GEOGRAPHICAL SYSTEMS IN THE FIRST CENTURY BC: POSIDONIUS' F 49 E–K AND VITRUVIUS' *ON ARCHITECTURE* VI 1. 3–13

Eduardo M. B. Boechat
Professor da UFRJ

ABSTRACT: The article analyses innovative ethno-geographical systems of the first century BC. During Hellenistic times, the science of geography made use of increasingly advanced mathematical and astronomical skills to ensure a scientific basis for the cartographical project; however, this geographical research apparently disregarded the natural and human environments. There is a paradigm change in the referred century. The Stoic Posidonius focuses on the concept of zones found in the early philosophers and finds a compromise between the 'scientific' and the 'descriptive' geographies. Likewise, Vitruvius conveys a geographical system which associates climatic, somatic, and psychic features.

KEYWORDS: Ethno-Geography, Posidonius, Vitruvius, First Century BC

I- Introduction

Greek philosophy began in the Archaic period (seventh–sixth centuries BC) with the naturalistic inquiry of the Presocratic philosophers. They speculated about the essence and structure of the universe seeking scientific explanations based on sensory assessment and logical inference. Theories about the physical layout of the world, including its shape, size, boundaries and inhabitants were offered as a rationalistic approach emerged. The science of geography – literally a written or drawn description of the earth (*gê*) – grew up from these roots, and in the words of one of its great authors in antiquity 'investigated things both human and divine … as regards knowledge both of the heavens and of things on land and sea, animals, plants, fruits, and everything else to be seen in various regions (Strabo's *Geography* I. 1. 1).' I shall offer a brief summary of the development of the science of geography leading to the main topic of this article.

Among the Presocratic philosophers, two traditions bear witness to their interest in what would be later described as the subject matter of geographers. There is the famous and enigmatic fragment where it is said that Anaximander (c. 580–545 BC) was the first to publish a geometrical tablet, i.e. a map of the world (DK 12 A 6); and there is also some extracts regarding the cosmological doctrines of Parmenides (c. 520–450 BC). Here we learn that besides being the first to declare that the Earth was spherical (D.L. IX 21), the metaphysical thinker also divided the globe into a complex combining location, climate and habitation (*Geo*. II. 2. 2). According to this doctrine, Parmenides would have conceived five climate zones on the globe. These were determined by the changing angle between the sun and the earth, and stretched across the globe parallel to the equator: an uninhabitable torrid zone encircling the equator; two gelid arctic zones situated by the poles; and two temperate zones located between the polar and the torrid zones (see Dueck 2012, 68−70 and 85).

Regarding the philosophers of the classical period, Plato (427−347 BC) seems not to have paid much attention to the budding science of geography. None of his dialogues makes an effort to speculate about geographical topics. In fact, the only noteworthy passage concerns the myth of Atlantis, as presented in the *Timaeus* and the *Critias*. The supposed size of Atlantis, 'larger than Libya and Asia together', hints at Plato's sense of the enormous size of the Ocean surrounding the continents. As for

Aristotle (384−22 BC), although he does not consider geography one of the special sciences, his treatises do make progress on developing the geographical lore which had been handed down. His *Meteorology* conveys supplementary concepts as regards Parmenides' division of the planet into zones and also shows, in the treatment of wind-directions, his concern about mapping the earth (*Meteo.* II 5−6). Moreover, supported by the authority of astronomers, Aristotle offered the figure of 400,000 stadia for the circumference of the world (*Cael*. II 14; see Dueck 2012, 72 and 77 and Wilson 2013, 164−69).

It was actually in the schools founded by the classical philosophers that the proper science of geography started taking shape. One should first mention Eudoxus of Cnidus (c. 408−355 BC), a pupil of Plato and Archytas, who certainly occupies an important position in the history of science. Eudoxus is a major figure in the fifth and sixth book of Euclides' *Elements*; furthermore, he was an astronomer who responded to Plato's question, whether or not there existed a way to "save the phenomena", that is, to provide some reason for the apparent irregularity of the planetary motions. His answer is in the theory of the so called homocentric spheres known to us through the reports of Aristotle and Simplicius. As for Eudoxus' geographical thought, the fundamental developments can be identified in the geometrical shape of the inhabited part of the earth (the *oikoumene*) that is long twice the width; in the probably methodical attempt of measuring the terrestrial circumference; in the idea of the *antoikoi*, who live in the southern area of the same hemisphere, and the antipodes, who are to be found in the southern zone of the opposite hemisphere; and in the rotation of the seasons and their contraposition in the hemispheres. Finally, Eudoxus conceived a meridian (linked to the course of the Nile) which symmetrically divided the *oikoumene* in an eastern and a western part (see Cataudella 2015).

Among Aristotle's pupils, one finds Dicaearchus of Messene (c. 350−285 BC), a geographer who followed the scientific approach to geography of Eudoxus. Like his master Aristotle, Dicaearchus made use of diagrams to graphically convey his ideas. His fundamental idea —fulcrum of his geographical conception— was the identification of an ideal line, a straight line, in the geometrical sense of the term, from the Pillars of Hercules to Mount Imaus (Hindu Kush most likely). So, in the same way that Eudoxus conceived an original meridian, Dicaearchus devised a central parallel geometrically

ordering the inhabited world (the *oikoumene*). Both geographical orientations would form the future grids mapping the earth. It is also attributed to Dicaearchus the development of the measurement of the heights of the mountains with geometric axioms of similar triangles (see Cataudella 2015).

As we see, both Eudoxus and Dicaearchus applied mathematics to the problems of geography. In fact, the ability and competence in mathematical sciences, most prominently astronomy, would become an indispensable background for those interested in the science of geography. The ancient geographer was first of all a cartographer; he needed both a critical examination of the astronomical data and the mathematical basis for geodesy in order to fulfil his task of drafting a map of the *oikoumene*. Accordingly, geographical accounts which limited themselves to the description of landscape or to topics such as ecology and human geography were often called 'chorography' as distinguished from geography in its proper sense. These texts were usually found in the reports of travel experiences (as Eudoxus of Cyzicus') or developed in the form of geographical digressions within literary or historiographical works (such as Herodotus' *Histories*). They were not necessarily fictional.

The scientific field of geography gained autonomy with the polymath Eratosthenes of Cyrene (276− 194 BC) who first coined the terms 'geographer' and 'geography'. He lived in the third century BC and managed the Royal Library of Alexandria during the reign of Ptolemy IV. As a cultural centre Alexandria was blooming and it already rivalled with Athens for the title of intellectual capital of the Greek world. So, taking into account the rich patrimony of empirical knowledge conserved in the repositories and texts at the Royal Library, as well as the results of the astronomic science and the geometric method of Platonic derivation, Eratosthenes began to draw the first 'scientific' map of the inhabited world. His cartographical system was founded on pinpointing two Cartesian axes, one drawn from the parallel identified by Dicaearchus, and the other from the meridian measured by Eratosthenes himself and which crossed the reference parallel at Rhodes. The map featured two important elements drawn from the reports of Pytheas, an explorer of 4th century BC: the latitude of Massalia (43°N), essential for drawing the Mediterranean, and the definition of the arctic circle (66°N), essential for calculating the width of the world.

Eratosthenes' *Geography* would remain the standard work in its field for centuries to come (see Bianchetti 2015).

Eratosthenes' attempt to transfer a spherical surface onto a flat one resulted in a geometrical grid with an orthogonal projection. Such grid was still in use in Strabo's time (end of first century BC), yet its flaws called the criticism of Hipparchus of Bithynia (c. 190−120 BC), another astronomer who also made substantial contributions to the science of geography. We do not know much about his life; he lived in the second century BC and made most of his astronomical observations in Rhodes. *Against the 'Geography' of Eratosthenes* was the title of his main work as a geographer. His goal in this book was to construct an accurate mathematical grid or web of the earth. Eratosthenes had made use of only a handful of latitudes and meridians for drawing his map, which were defined by important cities and landmarks of the *oikoumene*. These latitudes and meridians were still drawn at irregular distances. Now, Hipparchus constructed a theoretical grid of parallels ranging from 0 till 90° N, i.e. from the equator to the North Pole. He placed few cities into it which he had either measured himself or thought of their coordinates as correct. In principle, he demanded to observe and calculate the latitudes via measuring the heights of the gnomon and its shadow, or via determining the ratio between the longest and shortest day, or via measuring the culmination points of fixed stars. Besides the gnomon, Hipparchus' rigorous methods required sophisticated instruments for measuring, observing and calculating like the sundials, dioptra (sighting tubes), astrolabe, and the metereoscope (see Geus 2015).

As seen in this introductory summary, Greek geography has made a considerable progress from its beginnings up to the end of the 2nd century BC. It can be also pointed out that it had turned into a sort of Aristotelian special science whose specificity came both from the content – basically, measuring the earth and designing a map of the inhabited world – and also the method of investigation – the geometrical theorems applied to the analysis of astronomical data. Accordingly, there was not much association between the geographical systems in the scientific tradition seen above and the so-called chorographies, i.e. the geographical accounts found in the literary tradition (mainly historiography) which described the natural and human environments. We shall now see that there is a paradigm shift in the geographical systems of the first century BC, the main topic of this article. The innovative theory of the Stoic philosopher

Posidonius of Apamea bridges the gap and finds a compromise between the 'scientific' and the 'descriptive' geographies. Similarly, a complete interdependence uniting the heavenly patterns and the natural and human environments features in the geographical digression of Vitruvius' *On Architecture*.

II- Posidonius

As we know, the first century BC was a time of new directions for the traditional Hellenistic schools as a result of the revival of traditional Platonism and the renascence of Aristotelianism.[1] One striking development in this respect is the shift occurring within the Stoa following the fresh interest in the actual texts of Aristotle. Stoicised presentations of Aristotelianism, which show little sign of close attention to Aristotle's own writings, had been characteristic in the third and second centuries BC. Now came a change. It seems clear that, with Posidonius (c. 135−50 BC) as scholarch, the Stoics took a strong interest in the Peripatetic scientific quest. The engagement of Posidonius and his pupils with the so-called special sciences (e.g. astronomy, meteorology, hydrology, seismology, and mineralogy) can be witnessed in many passages of works such as Strabo's *Geography*, Seneca's *On Natural Questions* and Cleomedes' *Phaenomena*.[2] Accordingly, as we see in this section focusing on a long fragment preserved in Strabo (*Geo*. II. 2. 1−3. 8 = F 49 E−K), Posidonius revisits Aristotle's *Meteorology* and reorients the scientific tradition of geography following his philosophical approach.

Strabo' *Geography*, which was written in the second half of the first century BC, hands down many fragments of Posidonius and stands as a valuable source for his theories. In fact, the book's whole approach to the subject-matter combining scientific and descriptive geography was certainly influenced by Posidonius[3] although, as we shall see, Strabo disagrees with the Stoic philosopher regarding a fundamental principle. In the second book of the *Geography*, which is introductory to the main work, Strabo

[1] See Michael Frede's epilogue for *The Cambridge History of Hellenistic Philosophy* (Algra et all 1999). See also some of the recent publications in the topic: Schofield 2013; Sharples and Sorabji 2007.
[2] Posidonius' fragments which are concerned with the special sciences are listed from number 200 to 250 in the E−K collection. For Posidonius' acquaintance with Peripatetic physics see F 18, F 49, F 93, F 125, F 130, F 131a, F 133, F 137a, F 142−146, F 155, F 169, and F 183 E−K. The fragments E−K belong to the collection of Ludwig Edelstein and Ian Kidd (*Fragments*), which is limited to the texts that cite Posidonius by name.
[3] For Posidonius' presence in Strabo's *Geography* see *i.a.* Dueck 2012, 42−43 and Prontera 2015, 246−47.

reviews the contributions of his predecessors to the science of geography and states his own basic position. After summing up his attitude to Eratosthenes and Hipparchus, Strabo turns up his attention to Posidonius (II. 2. 1). Now, this very doxographical method used by Strabo features in Posidonius' fragment being characteristic of his philosophical work.[4]

> Let us have a look also at Posidonius and what he has to say in his *On Ocean*; for in it he seems to deal for the most part with geography, some of it strictly germane to the subject, but other sections are rather mathematical … Posidonius says that Parmenides was the founder (ἀρχηγὸν) of the division into five zones, but that Parmenides represents the torrid zone as almost double its real breadth, inasmuch as it falls beyond both the tropics and extends into the two temperate zones, while Aristotle calls "torrid" the region between the tropics, and 'temperate' the regions between the tropics and the "arctic circles." But Posidonius censures both systems, and with justice, for by 'torrid', he says, is meant only the region that is uninhabitable on account of heat … (*Geo.* II. 2. I−2= F 49 E−K)[5]

Strabo's introductory remarks imply that *On Ocean* was Posidonius' principal work on geography and that he knew it directly. It is also clear, as I said, that *On Ocean* included a history of geography regarding the early development of the discipline. Parmenides is credited with inaugurating discussion on zones; [6] and Aristotle diverges from him as regards the extension of the torrid or uninhabitable regions. We do not know the source of information about Parmenides nor whether Aristotle was aware of it since the *Meteorology* does not mention him (see Wilson, 2013 209−13). At any rate, the specific issue in debate sounds consistent with Posidonius' agenda for the discipline. As we have seen in the introduction, the scientific tradition of geography (i.e. Eratosthenes and Hipparchus) had turned the discipline into a sort of mathematical cartography. Conversely, the concept of zones combined astronomical data, location on the planet, and human habitation; that is, it directly interrelated the patterns of the skies and living things on earth. Posidonius is actually returning to the early philosophers to rescue the ecological and human dimension of geography.

[4] See Kidd (1988, 86–7, commentary to T 101/102 E−K) for Posidonius' interest in the development of ideas and doxographies. Cf. also F 129 and 130 E−K.

[5] All the translations from Strabo's *Geography* in this article belong to Jones 1932 (with some alterations).

[6] As Kidd comments (1988, 224), the word 'founder' (ἀρχηγὸν) suggests an archaic situation where Parmenides is the first to have a rough delimitation of zones in relation to the path of the sun. It is unlikely, thus, that he had a defined idea of the obliquity of the ecliptic or any scientific theory regarding the determination of the tropics.

It is also telling that the zone concept emerges in the *Meteorology* which analyses natural phenomena originating both from the skies and also from earth (i.e. evaporations). Posidonian geography would resemble meteorology in the sense that the *oikoumene* to be mapped occupies the same intermediate position being affected by both celestial and terrestrial processes. Accordingly, his criticism against Aristotle's position reads as a typical peripatetic contention *ad Aristotelem per Aristotelem*.[7] Although the torrid zone is rightly defined in the *Meteorology* as the uninhabitable zone because of heat, Aristotle situates the region as lying between the tropics, that is, as a simple projection of the celestial zone which does not match the actual environment on the ground. Strabo proceeds with the presentation.

> As for the arctic circles, Posidonius asks how could anyone determine the limits of the temperate zones, which are fixed and non-variable, by means of the 'arctic circles', which are not available to all observers and are not the same everywhere. Now the fact that the 'arctic circles' are not visible to all could be of no aid to his refutation of Aristotle, because the 'arctic circles' must be visible to all who live in the temperate zone, with reference to whom alone the term 'temperate' is in fact used. But his point that the 'arctic circles' are not everywhere visible in the same way, but are subject to variations, has been well taken. [2, 3] When Posidonius himself divides the earth into the zones, he says that five of them are useful with reference to the celestial phenomena; of these five, two — those that lie under the poles and extend to the regions that have the tropics as arctic circles — are 'periscian'; and the two that come next and extend to the people who live under the tropics are 'heteroscian'; and the zone between the tropics, 'amphiscian'. (*Geo*. II. 2. 2−3 = F 49 E−K)

Posidonius' correction of the geographical system as imagined by Aristotle carries on. He agrees with his great predecessor as regards the general division of the globe within five zones (two arctic, two temperate, and one torrid zone); however, besides the issue about the uninhabitable zone, Aristotle's determination of the arctic circle is also faulty. Aristotle defines the arctic circles as the circumpolar circle which is tangential to *the horizon of the observer*, and Posidonius rightly criticises the tenet since according to this view the limit changes following the observer's latitude.[8] He proposes instead a division of zones determined by fixed boundaries in relation to a celestial body; that is, the sun.[9] It avoids variable 'arctic circle' and the confusions of defining a

[7] For the typical reassessment of Aristotle's positions by Peripatetic philosophers see Hankinson 2002/3.
[8] Bear in mind that the celestial coordinates entail a terrestrial counterpart.
[9] Posidonius had probably in mind the different locations of the shadows cast by the gnomon when he conceived these divisions (periscian, heteroscian, amphiscian). See Evans 1998, 27−30.

torrid uninhabitable zone, which cannot be done with reference to celestial phenomena. Accordingly, we witness again the synthesising philosophical approach of Posidonius. On the one hand, like his predecessors in the scientific tradition of geography, he employs the mathematical-astronomical data in methodically organizing the geographical zones; on the other, by qualifying the system as 'useful with reference to the celestial phenomena' (χρησίμους πρὸς τὰ οὐράνια) he makes clear that other factors should also be taken into account. One reads about these factors in the passages below.

> These zones are also related to human geography along with two other zones (πρὸς δὲ τὰ ἀνθρώπεια ταύτας τε καὶ δύο ἄλλας στενὰς), narrow strips which lie under the tropics, where they have the sun directly overhead for about half a month. These two zones, he says, have a certain peculiarity, they are peculiarly arid and sandy, and produce nothing except silphium and some fiery burn-up fruits; for those regions have in their neighbourhood no mountains against which the clouds may break and produce rain, nor indeed are they coursed by rivers; and for this reason they produce creatures with woolly hair, crumpled horns, protruding lips, and flat noses (for their extremities are contorted by the heat); and the 'fish-eaters' also live in these zones. Posidonius says it is clear that these things are peculiar to those zones from the fact that the people who live farther south than they do have a more temperate atmosphere, and also a more fruitful, and a better-watered, country. (*Geo.* II. 2. 3 = F 49 E−K)

Posidonius' actual geographical system consists of seven zones. In addition to the five, there are two more subtropical zones which are distinguishable by peculiarities of their own. They lie under the tropics, narrow strips cut in two by each tropic. As with other zones, the correspondent southern hemisphere zone has to be inferred from the northern. So, the concept of five celestial zones organized according the distribution of sunlight reads as just a starting-point for the overall system of seven zones (πρὸς δὲ τὰ ἀνθρώπεια ταύτας τε καὶ δύο ἄλλας στενὰς τὰς ὑπὸ τοῖς τροπικοῖς). The exposition to the sun rays (or the astronomical pattern) does not absolutely determine the *oikoumene*. Human geography, or geography, is also related to temperature, climatic factors, topography, geology. In order to understand the occupation of the planet, all these factors should be taken into account. The fact that there are no mountains near for clouds to hit and produce rain, nor irrigation by rivers, resulted in a peculiar ethnic population (curly hair, protruding lips, flat noses) living in the strip of land under the tropics. Such location – natural environment – ethnic population complex was distinctive enough in the eyes of Posidonius to be identified as a global zone.

> [3.1] Polybius makes six zones: two that fall beneath the arctic circles, two between the arctic circles and the tropics, and two between the tropics and the equator. However, the division into five zones seems to me to be in harmony with natural philosophy as well as geography; with natural philosophy, in relation both to the celestial phenomena and to the temperature of the atmosphere; in relation to the celestial phenomena, because, by means of the 'periscian' and the 'heteroscian' and the 'amphiscian' regions (the best way to determine the zone), the appearance of the constellations to our sight is at the same time determined; for thus, by a kind of rough-outline division, the constellations receive their proper variations; and in relation to the temperature of the atmosphere, because since the temperature of the atmosphere is judged with reference to the sun, there are three distinctions which are most fundamental and contribute to the constitution of animals and plants, and to the semi-organizations of everything under the air, or in the air itself, namely excess, lack of, and moderate heat . And the temperature of the atmosphere receives its proper determination by this division of the earth into five zones: for the two frigid zones imply the absence of heat, agreeing in the possession of one characteristic temperature; and in like manner the two temperate zones agree in one temperature, that of moderate heat; while the one remaining is consistent in having the remaining characteristic, in that it is one and torrid in temperature … For the regions on the equator and in the torrid zone are uninhabitable because of the heat, and those near the pole are uninhabitable because of the cold; but it is the intermediate regions that are well-tempered (εὔκρατος) and inhabitable. But when he adds the two zones beneath the tropics, Posidonius does not follow the analogy of the five zones, nor yet does he employ a like criterion; but he was apparently representing zones by the ethnical criteria also, for he calls one of them the 'Ethiopic zone', another the 'Scythico-Celtic zone', and a third the 'intermediate zone'. (Strabo II. 2. 2–3 = F 49 EK)

The excerpt above contains Strabo's defence of the pentezonal theory; that is, the geographer agrees with part of Posidonius' innovative approach. Firstly, he praises the five zone in detriment of Polybius' six zone model as the former matches both natural philosophy and geography. Such argument specifically regards the genuine concerns of the discipline. The inclusion of the equatorial line as another limit framing the zone system would be an improper intromission of mathematical-astronomy in the geographical science (see Kidd 1988, 231− 34). Contrastingly, the five zone theory interweaves a proper system of natural correspondences: the path of the sun (the ecliptic) arranges both the earthly and the starry sphere; the atmospheric zones of temperature agree with the distribution of sun rays; and the temperature receives its proper determinations: frigid (lack of heat), temperate (moderate heat), and torrid (excess of heat). At the end of the passage Strabo turns his guns against Posidonius' seven zones which, according to him, extrapolate to an ethnic oriented model.

So, the geographer's position apparently outlines the physical grounds of Posidonius' system. The amount of exposition to the sun rays brings about the temperature of atmosphere which is fundamental for the constitution of animal and plants; respectively, five basic zones could be established according to the ecliptic. Yet, the final remarks reinforce the idea that Posidonius' theory speculated on a more complex physical picture where the incidence of sun rays stood just as a basic data. The topic regarding the possible habitation of the torrid zone returns a few lines later in the same fragment when Strabo presents the philosopher's reasons for defending this idea (II. 3. 3). Posidonius considered that the heat in the equatorial trip was bearable given the fast course of the sun there, and he also suspected that there were mountains in the region against which the clouds would strike and make rain.[10] Likewise, the criticism concerning the 'Ethiopic' and 'Scythico-Celtic' zones implies that the pentezonal model, which was solely based on celestial patterns, was ultimately inadequate according to the philosopher: it brings back the network combining location – natural environment – ethnic population.

The scope of Posidonian geography was surely wider than the Strabonian one. Both authors recompose the unity of geography bringing together the legacy of the scientific acquisitions of Hellenism and the rich tradition of descriptive geography (i.e. chorology). Still, the natural philosopher went further. He attempted to explain human geography as a natural growth of the geographical establishment of astronomical zones. This is actually the gist of the contention concerning ethnic zones. By organizing his geographical system with both 'periscian' and 'Scythico-Celtic' types of zones Posidonius ascertained the complete interrelation of celestial and terrestrial phenomena. Strabo's following remarks clarifies Posidonius' agenda for the discipline.

> Then, after an attempt to find fault with those who divide the inhabited world into continents, instead of by certain circles parallel to the equator through which they were likely to show variations in animals, plants, and climates, some connected with the frigid zone, others to the torrid (δι' ὧν ἔμελλον ἐξαλλάξεις δείκνυσθαι ζώων τε καὶ φυτῶν καὶ ἀέρων, τῶν μὲν τῇ κατεψυγμένῃ συναπτόντων, τῶν δὲ τῇ διακεκαυμένῃ) so that the continents would be practically zones, Posidonius again revises his own plea and withdraws his indictment, in that he again approves of the prevailing division into three continents, and thus he makes the question a mere matter of argument with no useful end in view. For such dispositions of animals, plants, and climates do not arise from providential design as neither do

[10] Cleomedes presents Posidonius defending the same idea (*Caelestia* I. 4. 90−131 = F 210 E−K).

> differences in respect of race or language, but by accident and chance. And again, as regards the various arts and faculties and political institutions of mankind (καὶ τέχναι δὲ καὶ δυνάμεις καὶ ἐπιτηδεύσεις ἀρξάντων τινῶν), most of them, when once men have made a beginning, flourish in any latitude whatsoever and in certain instances even in spite of the latitude; so that some local characteristics of a people come by nature, others by training and habit. For instance, it was not by nature that the Athenians were fond of letters, whereas the Spartans, and also the Thebans, who are still closer to the Athenians, were not so; but rather by habit. So, also, the Babylonians and the Egyptians are philosophers, not by nature, but by training and habit. And further, the excellent qualities of horses, cattle, and other animals, are the result, not merely of locality, but of training also. But Posidonius confounds all this. And when he approves of such a division into three continents as is now accepted, he uses as an illustration the fact that the Indians differ from the Ethiopians of Libya, for the Indians are better developed physically and less consumed by the dryness of the atmosphere (τοὺς Ἰνδοὺς τῶν Αἰθιόπων διαφέρειν τῶν ἐν τῇ Λιβύῃ· εὐερνεστέρους γὰρ εἶναι καὶ ἧττον ἔψεσθαι τῇ ξηρασίᾳ τοῦ περιέχοντος.). (Strabo II. 3. 7 = F 49 EK)

Strabo's language in the beginning of the passage is misleading as it implies that Posidonius had two different types of division in mind, i.e. by latitudinal zones and by continents, which would stand as exclusive alternatives. In fact, the philosopher's position basically reflects his elaborate and innovative approach of analysing geographical space through structures, beginning with larger units and moving to smaller ones: latitudinal zones, then continents, then countries, regions and cities (see Dueck 2012, 43). He could both criticize and praise the existing division into continents. On the one hand, environmental variations of fauna and flora, alongside ethnographical characters, were more likely to match the variations of latitudinal zones than the arbitrary division into continents (δι' ὧν ἔμελλον ἐξαλλάξεις δείκνυσθαι ζώων τε καὶ φυτῶν καὶ ἀέρων, τῶν μὲν τῇ κατεψυγμένῃ συναπτόντων, τῶν δὲ τῇ διακεκαυμένῃ). On the other, continents also have an influence because variations of environment in separate land masses, even in the same latitudinal band, produce special natural effects (τοὺς Ἰνδοὺς τῶν Αἰθιόπων διαφέρειν τῶν ἐν τῇ Λιβύῃ· εὐερνεστέρους γὰρ εἶναι καὶ ἧττον ἔψεσθαι τῇ ξηρασίᾳ τοῦ περιέχοντος).

In addition, Strabo's criticism conveys further aspects of Posidonius' use of descriptive geography.[11] We have seen above that his geography analysed the natural

[11] Besides the available literature, Posidonius certainly made use of his observations on his extensive travels in Spain, Gaul, Italy and the East.

effect of environment over the bodily constitution of peoples (*Geo*. II. 2. 3). Yet, following the contention here, one learns that he further speculated on the environment influence over cultural habits and even political institutions of the city-states.[12] Αἱ γὰρ τοιαῦται διατάξεις οὐκ ἐκ προνοίας γίγνονται … οὐ γὰρ φύσει Ἀθηναῖοι μὲν φιλόλογοι ... οὕτως οὐδὲ Βαβυλώνιοι φιλόσοφοι φύσει καὶ Αἰγύπτιοι … 'Such dispositions are not the result of providential design … it is not by nature that the Athenians are fond of literature … it is not by nature that Babylonians and Egyptians are philosophers.' For Posidonius, the locality – and by *topoi* one should understand a complex involving temperature, climatic factors, topography, and geology – was a determinant factor in shaping the general qualities of animals and humans.

In summary, the main focus of Strabo' criticism regards the (according to him) overreaching scope of Posidonius' geography. Although the geographer approves Posidonius' definition of five zones which reflect the incidence of the sun rays in the atmosphere (II. 3. 1), he disapproves supplementary concepts of his geographical system: that certain features of the terrain were significant enough to challenge the notion of a torrid uninhabitable zone between the tropics; that the natural environment determines the characters of animals and peoples. Accordingly, Strabo ends his general account with a specific criticism: 'For there is much enquiry into causes in him [Posidonius], that is, "Aristotelising", a thing which our School [the Stoics] sheers off from because of the concealment of causes' (Strabo II. 3. 8 = F 49 E−K). The objectionable Aristotelianism of Posidonius consisted in pursuing the causative nexus linking, on the one side, natural environment and climatic region (Ἡ μὲν οὖν εἰς πέντε διαίρεσις δοκεῖ μοι καὶ φυσικῶς ἅμα καὶ γεωγραφικῶς εἰρῆσθαι. II. 3. 1) and, on the other, its living beings (οὕτως οὐδὲ Βαβυλώνιοι φιλόσοφοι φύσει καὶ Αἰγύπτιοι, ἀλλ' ἀσκήσει καὶ ἔθει· 3. 7).[13]

So, as scholars regularly point out, Posidonius has influenced Strabo in the sense that the latter similarly brings together the legacies of scientific and descriptive geography.[14] Yet, as we have seen, Posidonius' striking attempt of establishing a direct

[12] Cf. καὶ τέχναι δὲ καὶ δυνάμεις καὶ ἐπιτηδεύσεις ἀρξάντων τινῶν ...
[13] Note that Aristotle briefly mentions the connection between climatic factors (or position on the globe) and the forms of plants, animals and human beings (*Hist. An.* 8. 28).
[14] See Prontera 2015, 254: 'Without making any original contribution to the scientific acquisitions of Hellenism, his theoretical [Strabo's] commitment aims to recompose along the lines of Posidonius the unity of geography, bringing together the legacies of Eratosthenes and Polybius.'

interconnection between locality and the qualities of animals and peoples[15] does not find space in the *Geography*. Strabo ascribes these qualities to accident, chance and arbitrary determination, and specifically criticizes Posidonius' Aristotelianism in his addiction to argument from causes. Correspondingly, following his own strictly descriptive agenda, the geographer alludes only in passing to the Aristotelian-like physical explanation underlying the influence of the natural environment. Yet, there is another geographical account written within few generations after Posidonius' work that restated the interrelation of latitudinal position and ethnographical characters. One should survey it to grasp the possible causal explanations for the phenomena.

III- Vitruvius

Vitruvius was a Roman military engineer who also lived in the first century BC (80−15 BC). He is the author of *De architectura*, known today as *The Ten Books on Architecture,* a treatise written in Latin on architecture, dedicated to the emperor Augustus. Vitruvius begins the first chapter of Book VI claiming that the types of buildings in an area depended on the climate there, and thus on latitude. The topic leads him to a long digression on the geography of the Roman world where the climate, i.e. the latitudinal position, is a determinant factor on shaping the peoples' characters. As scholars have already remarked, many details of Vitruvius' geographical system remind us of Posidonius' explanatory ethnography as portrayed by Strabo (K. Schmidt 1980, 26–32; Reinhardt 1921, 79–87). In this section, I shall analyse passages of *De architectura* that introduce philosophical notions underpinning the causal nexus between climate and characters. The report begins:

> If our designs for private houses are to be correct, we must at the outset take note of the countries and climates in which they are built (*quibus inclinationibus mundi constituantur*) … as the position of the heaven with regard to a given tract on the earth leads naturally to different characteristics, owing to the inclination of the circle of the zodiac and the course of the sun, it is obvious that designs for houses ought similarly to conform to the nature of the country and to diversities of climate (VI. 1. 1) … These effects are noticeable and discernible not only in things in nature, but they also are observable in the limbs and bodies of entire races. In places on which the sun throws out its heat in moderation, it keeps human bodies in their proper condition, and where its path is very close at hand, it parches them up,

[15] See also the philosopher's report about life in Liguria (F 268 and 269 E−K) for his notion that the peoples' characters reflect their natural environment. Cf. also Malitz' analysis of Posidonius' historical account of the celtiberians (Malitz 1983, 117−31).

> and burns out and takes away the proportion of moisture which they ought to possess. But, on the other hand, in the cold regions that are far away from the south, the moisture is not drawn out by hot weather, but the atmosphere is full of dampness which diffuses moisture into the bodies (*roscidus aer in corpora fundens umorem*), and makes the frame larger and the pitch of the voice deeper. This is also the reason why the races that are bred in the north are of vast height, and have fair complexions, straight red hair, grey eyes, and a great deal of blood, owing to the abundance of moisture and the coolness of the atmosphere. (1. 3) On the contrary, those that are nearest to the southern half of the axis, and that lie directly under the sun's course, are of lower stature, with a swarthy complexion, hair curling, black eyes, strong legs, and but little blood on account of the force of the sun.'[16]

Vitruvius' geographical account seems to be germane to the systems of Posidonius and Strabo as the digression begins by alluding to two complementary approaches for understanding the importance of climatic regions. The starting-point lies in the division of the tracts on the earth in accordance with the position of the heavens; that is, the mathematical grid of the earth useful with reference to the celestial phenomena (VI 1. 1 *si primo animadversum fuerit, quibus regionibus aut quibus inclinationibus mundi constituantur*). Complementarily, there is the observable reality of diverse ethnographic characteristics; i.e. the tradition of human geography (1. 3 *et consideranda atque etiam ex membris corporibusque gentium observanda*). So, following the tradition outlined in Strabo's *Geography* (II 2−3 = F 49 E−K), Vitruvius conceives a geographical system which combines the legacies of the so-called 'scientific' and 'descriptive' geographies.

Yet, Vitruvius is more generous than Strabo in providing the physical explanation underpinning the natural effect of climate on the peoples' bodily constitution. He envisages a causal nexus linking the position of the sun, the condition of the atmosphere, and the human body. The section above details the chain of effects in the cold north region: where the sun is distant, the resulting cold and damp atmosphere (*non exhauritur a caloribus umor*) produces large bodies, fair complexions, straight red hair, grey eyes, and plenty of blood. Likewise, he analyses the outcome of the force of the sun in the hot south. People there are of lower stature, and have a swarthy complexion, hair curling, black eyes, strong legs, and little blood. The explanation is that the sun burns them out taking away the due proportion of moisture (*eripit exurendo*

[16] The translations of Vitruvius are taken from Morgan 1914 (with some alterations).

temperaturam umoris). Specifically, Vitruvius overtly mentions what was implicit in Strabo's account:[17] his geographical system conceives two similar 'organisms' along the causal chain: it is the very moisture of the 'organism' atmosphere (or air) that determines the crucial moisture of the bodies (cf. *roscidus aer in corpora fundens umorem*). Further details about the causal nexus of the phenomena are introduced as the digression proceeds.

> Hence, too, this poverty of blood makes them overtimid to stand up against the sword, but great heat and fevers they can endure without timidity, because their frames are bred up in the raging heat. Hence, men that are born in the north are rendered overtimid and weak by fever, but their wealth of blood enables them to stand up against the sword without timidity (VI. 1. 4)… Further, it is owing to the rarity of the atmosphere that southern nations, with their keen intelligence due to the heat, are very free and swift in the devising of schemes, while northern nations, being enveloped in a dense atmosphere, and chilled by moisture from the obstructing air, have but a sluggish intelligence. That this is so, we may see from the case of snakes. Their movements are most active in hot weather, when they have got rid of the chill due to moisture, whereas at the winter solstice, and in winter weather, they are chilled by the change of temperature, and rendered torpid and motionless. It is therefore no wonder that man's intelligence is made keener by warm air and duller by cold (1. 9).

As we see, Vitruvius claims that the behaviour and intelligence of the peoples are also determined by the climatic region where they inhabit; that is, he extends the scope of the influence of the environment. On the one hand, the peoples who live under the sun's course, given its power there, do not have much blood and are consequently fearful in battle; however, the warm thin air makes them more intelligent and resistant to fevers. On the other, the peoples who live in the northern climates, given their abundance of blood, are braver and prone to be feverish; yet, the cold and dense atmosphere makes them less intelligent. So, Vitruvius presents a geographical account which sounds as completely dependent on physics or natural philosophy. What emerges is an aetiological theory for the *oikoumene* unifying climatic, somatic, and psychic factors.

The author closes the ethno-geographical digression of *On Architecture* off at section 13 ('I have now set forth the peculiar characteristics of localities …'). Two other

[17] Cf. II. 2. 3: 'they are peculiarly arid (αὐχμηράς τε ἰδίως) and sandy … and for this reason they produce creatures with woolly hair, …'; II. 3. 7: 'for the Indians are better developed physically and less boiled by the dryness of the atmosphere (τῇ ξηρασίᾳ τοῦ περιέχοντος).'

topics feature in the excursus. Between sections 5 and 8 he conceives a sort of graphic system where an imaginary axis with the direction Equator – North Pole indicates that the vocal types depart from a shrill and high-pitched voice and progressively acquire a heavier, bass tone. The nations that lie midway between the extremities display, accordingly, a voice of middle pitch 'like the notes in the middle of a musical scale' (*uti in diagrammate musico medianae* 1. 7). It is respectively stated that such melodic line of progression of vocal types (along the climatic regions) bear witness to the harmonic action of the sun (*ita videtur mundi conceptio tota propter inclinationem consonantissime per solis temperaturam ad harmoniam esse conposita* 1. 7). At last, Vitruvius ends the digression in a patriotic mood by ascribing the golden mean to Italy. It was the divine providence, the reader learns, that set the civic community of the Roman people in an excellent and temperate region (*ita divina mens civitatem populi Romani egregiam temperatamque regionem conlocavit* 1. 11) so that the hegemonic city-state could refrain the reckless barbarians and thwart the devices of the southerners (*Itaque consiliis refringit barbarorum virtutes, forti manu meridianorum cogitationes* 1. 11).

So, as mentioned above, scholars have noted the parallels between *On Architecture* VI 1. 1− 13 and the geographical theories that Strabo ascribes to Posidonius' *On Ocean*.[18] Theiler, following Reinhardt's general approach, considers the philosopher as the likely source of the Latin excursus and includes this passage in his collection of Posidonian fragments (F 71 Th).[19] In fact, *Quellenforschung* (source research) does not seem to be a credited methodology nowadays and it is not the purpose of this article to defend Theiler's viewpoint, yet, it is interesting (and legitimate) to speculate on how Posidonius' philosophy might provide physical concepts supporting the geographical account of *On Architecture*.

Firstly, let us consider the clear parallels between the text of F 49 E−K and Vitruvius' report. To start with, both geographical systems have the sun as absolute point of reference (cf. Strabo II 2. 3; *mundi conceptio tota propter inclinationem*

[18] Vitruvius names Posidonius, among other authorities, as his source for Book VIII which is concerned with water supplies (VIII. 3. 26−7 = T 50 E−K).
[19] Theiler' collection of Posidonian fragments (1982) is based on Karl Reinhardt's reconstruction of Posidonius' philosophy with texts that do not necessarily include the philosopher's name.

consonantissime per solis temperaturam 1. 7).[20] The effect of the sun over the atmosphere (or air) establishes three general types of zones (cf. ὅτι τῆς τούτου κράσεως πρὸς τὸν ἥλιον κρινομένης διαφοραὶ τρεῖς εἰσιν II 3. 1; *De Architecture* VI. 1. 1); a temperate zone (εὔκρατος; *temperata*), a hot south and a cold north. Further, the natural environment generates their respective ethnic types (cf. διόπερ οὐλότριχας καὶ οὐλόκερως καὶ προχείλους καὶ πλατύρρινας γεννᾶσθαι II 2. 3; ... *brevioribus corporibus, colore fusco, crispo capillo, oculis nigris, cruribus validis* 1. 2); likewise, locality is also responsible for psychic traits and the peoples' behaviour in general (cf. οὕτως οὐδὲ Βαβυλώνιοι φιλόσοφοι φύσει καὶ Αἰγύπτιοι II 3. 7; *meridianae nationes ex acuta fervore mente expeditius celeriusque moventur ad consiliorum cogitationes* 1. 4). At last, both authors maintain that the divine providence sustains the climatic – somatic – psychic complex of the *oikoumene* (Αἱ γὰρ τοιαῦται διατάξεις οὐκ ἐκ προνοίας γίγνονται II 3. 7; *ita divina mens* … 1. 11).

Regarding the possible physical theory underlying the ethno-geographical systems, we could at the outset invoke Posidonius' elemental dynamics where heat works as a sort of efficient cause.[21] It is manifest in both passages that heat stands as the major causal factor in the natural processes. In Strabo's *Geography* one learns that the constitution of animals and plants fundamentally correspond to the excess, lack of, and mean heat in the organisms (… ὑπερβολὴ θάλπους καὶ ἔλλειψις καὶ μεσότης 3. 1). Similarly, Vitruvius makes clear that the activity of heat determines both the atmosphere of the climatic regions (*sol quibus locis mediocriter profundit vapores* ...1. 1) and also the general qualities of their respective peoples (*Ita non est mirandum, si acutiores efficit calidus aer hominum mentes, refrigeratus autem contra tardiores* 1. 9).

Next, Posidonius' ethic-psychology provides theoretical support for the idea of a compelling sway of environmental factors. Note that this same idea is properly articulated within Posidonius' psychology in Galen's report about his critique of Chrysippus' orthodox position.[22] Posidonius criticises Chrysippus' approach to

[20] For the evidence that Posidonius considers the sun the hegemonic part of the universe see my forthcoming article 'The concept of the Sun as ἡγεμονικόν in the *Stoa* and in Manilius' *Astronomica*'.

[21] Cf. Simplicius *In De Caelo* 699, 13 – 700, 8 (= F 93 E−K): 'another is that in which heavy and cold things have the role of matter, light and hot things of form, as Aristotle himself says elsewhere and Theophrastus says in *On the coming to be of the elements*. Posidonius the Stoic borrows it from them and uses it all the time.' For the importance of this notion in Posidonius' physics see my article Boechat 2016.

[22] The relevant material preserved in Galen comes from Posidonius' *On Emotions* (F 30−35 E−K). See also the texts collected in the section 'fragments not assigned to books' (F 150−187 E−K) which also

emotions as narrowly cognitive or rationalistic, and introduces into Stoic philosophy the concept of irrational powers of the soul. Respectively, the irrational appetencies of the soul are germane to Posidonius' view that the physical environment was decisive in the formation of the psyche:[23] whereas Chrysippus focuses on beliefs and conceptions as the determinant cause for the origin of passions, the later Stoic philosopher finds their origins within the person's very physical constitution.[24] So, Posidonius' psychophysical approach to emotions may well be seen as underpinning the recurrent notion of *On architecture* that the soul's disposition, including its moral quality, depends on physiological processes in the body which fundamentally match the surrounding atmospheric condition. The notion is clearly expressed as Vitruvius conveys the unstructured soul of nations who live in the extremes of the *oikoumene*: '…and all these nations being allotted unbalanced blends' 1. 10 (*et omnes nationes inmoderatis mixtionibus disparatae*; see K. Schmidt 1980, 26–32).

Finally, the action of the atmosphere over the bodies (that ultimately shapes the peoples' temperaments) as described by Vitruvius may find support within Posidonius' meteorological research. Specifically, part of the physiological processes that determines the soul's dispositions can be clarified in accordance with the elemental dynamics underlying Posidonius' tidal theory. The physical explanation of the cycles of sea tides, the philosopher's greatest contribution to science, is preserved in the book of Pricianus Lydus, *Solutiones ad Chosroem*, which survives only in a Latin translation. I show the relevant passage of this long Posidonian fragment below.

> Why does the Red Sea every day and night flow high for a time and then recede, and the tides vary from more to less with the moon? … Therefore searching for the explanation for these phenomena, the Stoic Posidonius, who personally investigated this kind of interaction (*reciprocationis*), distinguishes its main cause as being the moon and not the sun. For the sun's fire is pure (*sincerum*) and has its greatest power (*summae virtutis*); thus, however much vapour it raises up (*vapores … sublevat*) from the earth and sea is soon destroyed by its

features in Galen's work. For the idea that Galen basically misrepresents Chrysippus' psychological tenets, see Gill 2006, 207–66.

[23] Cf. Galen *On the Doctrines of Hippocrates and Plato* 437. 1−444. 11 (= F 169 E−K): 'Posidonius reasonably attaches to his discussion the phenomena from physiognomy; all broad-chested and warmer creatures and humans are more spirited by nature, the broad-hipped and colder, more cowardly. And environment contributes to considerable differences in human character with regard to cowardice, daring, love of pleasure or toil; the grounds for this are that the emotional movement of the soul follow always the physical state (ὡς τῶν παθητικῶν κινήσεων τῆς ψυχῆς ἑπομένων ἀεὶ τῇ διαθέσει τοῦ σώματος), which is altered in no small degree from the temperature in the environment (ἣν ἐκ τῆς κατὰ τὸ περιέχον κράσεως οὐ κατὰ ὀλίγον ἀλλοιοῦσθαι).'

[24] See Reydams-Schils 1999, 67–68; Filion-Lahille 1984, 102.

> fire (*ab igne demolitur*). But the moon's fire (*lunae ignem*) is not pure but weaker and mild, and hence more productive on things on the earth; it is incapable of using up what it heats, and it can only elevate liquids (*elevare umida*) and produce waves (*fluctificare*) by driving them with its heat, but without reducing them, due both to the weakness of its heat and its great moisture. That is why any [water] heated by the moon putrefies more readily; likewise, when water in a kettle is heated gently, it first swells, rises and flows (*mensurate primum intumescit et extollitur fusa*); but if fire is applied steadily, the water is used up and decreases. Likewise the ocean is affected by the sun just as water in a kettle is by intense heat, but by the moon as water is by a weak initial heat. Thus the ocean's tide also goes round together with the moon.' (*Solutiones* VI = F 219. 1–4, 77–95 E−K)

I analyse elsewhere the theory of elements underlying the explanation for the meteorological phenomena (cf. Boechat 2016, 452−56). Priscianus' report explains the occurrence of tides as follows. The moon is the primary factor in the occurrence of sea tides because the weak heat emitted by the moon (*lunae ignem*) just expands the spatial volume of the sea water (*elevare umida et fluctificare*). Conversely, the sun's heat is too strong and, as a result, it can transform water into vapour (*vapores ... sublevat*). The analogy between the power of solar heat over the sea and water in a warmed kettle helps to illuminate in the micro-scale the contrasting physical transformations undergone by the element water. On the one hand, the action of the kettle gently warming water matches the moon's effect; the water swells, rises and flows (*mensurate primum intumescit et extollitur fusa*). On the other, when the kettle intensely heats water, it matches the sun's effect; the water is used up (*consumata*) and decrease (*consumata subsidit*).To summarise, the description of the physical processes shows that the ocean follows the same courses of elemental transformation which the element water itself undergoes when exposed to heat. On the one hand, the mild intensity (i.e. the moon's heat) just expands the volume of the element (*elevare umida; extollitur fusa*). On the other, the strong intensity (i.e. the sun's heat) makes the water go up too (*vapores ... sublevat*); however, its strength actually results in elemental change (*ab igne demolitur*; *consumata*).

Now, as I said, the physiological processes which are implied in the ethno-geographical account of Vitruvius (and of Posidonius in Strabo) may be better understood having this elemental dynamics as background. The passage above provides a physical theory illuminating the effect of the atmosphere over human bodies: the kettle simile works for the ethnic variation along the climatic regions as it works for the

sea tides. On the one hand, the boiling kettle matches the southern region as the intense heat there similarly uses the organic moisture up; therefore, it decreases the blood volume and body sizes (cf. 1. 3 *sanguine exiguo solis impetu*). On the other hand, the mildly heated kettle corresponds to the northern region as the low temperatures similarly raise the organic moisture up without actually elemental transforming it; that is, it expands the blood volume and body sizes (cf. 1. 4 *sanguine multo ab umoris plenitate caelique refrigerationibus*).[25] One should also bear in mind that, according to the ancient medical tradition,[26] blood was moist and hot. This concept may provide further theoretical support for Vitruvius' geography in the sense that heat is the lynchpin of Posidonian elemental dynamics. Specifically, both natural phenomena in discussion essentially correspond to the circulation or reciprocal exchange (*reciprocatio*) of heat: as the sun and the moon interact with the 'flame' that is inherent in the sea (cf. *submoventem ea a caliditate … calidissima virtute salitatis*, cf. Boechat 2016 456), the sun (through the atmosphere) sends in and receives heat from the warm and moist blood.[27]

Again, having noted that Posidonius' geography in Strabo (F 49 E−K) overlaps substantially with Vitruvius' *On Architecture* VI 1. 3− 9, I have basically offered a conjecture as to how Posidonius' natural philosophy could supplement Vitruvius' explanatory ethnography. The fact that Posidonius' physics is apposite to Vitruvius' digression does not prove that the former stands as source of the latter. Nonetheless, the correspondence shows that there was a conceptual framework available in the second half of first century BC supporting Vitruvius' systematic arrangement of the *oikoumene*. Moreover, it discloses the present zeitgeist. The recurrent notion that the person's temperament and the population's culture are directly derived from physiological processes and geographical positions bears witness to the materialistic or 'physicalist'

[25] Also note how Posidonius distinguishes the Indians from the Ethiopians: εὐερνεστέρους γὰρ εἶναι καὶ ἧττον ἕψεσθαι τῇ ξηρασίᾳ τοῦ περιέχοντος II 3. 7. In other words, the Indians have a larger frame (εὐερνεστέρους) because (like the northerners in Vitruvius) their organic moisture (or blood) is less consumed (ἧττον ἕψεσθαι) by the dry atmosphere.
[26] Cf. Galen *Causes of Diseases* VII 21−22. See analysis in Hankinson 2008, 219.
[27] The concept that blood is naturally warm and moist probably underlies the Vitruvian idea of northern peoples being prone to be feverish (VI. 1. 4). Their abundance of warm blood makes them easily alterable by heat. See the medical tradition: Galen *On Uneven Distemper* VIII 740–1 'whatever is easily altered by heat, or is naturally hot, is heated first, just as whatever is easily affected by cold, or is naturally cold, is cooled first'. Likewise, the natural qualities of blood could explain why they are brave soldiers (*sanguinis autem abundantia ferro resistunt sine timore* 1. 4). There is a sympathetic element between them and the swords since the fiery metallurgy is implicit in iron production.

viewpoint of intellectual circles of the period.[28] The multifaceted variety of life is considered to be completely dependent on the matter where they reside.

We can conclude our research now. I have first offered a condensed summary of the journey of Greek geographical thought from its origins in Presocratic philosophy up to the end of the second century BC. It was respectively observed that during the Hellenistic era, or after Aristotle, the discipline became a sort of specialized science whose purpose essentially consisted in measuring the earth and drafting a map of the *oikoumene*. Its major authors (Eudoxus, Dicaearchus, Eratosthenes, and Hipparchus) made use of increasingly advanced mathematical and astronomical skills in order to ensure a scientific basis for the cartographical project; however, their geographical research apparently disregarded the natural and human environments which seem to have been, in this period, confined to the so-called chorographies, i.e. the geographical accounts found in the literary tradition.

As we have also seen, there is a paradigm change in the first century BC. The Stoic philosopher Posidonius focused on the concept of zones found in the early philosophers to rescue the ecological and human dimension of scientific geography. Posidonius also employs mathematical-astronomical data in methodically organizing the geographical zones, yet he interrelated the patterns of the skies and living things on earth by pursuing the nexus of intermediate causation operating through the whole physical and animate features of a region. Likewise, Vitruvius conveys a geographical system which associates climatic, somatic, and psychic features. Vitruvius does not mention the source of his digression yet we have observed that his relatively well detailed explanatory geography could be grounded by physical concepts of Posidonius' philosophy.

At last, both geographical accounts witness the new directions taken by philosophical thought in the first century BC. The renascence of Peripatetic philosophy, which entailed the meteorological research shared by the Stoa under Posidonius, the Epicurean Lucretius (book V and VI) and also the middle Platonic Eudorus of Alexandria, meant the revitalized quest for the motive (or efficient) causes operating

[28] See the similar ethno-geography of Manilius' *Astronomica* (IV 711–43). Also note that Virgil portrays the war between Rome and Carthage as a battle between geographical positions: *litora litoribus contraria, fluctibus undas*/*imprecor, arma armis: pugnent ipsique nepotesque*. (*Aen*. IV 628−29). Cf. also the following note.

through the natural world. The geographical systems analysed in this article show that this quest was ultimately extended to humankind. When the aetiological research, or what Strabo calls 'aristotelising', was applied to the study of the *oikoumene*, humankind as a whole becomes a sort of meteorological phenomena – a natural product of the geographical establishment of astronomical zones. Accordingly, such rather sophisticated ethno-geographies were an integral part of the 'physicalist' approach of the period: the form is considered to be dependent on, and less fundamental than, the underlying subtract.[29]

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[29] See, for instance, Boethus of Sidon' commentary of the *Categories* where matter is considered to be more substantial than form (Simplicius' *in Cat.* 78.5−20) and Posidonius' hierarchical distinction between physical philosophy and mathematical astronomy (Simplicius *in Phys.* ii 2, 193b23 = F 18 E−K; see the analysis in White 2007, 60−62).

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