nalazio na 35°40' SGŠ, što odgovara geografskoj širini rta Andreas na sjeveroistočnome rubu Cipra.

Pogledajmo sada zapadni pravac plovidbe s Krete. Pretpostavlja se da je minojski (ili mikenski) put plovidbe prema Siciliji išao uz obalu, dakle pravcem Kreta – Antikitera – Kitera – Peloponez, pa dalje prema sjeverozapadu, kako smo to naveli ranije. No opet su moguće i druge varijante. Prvo, Krećani su navedenim putom mogli doploviti do Pila, a otuda gore opisanim putom ploviti po 37. paraleli. Time bi put od Krete do Sirakuze smanjili s oko 600 NM na oko 430 NM. No mogli su ploviti i na drugi način. Sjeverozapadni rt Krete (Spata), ujedno i najsjevernija točka na otoku, nalazi se na 35°40' SGŠ. Malta, udaljena oko 430 NM prema zapadu, nalazi se između 35°50 i 36°05' SGŠ (uključujući otok Gozo u neposrednoj blizini). Dakle, uz upotrebu pravih zvijezda opet je moguća "plovidba po geografskoj širini". Od Malte je lako doploviti do Sicilije (karta 1). Napomenimo da su kontakti između Krete i Cipra s jedne strane te između Krete i Sicilije s druge arheološki potvrđeni. Ti kontakti potvrđeni su osobito u mikenskome razdoblju (Castleden 2002: 118–122). Kao ilustracija tih dodira Krete i Sicilije može poslužiti mit o Dedalu i Minosu. Naime Dedal je, nakon Ikarove pogibije, dospio u grad Kamik na Siciliji (kraj Agrigenta), gdje ga je primio kralj Kokal. Za njim je u potjeru, zajedno s velikom flotom, krenuo Minos. Kretski je kralj na prevaru otkrio da Kokal skriva Dedala, no kraljeve su kćeri Minosa na lukav način ubile. Minosov je grob poslije bio mjesto hodočašća za brojne stanovnike Sicilije jer je bio smješten u Afroditinu hramu. Sicilijanci su spalili većinu kretske flote, pa su Krećani bili prisiljeni ostati na Siciliji, osnovavši ondje gradove Minou, Hiriju i Engij (Graves 1992: 313–314; antički izvori iz kojih je priča sakupljena jesu Verg. Aen. VI.14–33; Paus. VII.4; D. S. IV.78–79; Apollod. Epit. I.14–15; Hdt. VII.170; Zen. IV.92).

Navedimo još dva moguća pravca takve plovidbe. Jedan bi po 36. paraleli vodio od južnih obala Likije, Pamfilije i Kilikije (najjužnije se obala Male Azi-

this and the preceding two points can be verified in Table 4a.

In the description of this hypothetical voyage, it should be noted that the point of departure is the town of Pylos. This refers to Pylos in Messenia, located at 37° north latitude. Returning to discussion of the Alfeios, and the differing accounts of this river's source, course and mouth, additional confusion in the ancient times was caused by a verse in which Homer mentions the river "...Alpheius that flows in broad stream through the land of the Pylians".[39] There are three Pyloi on the Peloponnese, that of Messenia, Elis and Triphylia (or Leprea or Arcadia) respectively (Str. VIII.3.7), so the question arises as to which Pylos the poet referred. Historians and archaeologists have generally accepted the view that the famed Nestor's Pylos was the one in Messenia, which is used in the example here; this view was also predominant in the Antiquity: "…most of the more recent writers, both historians and poets, say that Nestor was a Messenian" (Str. VIII.3.7). But Pausanias believed that Nestor's Pylos was a place in Elis (Paus. VI.22). Strabo said that this is "…not the city of Nestor, but another Pylus which has nothing in common with the Alpheius..." (Str. VIII.3.7), with which this author must agree. But Strabo thought that the Pylos mentioned by Homer is the city of Tryphilia near the river that is today called Alfeios (Str. VIII.3.14). Strabo dedicates the remainder of the third chapter in Book VIII (24–29) to proving, by means of geographic interpretation of certain myths, that Nestor's Pylos is precisely that in Triphylia, and neither the Messenian nor Elean Pylos. The fact that the Messenian Pylos is on an identical latitude as Ortygia on Sicily leads this author to believe that this is precisely the city mentioned by Homer. To be sure, there are no major rivers near this Pylos, particularly not one that could be called the Alfeios, but this does not count for much since a local river could have had that name during Homer's time. The length of the Arethusa on Ortygia is also negligible.

Having described two maritime routes over the open sea (along the 37th parallel from Pylos to Syracuse and along the 38th parallel from Kefallonia to the Straits of Messina – see Map 1), it is time to see if there were any other routes that ancient seafarers may have used, primarily using celestial navigation, which can be referred to as "latitude sailing". The first point to be observed will be the island of Crete, the hub of a major maritime civilisation which blossomed in the first half of the second millennium BC, and which Homer described with the well known

[39] Il. V.545.

je spušta kod grada, odnosno rta, Anamur u Kilikiji, današnja Turska, na 36° SGŠ, te kod otočića ispred gradova Finike, blizu rta Gelidonija gdje je pronađen poznati brončanodobni brodolom, 36°05' SGŠ, i Kasa, 36°10' SGŠ, oba u Likiji, također danas u Turskoj), preko Roda (čija je najjužnija točka na 35°50' SGŠ), odnosno Karpata (čija je najsjevernija točka na 36° SGŠ, uzevši u obzir i otočić Sariju u neposrednoj blizini), na južni rt otoka Kitere ispod Peloponeza (36°10' SGŠ) i zatim dalje, po 36. paraleli, preko otvorenoga mora sve do Malte (smještena između 35°50' i 36°05' SGŠ). Taj pravac mogao se produžiti od rta Anamur prema istoku do sirijske obale, gdje se nalazilo poznato trgovačko središte Ugarit, na 35°40' SGŠ. Drugi takav mogući put išao bi od sjeverne obale Roda (36°30' SGŠ), prema zapadu uz južnu obalu otoka Tere (36°25' SGŠ), odnosno uz južni rub Kikladskog otočja, zatim preko rtova Malea i Matapan na Peloponezu (36°25' SGŠ) na otvoreno more i dalje do Sicilije (najjužnija točka Sicilije je Punta della Formiche na 36°40', u neposrednoj blizini jugoistočnoga rta Sicilije, rta Passero). Postoji i druga varijanta ovoga puta, a ta je da se dođe do rta Akritas na Peloponezu (36°45' SGŠ) pa se odande nastavi prema Siciliji.

Pokušajmo sada rekonstruirati jedan od putova koje smo gore naveli. Uzmimo za primjer trasu između Kitere i Malte, put koji je vodio po 36. paraleli, a kojim su se Krećani mogli služiti za svoja putovanja na Siciliju. Dakle, minojski navigator koji bi godine 1700. pr. Kr. plovio između Kitere i Malte morao bi bio obratiti pozornost na sljedeće:

1. Morao bi bio držati sjeverni nebeski pol na svojoj desnoj strani na visini od 36° (ako pretpostavimo da je mogao odrediti pol, što vjerojatno jest). Te su godine najbliže polu bile zvijezde Kochab (udaljena 7°14'), κ *Draconis* (udaljena 5°16') te Thuban (mag. 3.67, udaljena od pola 6°11').

2. Mogao bi bio pratiti visinu donje kulminacije zvijezde θ *Ursae Maioris*, koja je iznosila 4°17', također na desnoj strani broda, na sjevernome horizontu.

3. Mogao bi bio pratiti visinu gornje kulminacije zvijezde β *Piscis Austrini*, koja je iznosila 8°13', na lijevoj strani broda prema južnome horizontu.

4. Naposljetku, mogao bi bio pratiti zvijezdu ξ *Herculis* u gornjoj kulminaciji, koja je na 36° sjeverno prolazila točno kroz zenit promatrača.

Iz tablice 5 vidljivo je da je zvijezda θ *Ursae Maioris* bila vidljiva u donjoj kulminaciji tijekom plovnoga razdoblja od svibnja do rujna, zvijezda β *Piscis Austrini* u gornjoj kulminaciji od svibnja do listopada, a zvijezda ξ *Herculis* također u gornjoj kulminaciji od svibnja do rujna.

Potkrepu ovomu hipotetskom putu između Roda i Sicilije nalazimo u Strabona. On piše da je "Iberski rt, kojeg nazivaju Sveti rt, najzapadnija točka naseljenog

verse: "There is a land called Crete, in the midst of the wine-dark sea, a fair, rich land, begirt with water, and therein are many men, past counting, and ninety cities..."[40]

Crete lies between 34°55' and 35°40' north latitude. At first glance, there are two maritime routes that lead from the island toward any other destination: the north-western route via the small island of Antikythera and the island of Kythera[41] toward the Peloponnese, and a north-eastern route via the island of Karpathos and then Rhodes and further toward Asia. Both of these routes do not require losing sight of the mainland at any time. Thus, for example, Minoan (or Mycenaean) seafarers travelling to Cyprus used the following route: Crete – Karpathos – Rhodes – Asia Minor coast – Cyprus.[42] There is also another way. The southeastern cape of Crete, Goudouras, lies precisely on 35° north, while Cape Arnauti on the north-western edge of Cyprus lies at 35°05' north. So by "latitude sailing" technique, seafarers could easily travel from Crete to Cyprus using celestial navigation. Another possible route would be that between Crete's north-eastern cape, Sidera (35°20' north), and the most prominent point on the northern coast of Cyprus facing east, near the city of Kyrenia (at 35°25' north). These are two possible routes from Crete to Cyprus. From Cyprus is was possible to sail to the coast of Syria (and back), more precisely to Ugarit, the large Bronze Age port that maintained contacts with Cyprus and Crete already in the eighteenth century BC, and particularly from 1400 to 1200 BC. Even here latitude sailing was possible. This is because Ugarit was at 35°40' north, which corresponds to the latitude of Cape Andreas on the north-eastern edge of Cyprus.

Now let us turn to travel from Crete toward the west. It is assumed that Minoan (or Mycenaean) navigation routes to Sicily ran along the coast. Thus, along the Crete-Antikythera-Kythera-Peloponnese route, and further toward the north-west, as stated earlier. But again, other variants are possible. First, the Cretans could have sailed to Pylos along this route, and from there sail along route on the 37th parallel described above. They would have

[40] Od. XIX.172–174.

[41] "Her gods and men call Aphrodite... and Cytherea because she reached Cythera..." (Hes. Th. 196–197; see also h.Ven. (V) 5, 175 etc.).

[42] "[Aphrodite is also called] Cyprogenes because she was born in billowy Cyprus" (Hes. Th. 200); "Of Cytherea, born in Cyprus, I will sing" (h.Ven X.1). The principal site of reverence to Aphrodite in Antiquity was Paphos on Cyprus. Interestingly, although in reality Paphos and Kythera are quite far apart in terms of latitude (Kythera 36°10'–36°25' north, Paphos 34°45' north), Ptolemy placed them at almost the same latitude (Kythera 34°40' north, Paphos 35° north; Ptol. Geog. III.14, V.13).

svijeta; a taj rt leži otprilike na liniji koja prolazi kroz Gades, [Heraklove] Stupove, Sicilski prolaz i Rod. Na svim tim točkama, kažu, sjene koje baca gnomon se slažu [jednako su duge], vjetrovi koji pušu u bilo kojem smjeru dolaze iz istog smjera, a dužine najdužih dana i noći su iste; jer najduži dan i najduža noć traju 14 i ½ ekvinocijalnih sati" (Str. II.5.14).[43] To implicira da su antički pomorci znali da su Rod i južni rub Sicilije na sličnoj geografskoj širini te da je prema tome između njih bila moguća plovidba po geografskoj širini. Već smo ranije vidjeli da Ptolemej donosi širinu od 36° za najjužniju točku Sicilije, kao i za sjevernu obalu Roda. Za Gibraltar donosi geografsku širinu od 36°15', a najjužniju točku Europe smješta nešto zapadnije na 36°05' (Ptol. Geo. II.3). Najsjeverniju točku Mauretanije smješta na 35°55' SGŠ (IV.1), tako da ti iznosi potvrđuju Strabona. U stvarnosti je najjužnija točka Sicilije na 36°40' sjeverno, a najjužnija točka Iberskoga poluotoka, Punta de Tarifa, na točno 36° (Gibraltar je na 36°05' SGŠ). Najsjevernija je točka Afrike kod Ceute, na 35°55' SGŠ.

Zaključak

Čini se da poznati grčki mit o Alfeju i Aretuzi[44] predstavlja slikovit opis prakticiranja plovidbe po

[43] Strabon nadalje tu paralelu opisuje kao "liniju... koja ide od zapada kroz [Heraklove] Stupove i Sicilski tjesnac do Roda i Iškoga zaljeva, prolazi uz planinski lanac Taurusa, koji zaogrnjuje Aziju, i završava u Istočnom moru između Indije i zemlje onih Skita koji žive iza Baktrije" (Str. II.5.14). On također prenosi Posidonija, koji tvrdi da "Knid leži na istoj paraleli kao i Rod, na kojoj leže i Gades i tamošnja obala" (Posidonije *apud* Str. II.5.14). Strabon prenosi slične Eratostenove (Eratosten *apud* Str. II.1.1) i Hiparhove (Hiparh *apud* Str. II.1.11) tvrdnje. Zanimljivo je da tvrdi kako se Hiparh za tvrdnju "kako Kilikija leži točno u pravcu istoka u odnosu na [Heraklove] stupove" morao "potpuno osloniti na tvrdnje mornara" za dio puta "između Stupova i Mesinskog tjesnaca" (*ibid.*). Plinije, kad opisuje mjerenja opsega Zemlje, spominje dva pravca: prvi, koji ide od ušća Gangesa prema zapadu, te drugi, koji teče nešto sjevernije. Nas zanimaju samo odsječci tih pravaca vezani uz pomorske putove koje spominjemo u članku. Tako prvi pravac prolazi kroz Mirijandar, grad u Siriji u Iškome zaljevu (nešto sjevernije od Ugarita), preko Cipra, Patare u Likiji, Roda, Astipaleje (otoka kod Karpata), rta Tenar u Lakoniji, Lilibeja na Siciliji i Kalarisa na Sardiniji; drugi pravac prolazi kroz Efez, zatim preko Dela ide na Korintski kanal, dalje kroz Patru i rt Leucatu do Korkire i dalje do Italije (H. N. II.112). Prvi pravac otprilike odgovara putovima po 36. (do 36°30'), a drugi po 37. (odnosno 38.) paralaleli.

[44] Spomenimo na ovome mjestu ostale antičke lokacije istog imena. Izvor Aretuza na Itaci (iako Homerova Itaka do danas nije sasvim precizno identificirana, današnji otok tog imena leži na oko 38°20' SGŠ) koji Homer spominje u *Odiseji* (Od. XIII.408) te izvor u blizini Halkide na Eubeji (H. N. IV.12; Str. I.3.16) uklapaju se u sheme pomorskih putova koje smo opisali (Halkida se nalazi na 38°25' SGŠ). Grad u Makedoniji istog imena vjerojatno su osnovali kolonisti iz Halkide, a gradu Aretuzij u Siriji, nedaleko od Apameje (H. N. V.19), ime je helenizirao Seleuk Nikator (App. Syr. 57). Grad se danas naziva Rastan i nalazi se na 34°55' SGŠ. Plinije (H. N. VI.31) Aretuzom naziva i jedno jezero u Armeniji, kroz koje navodno, a da ne miješa svoje vode s njime, protječe Tigris. Ta nas priča neodoljivo podsjeća na Alfejevo nemiješanje s vodama Jonskoga mora.

thereby shortened the voyage from Crete to Syracuse from approximately 600 to approximately 430 NM. But they could have travelled differently as well. The north-western cape of Crete (Spatha), also the island's northernmost point, lies at 35°40' north. Malta, approximately 430 NM to the west, lies between 35°50 and 36°05' north (including the island of Gozo in the immediate vicinity). Thus, by using the right stars, "latitude sailing" is again possible. From Malta it is simple to sail on to Sicily (Map 1). It is worthwhile noting that archaeological research has confirmed contacts between Crete and Cyprus on one hand and between Crete and Sicily on the other. These contacts have been confirmed particularly for the Mycenaean periods (Castleden 2002: 118–122). The myth of Daedalus and Minos can serve as an illustration of these contacts between Crete and Sicily. After the death of Icarus, Daedalus made his way to the city of Camicus on Sicily (next to Agrigento), where he was received by King Cocalus. Minos pursued him with a vast fleet. By deception, the Cretan king learned that Cocalus was concealing Daedalus, but the daughters of Cocalus killed Minos in a clever fashion. The tomb of Minos was later a pilgrimage site for numerous Sicilian natives, because it was placed in the temple of Aphrodite. The Sicilians set fire to most of the Cretan fleet, so the Cretans were forced to remain on Sicily, there establishing the towns of Minoa, Hyria and Enguos (Graves 1992: 313–314; the Classical sources from which the stories were collected are Verg. Aen. VI.14–33; Paus. VII.4; D.S. IV.78–79; Apollod. Epit. I.14–15; Hdt. VII.170; Zen. IV.92).

Two other possible routes for such navigation should be noted. One would run along the 36th parallel, from the southern coast of Lycia, Pamphylia and Cilicia (the southernmost coast of Asia Minor descends at the city and cape of Anamur in Cilicia, today's Turkey, at 36° north, and the small islands in front of the cities of Finica, near Cape Gelidonia, where the well-known Bronze Age shipwreck was found, 36°05' north, and Kas, 36°10' north, both in Lycia, also in today's Turkey), via Rhodes (whose southernmost point lies at 35°50' north), and Karpathos (whose northernmost point lies at 36° north, taking into account the nearby small island of Saria), to the southern cape of the island of Kythera below the Peloponnese (36°10' north) and then beyond, along the 36th parallel, across the open sea up to Malta (situated between 35°50' and 36°05' north). This route may have extended from Cape Anamur to the east and the Syrian coast, where the well-known trade hub Ugarit was located, at 35°40' north. The other possible route ran from the northern coast of Rhodes (36°30' north), westward to the southern cost of island of Thira (36°25' north),

geografskoj širini između Peloponeza i Sicilije. Vrlo slična geografska širina tih dviju lokacija omogućila je takvu plovidbu. Druga objašnjenja tog neobičnog mita manje su uvjerljiva. Moguće je da su po toj trasi pomorci plovili već u mikensko vrijeme, a i prije.

Pokušavajući objasniti način na koji se u to vrijeme moglo navigirati prema zvijezdama došao sam do zaključka da je jedna od najvažnijih zvijezda korištenih u to vrijeme mogla biti Rastaban iz zviježđa Zmaja. Pronašao sam i potvrdu o korištenju te konstelacije u navigacijske svrhe. Činjenica je da su antički učenjaci pomno promatrali visine pojedinih asterizama i uočavali njihovu različitost ovisno o točki promatranja. Rastaban je mogla dobro poslužiti kao zadnja cirkumpolarna zvijezda na geografskoj širini od oko 37° SGŠ te se pomoću nje moglo prilično točno navigirati između Peloponeza i Sicilije i obratno. Potvrdu o promatranju udaljenosti zviježđa Zmaja od pola također nalazimo kod nekih autora.

Donosimo još nekoliko tehnika kojima se mogla dopunjavati gore spomenuta navigacija: to su promatranje visine sjevernoga nebeskog pola, zatim promatranje visina gornjih kulminacija nekih svijetlih zvijezda južnoga neba i, naposljetku, promatranje tzv. zenitnih zvijezda. Zenitna zvijezda neke lokacije je ona koja u gornjoj kulminaciji prolazi kroz zenit promatrača, a ima deklinaciju jednaku geografskoj širini promatrača.

Sa sicilskom Ortigijom povezali smo još dvije Ortigije: otok Del, koji se tako zvao u davnini, i grad Efez, koji je imao svetište istog imena. Sve su te lokacije na sličnoj geografskoj širini te su posvećene boginji Artemidi. Pomorski put između Efeza i Mesinskoga tjesnaca po 38. paraleli vodio je preko Korintske prevlake.

Raspravlja se i o drugim mogućim putovima kojima su sredozemni pomorci mogli ploviti sve od brončanoga doba. Dani su primjeri nekoliko pomorskih putova između velikoga brončanodobnog trgovišta Ugarita na obali Sirije, preko južne obale Male Azije, otoka Cipra, Roda i Krete, prema Siciliji i zapadnom Mediteranu. Te su putove mogli koristiti već minojski pomorci. Opisane su i zvijezde koje su na tim trasama mogle služiti za navigaciju, a tehnike su vjerojatno bile identične opisanima kod pomorskoga puta između Peloponeza i Sicilije.

Iz svega gore navedenoga možemo zaključiti da je plovidba po geografskoj širini, često korištena na Indijskom oceanu vjerojatno već od najstarijih vremena, bila prisutna i na mediteranskome prostoru već od brončanoga doba.

Konkretnu potvrdu postojanja izravnoga pomorskog puta između Sirakuze i ušća Alfeja, kao i točnu vremensku odrednicu u kojoj se putovanje odvijalo,

along the southern edge of the Cyclades, and then past Capes Malea and Matapan on the Peloponnese (36°25' north) to the open sea and on to Sicily (the southernmost point on Sicily is Punta della Formiche at 36°40', close to the southeastern cape of Sicily, Cape Passero). There is another variation on this route, running from Cape Akritas on the Peloponnese (36°45' north) and then on to Sicily.

Now let us attempt to reconstruct one of the voyages as described above. The route between Kythera and Malta, which ran along the 36th parallel, which the Cretans could have used to travel to Sicily, will be taken as an example. Thus, a Minoan navigator who sailed between Kythera and Malta in 1700 BC would have had to accord attention to the following:

1. He would have had to maintain the northern celestial pole to his right at an altitude of 36° (assuming that he could determine the pole, which he probably could). In this year, the stars closest to the pole were Kochab (7°14' away), κ *Draconis* (5°16' away) and Thuban (mag. 3.67, 6°11' from the pole).

2. He could have followed the altitude of the lower culmination of θ *Ursae Maioris*, which was 4°17', also to the right of the ship, on the northern horizon.

3. He could have followed the upper culmination of β *Piscis Austrini*, which was 8°13', to the left of the ship toward the southern horizon.

4. Finally, he could have followed ξ *Herculis* at its upper culmination, which passed precisely over the observer's zenith at 36° north.

From Table 5 it is clear that θ *Ursae Maioris* was visible at its lower culmination during the sailing season from May to September, β *Piscis Austrini* at its upper culmination from May to October, and ξ *Herculis* also at its upper culmination from May to September.

Confirmation of this hypothetical voyage between Rhodes and Sicily can be found in Strabo. He wrote that "the most western point of the habitable earth is the promontory of the Iberians named the Sacred Promontory. It lies nearly in a line with Gades, the Pillars of Hercules, the Strait of Sicily, and Rhodes; for they say that the horologes accord, as also the periodical winds, and the duration of the longest nights and days, which consist of fourteen and a half equinoctial hours" (Str. II.5.14).[43] This implies

[43] Strabo further describes this parallel as "...a line drawn from the west... passing by the Pillars of Hercules and the Strait of Sicily to Rhodes and the Gulf of Issus, then proceeding along the chain of the Taurus, which divides Asia, and terminating in the Eastern Ocean, between India and the Scytihians dwelling beyond Bactriana" (Str. II.5.14). He also cites Posidoniuis, who claimed that "Cindus is under the same parallel as Rhodes, which is likewise that of Gades and its sea-coast" (Posidonius *apud*

pa čak i trajanje putovanja, nalazimo u Filostratovu *Životu Apolonija iz Tijane.* Opisujući Apolonijevo putovanje iz Italije u Heladu, Filostrat piše sljedeće: "Nakon toga [putovanja iz Puteola kroz Mesinski tjesnac preko Taormine] stigli su [Apolonije i njegov pratilac Damis] u Sirakuzu te su se otputili za Peloponez, otprilike početkom jeseni; preplovivši zaljev [Jonsko more] nakon šest dana plovidbe stigli su do ušća Alfeja, gdje rijeka izlijeva svoje vode, još uvijek slatke, u Jadransko i Sicilijansko more" (Philostr. VA VIII.15). Šest dana svakako je previše za prelazak puta između Sirakuze i Peloponeza – put između Sirakuze i Elide trajao je nešto više od dva dana i dvije noći[45] – no nevjerojatno bi bilo da je Apolonije plovio iz Messine na jug sve do Sirakuze pa natrag na sjever prema Otrantu. Nešto prije u istom odlomku Filostrat spominje kako je Apolonije uz povoljan vjetar putovao od Dikearhije (Puteola) kroz Mesinski tjesnac do Tauromenija (Taormina na istočnoj obali Sicilije, otprilike na pola puta između Messine i Catanie). Put je trajao tri dana, pa je moguće da se šest dana puta odnosi na *ukupno* trajanje putovanja od Puteola do Peloponeza (dva do tri dana od Puteola do Taormine, pretpostavljeni jedan dan – ili manje – do Sirakuze[46] i dva do tri dana do Peloponeza). To potkrepljuje raniji opis Apolonijeva putovanja iz Korinta do Puteola. Apolonije je "oko podneva" izrazio štovanje Suncu u Korintu, te je uz "povoljan vjetar i morsku struju koja je tekla njegovim smjerom putovanja" stigao u Puteole *petoga* dana plovidbe (Philostr. VA VII.10). Bilo bi krajnje neobično da je putovanje od Korinta do Puteola trajalo pet dana, a od Sirakuze do ušća Alfeja čak šest; izvjesnija je varijanta po kojoj je povratno putovanje trajalo ukupno šest dana (vidi kartu 2). Čini se da u ovome Filostratovu odlomku nalazimo izravnu i nedvosmislenu potvrdu pomorskoga putovanja otvorenim morem između Sicilije i Peloponeza, štoviše između Ortigije (Sirakuze) i ušća Alfeja! Gotovo je nevjerojatno da Filostrat nije poznavao mit o Alfeju i Aretuzi – "još uvijek slatke" Alfejeve vode govore nam da je bio upoznat s mitom. Čini se, štoviše, da ga je on jedini od klasičnih autora pravilno interpretirao.

[45] Ako bi brod iz Sirakuze isplovio uz izlazak sunca, do ušća Alfeja stigao bi preko otvorenoga mora (uz idealne uvjete) tijekom poslijepodneva trećega dana putovanja; ako bi isplovio uz zalazak sunca, na cilj bi stigao krajem treće noći.

[46] Taormina je od Sirakuze udaljena nekih 50 NM, a od Puteola do Taormine ima oko 190 NM; dakle od Puteola do Sirakuze ima nekih 240 NM, a od Sirakuze do ušća Alfeja oko 300 NM.

that ancient seafarers knew that Rhodes and the southern edge of Sicily are at similar latitude and that navigation along this latitude was thus possible. It was already shown that Ptolemy cited a latitude of 36° as the southernmost point on Sicily, and for the northern coast of Rhodes. He cited a latitude of 36°15' for Gibraltar, while he placed the southernmost point in Europe a little farther to the west, at 36°05' (Ptol. Geo. II.3). He placed the northernmost point of Mauretania at 35°55' north (IV.1), and these figures confirm Strabo's assertions. Actually, the southernmost point of Sicily is at 36°40' north, while the southernmost point of the Iberian peninsula, Punta de Tarifa, lies at exactly 36° (Gibraltar is at 36°05' north). The northernmost point of Africa is at Ceuta, at 35°55' north.

Conclusion

It would appear that the Greek myth of Alpheus and Arethusa[44] is actually a picturesque portrayal of the practice of latitude sailing between the Peloponnese and Sicily. The very similar latitude of these two sites made such navigation possible. The other explanations of this unusual myth are less convincing. It is

Str. II.5.14). Strabo cites similar assertions made by Eratosthenes (Eratosthenes *apud* Str. II.1.1) and Hipparchus (Hipparchus *apud* Str. II.1.11). Interesting is his statement that Hipparchus, for his claim that "…the Pillars and Cilicia lie in a direct line due east" had to depend "...entirely on the assertion of sailors…" for that part of the route "…between the Pillars and the Strait of Sicily" (*Ibid.*). Pliny, when he describes measurement of the Earth's size, mentions two routes: the first, running from the mouth of the Ganges to the west, and the second, which runs somewhat farther north. Interesting here are only those sections of these routes related to the maritime routes mentioned in the article. Thus the first route passes through Myriandrus, a city in Syria in the Gulf of Issus (slightly north of Ugarit), through Cyprus, Patara in Lycia, Rhodes, Astypalaea (an island near Karpathos), Cape Taenarum in Laconia, Lilybaeum on Sicily and Calaris on Sardinia; the other route runs though Ephesus, then over Delos and on to the Corinth Canal, continuing through Patrai and Cape Leucate to Korkyra and on to Italy (H.N. II.112). The first route roughly corresponds to routes along the 36th (up to 36°-30'), and the second along the 37th (or 38th) parallels.

[44] Worth mention here are the remaining ancient locations with the same names. The spring of Arethusa on Ithaca (even though Homer's Ithaca has still not been precisely identified, today's island bearing that name lies at approximately 38°20' north) that Homer mentions in the *Odyssey* (Od. XIII.408) and the spring near Chalcis on Euboea (H.N. IV.12; Str. I.3.16) fit into the scheme of maritime routes here described (Chalcis lies at 38°25' north). A city in Macedonia of the same name was probably established by colonists from Chalcis, while the city of Arethusa in Syria, not far from Apamea (H.N. V.19), had its name Hellenised by Seleucus Nicator (App. Syr. 57). The city is today called Rastan and it is located at 34°55' north. Pliny (H.N. VI.31) also referred to a lake in Armenia as Arethusa, through which the Tigris River flows without their waters intermingling. This story tantalisingly recalls the waters of the Alpheus not mixing with the Ionian Sea.

possible that seafarers sailed along this route during the Mycenaean period, and perhaps earlier.

In attempting to explain the manner in which celestial navigation was possible at that time, I came to the conclusion that one of the most important stars used may have been Rastaban from the Draco constellation. I found confirmation of the use of this constellation for navigational purposes. The fact is that ancient scholars carefully observed the altitudes of individual asterisms and noticed the differences depending on the point of observation. Rastaban may have served well as the last circumpolar star at a latitude of approximately 37° north, and using it one could relatively accurately navigate between the Peloponnese and Sicily and back. Confirmation of observations of the distance between the constellation Draco and the pole can also be found in the works of some authors.

There are still several other techniques that can serve as a supplement to the aforementioned navigation: this includes observation of the height of the northern celestial pole, observation of the height of the upper culmination of certain brighter stars in the southern skies and, finally, observation of the so-called zenith stars. The zenith star for a given location is that which passes over the zenith of the observer at its upper culmination, and its declination is the same as the latitude of the observer.

Two more Ortygias were tied to the Sicilian Ortygia: the island of Delos, which once bore the name long ago, and the city of Ephesus, which had a shrine bearing this name. All of these sites lie on a similar latitude and they are dedicated to the goddess Artemis. The maritime route between Ephesus and the Straits of Messina along the 38th parallel led through the Corinthian isthmus.

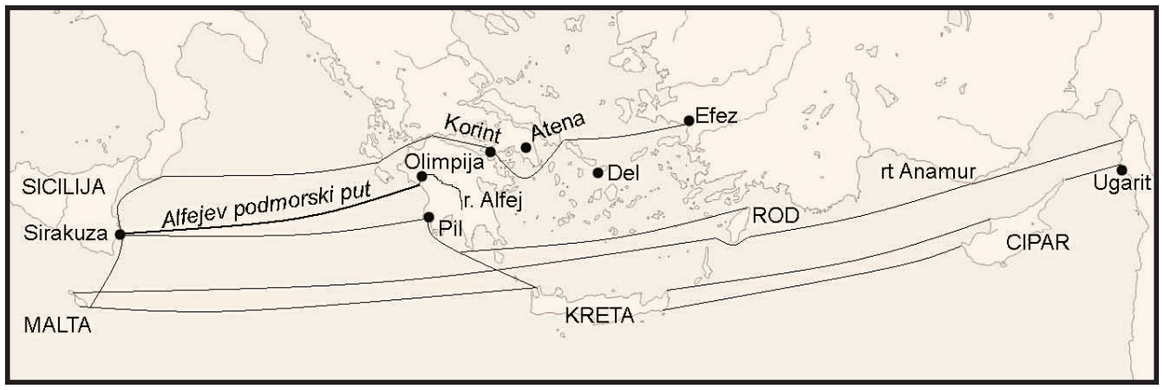
There is also discussion of other possible routes that may have been used by Mediterranean seafarers since the Bronze Age. Examples are provided of several maritime routes between the major Bronze Age city Ugarit on the Syrian coast, through the southern coast of Asia Minor, the islands of Cyprus, Rhodes and Crete, to Sicily and the western Mediterranean. These routes may already have been used by Minoan seafarers. The stars that may have been used to navigate along these routes are also described, and the techniques were probably identical to those described for the maritime route between the Peloponnese and Sicily.

All of this leads to the conclusion that latitude sailing, often used on the Indian Ocean, probably from the earliest times, was also present on the Mediterranean already during the Bronze Age.

Specific confirmation of the existence of a direct maritime route between Syracuse and the mouth of the Alpheus, as well as the precise time at which the voyage took place, and even the duration of the voyage, can be found in Philostratus' *Life of Apollonius of Tyana.* Describing Apollonius' journey from Italy to Hellas, Philostratus wrote the following: "After that [the journey from Puteoli through the Straits of Messina to Taormina] they arrived [Apollonius and his pupil Damis] at Syracuse and put out for the Peloponnese about the beginning of the autumn; and having traversed the gulf [the Ionian Sea] they arrived after six days at the mouth of the Alpheus, where that river pours its waters, still sweet, into the Adriatic and Sicilian Sea" (Philostr. VA VIII.15). Six days is certainly too long for the voyage from Syracuse to the Peloponnese – the voyage from Syracuse to Elis took just over two days and two nights[45] – and it is not likely that Apollonius sailed from Messina southward to Syracuse, then back north toward Otranto. A little previously in the same passage, Philostratus mentioned that Apollonius travelled from Dicaearchia (Puteoli) with a favourable wind through the Straits of Messina to Tauromenium (Taormina on the eastern coast of Sicily, approximately halfway between Messina and Catania). The voyage took three days, so it is possible that six days is the *total* duration of the voyage from Puteoli to the Peloponnese (two to three days from Puteoli to Taormina, an assumed one day, or less, to Syracuse[46] and two to three days to the Peloponnese). This is confirmed by the earlier description of Apollonius' travels from Corinth to Puteoli. Apollonius paid reverence to the Sun at "about midday", and then "…with a favorable wind and a good current that ran in his direction" he arrived in Puteoli on the *fifth* day of the voyage (Philostr. VA VII.10). It would have been extremely unusual for the voyage from Corinth to Puteoli to last five days, and that from Syracuse to the mouth of the Alfeios to last as many as six; a more likely variant is a return trip whereby the whole voyage would have taken six days (see Map 2). It seems that in this passage by Philostratus we can find a direct and unambiguous confirmation of maritime voyage on the open sea between Sicily and the Peloponnese, between Ortygia (Syracuse) and the mouth of the Alfeios in fact! It would be unbelievable if Philostratus was not aware of the myth of Alpheus and Arethusa – "still sweet" waters of the Alfeios tell us that he was familiar with the myth – and it seems that he was the only Classical author to correctly interpret it.

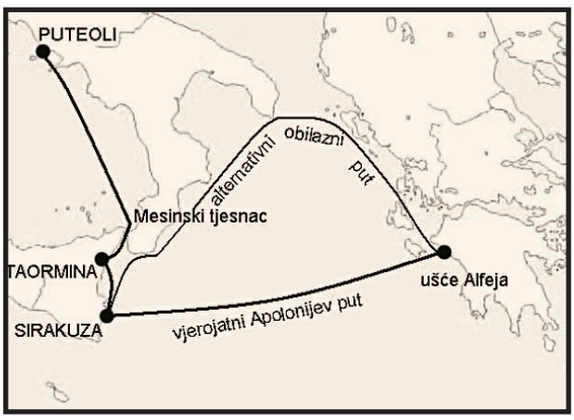
[45] If a ship set off from Syracuse at sunrise, it would arrive at the mouth of the Alfeios over the open sea (under ideal conditions) during the afternoon of the third day of the voyage; if it set off at sunset, it would reach its destination at the end of the third night.

[46] Taormina is approximately 50 NM from Syracuse, while the distance from Puteoli to Taormina is approximately 190 NM; so it is about 240 NM from Puteoli to Syracuse, and approximately 300 NM from Syracuse to the mouth of Alfeios.



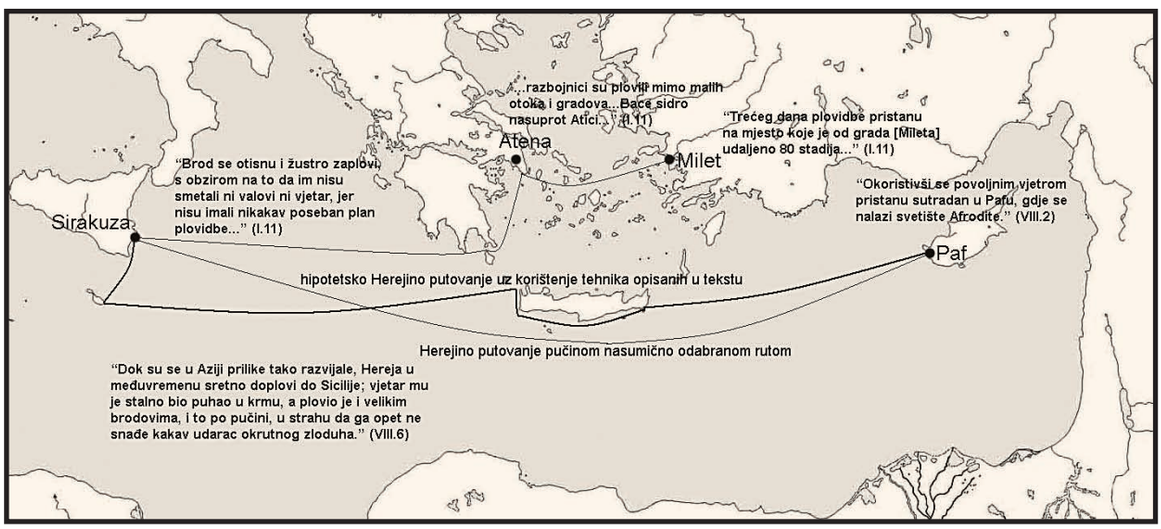
Karta 1. Pomorski putovi opisani u tekstu, kao i zamišljeni Alfejev podmorski put. Osim plovidbe po 37. i 38. paraleli ističe se važnost Malte u hipotetskim plovidbama kretskih pomoraca na zapad (autor: Tomislav Bilić, 2005).

Map 1. Maritime routes described in the text, and the imagined undersea journey of Alpheus. Besides navigation along the 37th and 38th parallels, the importance of Malta in the hypothetical westward voyages of Cretan seafarers is also stressed (by Tomislav Bilić, 2005).



Karta 2. Prikaz Apolonijeva puta iz Puteola u Olimpiju prema Filostratovu opisu (autor: Tomislav Bilić, 2005).

Map 2. Depiction of Apollonius' voyage from Puteoli to Olympia according the description of Philostratus (by Tomislav Bilić, 2005).



Karta 3. Putovanja Hereje i Kaliroje opisana u istoimenu Haritonovu romanu iz 50. pr. Kr. – 50. po Kr. Radnja romana odvija se krajem V. st. pr. Kr. Citirano prema Hariton: Zgode Hereje i Kaliroje. Prev. Darko Novaković. Latina et Graeca, Zagreb, 1989 (autor: Tomislav Bilić, 2005).

Map 3. The travels of Chaereas and Callirhoe described in the romance by Chariton from 50 BC to 50 AD. The story takes place at the end of the fifth century BC. Cited according to Chariton: The Loves of Chaereas and Callirhoe (by Tomislav Bilić, 2005).

Tablica 1

Donosimo tablicu s vrijednostima visina nekoliko zvijezda ''kandidata'' za zadnju cirkumpolarnu zvijezdu na danim geografskim širinama, u trima različitim vremenskim razdobljima. Masno su otisnute vrijednosti koje impliciraju da su zvijezde bile vidljive za promatrača na određenoj geografskoj širini, a kurzivom su istaknuti najjači kandidati za «zadnju cirkumpolarnu zvijezdu».

Table 1

The following table provides the altitude values of several stars that can be 'candidates' for the last circumpolar star at specific latitudes in three different periods. The values marked in bold imply stars that were visible to observers at specific latitudes, while those marked in italics are the strongest candidates for 'last circumpolar star'.

zvijezda *Star*	magnituda *Magnitude*	δ 1700. pr. Kr. *δ 1700 BC*	v_{dk} 1700. pr. Kr. sa / alt_{lc} *1700 BC from* 35°/36°/37°/38°	δ 1300. pr. Kr. *δ 1300 BC*	v_{dk} 1300. pr. Kr. sa / alt_{lc} *1300 BC from* 35°/36°/37°/38°	δ 700. pr. Kr. *δ 700 BC*	v_{dk} 700 pr. Kr. sa / alt_{lc} *700 BC from* 35°/36°/37°/38°
β *Draconis*	2.79	58°24'	***3°23'*** **4°23'** **5°23'** **6°23'**	57°27'	2°27' ***3°27'*** **4°27'** **5°27'**	56°07'	1°08' 2°08' ***3°08'*** **4°08'**
γ *Draconis*	2.24	55°31	31' 1°31' 2°31' ***3°31'***	54°45'	-15' 45' 1°45' 2°45'	53°44'	-1°18' -18' 42' 1°42'
β *Cephei*	3.23	56°10'	1°10' 2°10' 3°10' ***4°10'***	57°29'	2°28' 3°28' ***4°28'*** **5°28'**	59°36'	***4°36'*** **5°36'** **6°36'** **7°36'**
γ *Cephei*	3.21	58°19'	3°18' ***4°18'*** **5°18'** **6°18'**	60°13'	**5°12'** **6°12'** **7°12'** **8°12'**	63°10'	**8°09'** **9°09'** **10°09'** **11°09'**
θ *Ursae Maioris*	3.17	58°17'	3°17' ***4°17'*** **5°17'** **6°17'**	58°49'	***3°50'*** **4°50'** **5°50'** **6°50'**	59°02'	***4°02'*** **5°02'** **6°02'** **7°02'**
ψ *Ursae Maioris*	3.00	58°54'	***3°53'*** **4°53'** **5°53'** **6°53'**	58°17'	3°17' ***4°17'*** **5°17'** **6°17'**	56°46'	1°57' 2°57' ***3°57'*** **4°57'**
γ *Boötis*	3.04	57°25'	2°25' 3°25' **4°25'** **5°25'**	55°10'	9' 1°09' 2°09' 3°09'	51°50'	-3°11' -2°11' -1°11' -11'
β *Boötis*	3.49	58°29'	3°29' ***4°29'*** **5°29'** **6°29'**	56°18'	1°20' 2°20' 3°20' ***4°20'***	53°01'	-2° -1° 0° 1°

Tablica 2

Ovdje dajemo primjere južnih zvijezda koje su navigatori mogli promatrati. Vrijednosti u tablici dane su za promatrača s različitih geografskih širina. Masno su otisnute vrijednosti koje impliciraju da su zvijezde bile nevidljive za promatrača na određenoj geografskoj širini.

Table 2

The following table features examples of the southern stars that navigators may have observed. The values in the table are provided for observers at various latitudes. The values marked in bold imply that the stars were not visible to the observer at a given latitude.

zvijezda *Star*	magnituda *Magnitude*	δ 1700. pr. Kr. *δ 1700 BC*	V_{gk} 1700. pr. Kr. sa / alt_{uc} *1700 BC from* 38°/37°/36°/35°	δ 1300. pr. Kr. *δ 1300 BC*	V_{gk} 1300. pr. Kr. sa / alt_{uc} *1300 BC from* 38°/37°/36°/35°	δ 700 pr. Kr. *δ 700 BC*	V_{gk} 700. pr. Kr. sa / alt_{uc} *700. BC from* 38°/37°/36°/35°
α *Crucis*	0.77	-43°28’	8°32’ 9°32’ 10°32’ 11°32’	-45°23’	6°37’ 7°37’ 8°37’ 9°37’	-48°23’	3°37’ 4°37’ 5°37’ 6°37’
β *Centauri*	0.61	-40°17’	11°43’ 12°43’ 13°43’ 14°43’	-42°27’	9°32’ 10°32’ 11°32’ 12°32’	-45°46’	6°13’ 7°13’ 8°13’ 9°13’
β *Arae*	2.84	-41°58’	10°01’ 11°01’ 12°01’ 13°01’	-44°06’	7°53’ 8°53’ 9°53’ 10°53’	-47°07’	4°52’ 5°52’ 6°52’ 7°52’
β *Piscis Austrini*	4.29	-44°46’	7°13’ 8°13’ 9°13’ 10°13’	-44°20’	7°40’ 8°40’ 9°40’ 10°40’	-43°11’	8°49’ 9°49’ 10°49’ 11°49’
α *Piscis Austrini*	1.17	-43°48’	8°11’ 9°11’ 10°11’ 11°11’	-43°04’	8°55’ 9°55’ 10°55’ 11°55’	-41°31’	10°28’ 11°28’ 12°28’ 13°28’
ν *Puppis*	3.17	-44°50’	7°10’ 8°10’ 9°10’ 10°10’	-44°11’	7°49’ 8°49’ 9°49’ 10°49’	-43°25’	8°35’ 9°35’ 10°35’ 11°35’
δ *Velorum*	1.93	-44°54’	7°06’ 8°06’ 9°06’ 10°06’	-45°33’	6°26’ 7°26’ 8°26’ 9°26’	-46°44’	5°16’ 6°16’ 7°16’ 8°16’
ι *Carinae*	2.21	-47°	5° 6° 7° 8°	-47°58’	4°01’ 5°01’ 6°01’ 7°01’	-49°36’	**2°24’** 3°24’ 4°24’ 5°24’
θ *Carinae*	2.74	-47°33’	4°27’ 5°27’ 6°27’ 7°27’	-49°04’	**2°56’** 3°56’ 4°56’ 5°56’	-51°30’	**30’** **1°30’** **2°30’** 3°30’
τ *Puppis*	2.94	-50°11’	**1°48’** **2°48’** 3°48’ 4°48’	-49°51’	**2°09’** **3°09’** 4°09’ 5°09’	-49°30’	**2°30’** **3°30’** 4°30’ 5°30’

α *Centauri*	-0.01	-42°02'	9°58' 10°58' 11°58' 12°58'	-44°12'	7°48' 8°48' 9°48' 10°48'	-47°26'	4°33' 5°33' 6°33' 7°33'
λ *Centauri*	3.11	-44°29'	7°30' 8°30' 9°30' 10°30'	-46°13'	5°46' 6°46' 7°46' 8°46'	-48°58'	**3°02'** 4°02' 5°02' 6°02'
γ *Triangulum Australe*	2.87	-49°36'	**1°24'** **2°24'** 3°24' 4°24'	-51°51'	**9'** **1°09'** **2°09'** 3°09'	-55°13'	**-3°14'** **-2°14'** **-1°14'** **-14'**
γ *Gruis*	3.00	-46°27'	**5°32'** **6°32'** **7°32'** **8°32'**	-46°32'	**5°28'** **6°28'** **7°28'** **8°28'**	-46°06'	**5°54'** **6°54'** **7°54'** **8°54'**

Napomena uz tablice 1 i 2: u navedene iznose treba uračunati i refrakciju. To znači da stvarnoj visini zvijezde treba pridodati određeni iznos (za visinu od 30' treba dodati 0.49°, za visinu od 1° 0.41°, za visinu od 1°30' 0.35°, za 2° 0.30°, za 3° 0.24°, za 4° 0.20°, za 5° 0.17° itd.; prema Šprajc, 1991: 48) kako bi se dobila visina koju možemo opaziti golim okom. Posljedica toga jest to da je zvijezda promatrana golim okom zapravo nešto bliže horizontu nego što se to čini.

Note to Tables 1 and 2: refraction should also be computed into these values. This means that the actual altitude of the star should be increased by a given amount (for an altitude of 30', 0.49° should be added; for an altitude of 1°, 0.41° should be added; for an altitude of 1°30', 0.35° should be added, for an altitude of 2°, 0.30° should be added; for an altitude of 3°, 0.24° should be added, for an altitude of 4°, 0.20° should be added; for an altitude of 5°, 0.17° should be added, etc., according to Šprajc, 1991: 48) to obtain the altitude that could have been observed with the naked eye. As a consequence, the star observed with the naked eye is actually a little closer to the horizon than it actually appears.

Tablica 3

Donosimo neke zvijezde koje su mogle poslužiti kao zenitne zvijezde za geografske širine između 35. i 38. paralele

Table 3

The following table contains some stars that may have served as zenith stars at latitudes between the 35th and 38th parallels.

zvijezda *Star*	magnituda *Magnitude*	δ 1700. pr. Kr. *δ 1700 BC*	δ 1300. pr. Kr. *δ 1300 BC*	δ 700. pr. Kr. *δ 700 BC*
α *Boötis (Arcturus)*	-0.05		38°28'	34°47'
η *Boötis*	2.68		36°37'	
β *Lyrae*	3.52	34°56'		
δ2 *Lyrae*	4.22	37°45'	37°07'	36°24'
ζ1 *Lyrae*	4.34		38°31'	37°41'
η *Lyrae*	4.43		37°43'	37°19'
θ *Lyrae*	4.35	37°01'	36°35'	36°12'
α *Cygni (Deneb)*	1.25	36°43'	37°09'	38°01'
α *Aurigae (Capella)*	0.08			37°58'
β *Aurigae*	1.90		36°18'	
α *Coronae Borealis*	2.12			38°21'
γ *Coronae Borealis*	3.81			37°26'
δ *Coronae Borealis*	4.59			36°58'
ε *Coronae Borealis*	4.14			37°24'
ε *Herculis*	3.92			37°52'
β *Herculis*	2.78	35°08'		
δ *Herculis*	3.12	35°11'		
ξ *Herculis*	3.70	35°42'		
δ *Leonis*	2.56	36°26'	35°23'	
ζ *Leonis*	3.43	35°18'	34°53'	
μ *Leonis*	3.88	36°03'	35°53'	
α *Cassiopeiae*	2.24	36°47'		
α *Persei (Mirfak)*	1.79			36°58'
γ *Persei*	3.77	36°28'		
δ *Persei*	3.01			35°31'
η *Persei*	2.91		36°39'	

Tablica 4a i 4b

Donosimo vremena kulminacija pojedinih zvijezda, kao i vrijeme izlaska i zalaska Sunca na pojedine datume, kako bi se vidjelo koje zvijezde su vidljive na te datume. Lokacija promatrača je na objema tablicama 37° sjeverne geografske širine. Masno su označene vrijednosti koje impliciraju da je u tom trenutku pojedina zvijezda vidljiva. Prve dvije zvijezde cirkumpolarne su na toj širini, u trećoj kolumni je zenitna zvijezda u danome razdoblju, a sljedeće tri zvijezde su svjetlije zvijezde južnoga neba vidljive u tom dijelu godine. Vrijeme kulminacija zvijezda mjereno je s geografske širine od 18° istočno, otprilike na pola puta između Pila i Sirakuze.

Tables 4a and 4b

The following table shows the culmination times of individual stars, and the time of sunrise and sunset at individual dates, in order to see which stars were visible on those dates. The location of the observer on both tables is 37° north latitude. The values marked in bold imply that at that moment a given star was visible. The first two stars are circumpolar at that latitude, the third column contains a zenith star at the given period, while the three following stars are brighter stars of the southern skies visible in that part of the year. The culmination time of the star is measured from the latitude of 18° east, approximately halfway between Pylos and Syracuse.

4a

datum / *date* (1300. pr. Kr.) *(1300 BC)*	*Rastaban* v_{dk} / alt_{lc} = 4°27'	ψ *Ursae Maioris* v_{dk} / alt_{lc} = 5°17'	*Deneb* v_{gk} / alt_{uc} = 89°51'	*Fomalhaut* v_{gk} / alt_{uc} = 9°55'	β *Piscis Austrini* v_{gk} / alt_{uc} = 8°40'	β *Arae* v_{gk} / alt_{uc} = 8°53'	Sunce / *Sun* (izlazak - *rise* / zalazak - set)
1. svibnja / *1 May*	t_{dk} / t_{lc} = 14:23	**t_{dk} / t_{lc} = 05:19**	**t_{gk} / t_{uc} = 04:50**	**t_{gk} / t_{uc} = 05:32**	**t_{gk} / t_{uc} = 04:59**	**t_{gk} / t_{uc} = 23:26**	05:06/18:22
1. lipnja / *1 June*	t_{dk} / t_{lc} = 12:21	**t_{dk} / t_{lc} = 03:17**	**t_{gk} / t_{uc} = 02:48**	**t_{gk} / t_{uc} = 03:30**	**t_{gk} / t_{uc} = 02:57**	**t_{gk} / t_{uc} = 21:24**	04:30/18:48
1. srpnja / *1 July*	t_{dk} / t_{lc} = 10:19	**t_{dk} / t_{lc} = 01:19**	**t_{gk} / t_{uc} = 00:50**	**t_{gk} / t_{uc} = 01:32**	**t_{gk} / t_{uc} = 00:59**	t_{gk} / t_{uc} = 19:26	04:20/19:05
1. kolovoza / *1 August*	t_{dk} / t_{lc} = 08:17	**t_{dk} / t_{lc} = 23:17**	**t_{gk} / t_{uc} = 22:44**	**t_{gk} / t_{uc} = 23:26**	**t_{gk} / t_{uc} = 22:53**	t_{gk} / t_{uc} = 17:24	04:37/19:02
1. rujna / *1 September*	t_{dk} / t_{lc} = 06:15	**t_{dk} / t_{lc} = 21:15**	**t_{gk} / t_{uc} = 20:43**	**t_{gk} / t_{uc} = 21:24**	**t_{gk} / t_{uc} = 20:52**	t_{gk} / t_{uc} = 15:22	05:06/18:34
1. listopada / *1 October*	**t_{dk} / t_{lc} = 04:17**	**t_{dk} / t_{lc} = 19:17**	**t_{gk} / t_{uc} = 18:45**	**t_{gk} / t_{uc} = 19:26**	**t_{gk} / t_{uc} = 18:54**	t_{gk} / t_{uc} = 13:24	05:36/17:52

4b

datum / *date* (700. pr. Kr.) *(700 BC)*	*Rastaban* v_{dk} / alt_{lc} = 3°08'	ψ *Ursae Maioris* v_{dk} / alt_{lc} = 3°57'	η *Lyrae* v_{gk} / alt_{uc} = 89°41'	*Fomalhaut* v_{gk} / alt_{uc} = 11°28'	β *Piscis Austrini* v_{gk} / alt_{uc} = 9°49'	β *Arae* v_{gk} / alt_{uc} = 5°52'	Sunce / *Sun* (izlazak - *rise* / zalazak - set)
1. svibnja / *1 May*	t_{dk} / t_{lc} = 14:16	t_{dk} / t_{lc} = 05:50	**t_{gk} / t_{uc} = 03 :25**	t_{gk} / t_{uc} = 05:55	t_{gk} / t_{uc} = 05:23	**t_{gk} / t_{uc} = 23:44**	05:00/18:26
1. lipnja / *1 June*	t_{dk} / t_{lc} = 12:14	**t_{dk} / t_{lc} = 03:48**	**t_{gk} / t_{uc} = 01 :23**	**t_{gk} / t_{uc} = 03:53**	**t_{gk} / t_{uc} = 03:22**	**t_{gk} / t_{uc} = 21:42**	04:28/18:51
1. srpnja / *1 July*	t_{dk} / t_{lc} = 10:12	**t_{dk} / t_{lc} = 01:50**	**t_{gk} / t_{uc} = 23 :21**	**t_{gk} / t_{uc} = 01:55**	**t_{gk} / t_{uc} = 01:24**	**t_{gk} / t_{uc} = 19:44**	04:22/19:07
1. kolovoza / *1 August*	t_{dk} / t_{lc} = 08:10	**t_{dk} / t_{lc} = 23:48**	**t_{gk} / t_{uc} = 21 :19**	**t_{gk} / t_{uc} = 23:50**	**t_{gk} / t_{uc} = 23:18**	t_{gk} / t_{uc} = 17:42	04:41/19:00
1. rujna / *1 September*	t_{dk} / t_{lc} = 06:08	**t_{dk} / t_{lc} = 21:46**	**t_{gk} / t_{uc} = 19 :18**	**t_{gk} / t_{uc} = 21:48**	**t_{gk} / t_{uc} = 21:16**	t_{gk} / t_{uc} = 15:41	05:10/18:27
1. listopada / *1 October*	**t_{dk} / t_{lc} = 04:10**	**t_{dk} / t_{lc} = 19:48**	t_{gk} / t_{uc} = 17:20	**t_{gk} / t_{uc} = 19:50**	**t_{gk} / t_{uc} = 19:18**	t_{gk} / t_{uc} = 13:43	05:39/17:44

Tablica 5

Donosimo vremena kulminacija pojedinih zvijezda, kao i vrijeme izlaska i zalaska Sunca na pojedine datume, kako bi se vidjelo koje zvijezde su vidljive na te datume. Lokacija promatrača je 36° sjeverne geografske širine. Masno su označene vrijednosti koje impliciraju da je u tom trenutku pojedina zvijezda vidljiva. Prva zvijezda cirkumpolarna je na toj širini, u drugoj kolumni je zenitna zvijezda u danom razdoblju, a treća zvijezda je zvijezda južnoga neba vidljiva u tom dijelu godine. Vrijeme kulminacija zvijezda mjereno je s geografske širine od 18° istočno, otprilike na pola puta između Krete i Malte.

Table 5

The following table shows the culmination times of individual stars, and the time of sunrise and sunset at individual dates, in order to see which stars were visible on those dates. The location of the observer is 36° north latitude. The values marked in bold imply that at that moment a given star was visible. The first star is circumpolar at that latitude, the second column contains a zenith star at the given period, while the third star is a star of the southern skies visible in that part of the year. The culmination time of the star is measured from the latitude of 18° east, approximately halfway between Crete and Malta.

datum / *date* (1700. pr. Kr.) *(1700 BC)*	θ *Ursae Maioris* v_{dk} / alt_{lc} = 4°17'	ξ *Herculis* v_{gk} / alt_{uc} = 89°41'	β *Piscis Austrini* v_{gk} / alt_{uc} = 8°13'	Sunce / *Sun* (izlazak - *rise* / zalazak - set)
1. svibnja / *1 May*	**t_{dk} / t_{lc} = 02:46**	**t_{gk} / t_{uc} = 01:50**	**t_{gk} / t_{uc} = 04:42**	05:11/18:17
1. lipnja / *1 June*	**t_{dk} / t_{lc} = 00:45**	**t_{gk} / t_{uc} = 23:44**	**t_{gk} / t_{uc} = 02:40**	04:34/18:41
1. srpnja / *1 July*	**t_{dk} / t_{lc} = 22:47**	**t_{gk} / t_{uc} = 21:46**	**t_{gk} / t_{uc} = 00:42**	04:22/19:00
1. kolovoza / *1 August*	**t_{dk} / t_{lc} = 20:45**	**t_{gk} / t_{uc} = 19:44**	**t_{gk} / t_{uc} = 22:36**	04:36/19:01
1. rujna / *1 September*	t_{dk} / t_{lc} = 18:43	t_{gk} / t_{uc} = 17:42	**t_{gk} / t_{uc} = 20:35**	05:05/18:36
1. listopada / *1 October*	t_{dk} / t_{lc} = 16:45	t_{gk} / t_{uc} = 15:44	t_{gk} / t_{uc} = 18:37	05:34/17:56

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