

Anaxagoras' Argument Against the Sphericity of the Earth

The discovery of the sphericity of the earth occupies a very special place in the history of human thought. Although "we have no account of how the sphericity of the earth was discovered"¹, we at least are told by Diogenes Laertius that Parmenides "was the first to declare that the earth is spherical and is situated in the centre of the universe". Diogenes explicitly names Theophrastus as his authority (D. L. 9. 21 sq.; cf. 8. 48).

The earliest exposition of the doctrine of the earth's sphericity is to be found, however, in Plato's *Phaedo* (108 e sqq.), more than one hundred years after Parmenides' poem. Moreover, it is introduced there as a doctrine opposing the prevalent views, and indeed it is difficult to indicate any clear mention of a spherical earth in the extant literature from the fifth and early fourth centuries. All this provides basis for radical scepticism in respect of Diogenes' testimony².

Considering the arguments of the sceptics, one should not assume that all details of the earth description in the *Phaedo* are thought to be innovative. For instance, Plato employs that theory of the earth's stability

¹ Otto Neugebauer, *A History of Ancient Mathematical Astronomy* II (Berlin, etc. 1975) 576. See further: Charles H. Kahn, *Anaximander and the Origins of Greek Cosmology* (New York 1985) 115 ff.; Walter Burkert, *Lore and Science in Ancient Pythagoreanism* (Cambridge, Mass. 1972) 304 f.; Sir Karl Popper, "Back to the Presocratics", in *Studies in Presocratic Philosophy*, ed. David J. Furley and R.E. Allen I (London 1970) 130 ff.; F. Gisinger, "Geographie", in *RE* Suppl. 4 (1924) 572 ff.; Sir Thomas Heath, *Aristarchus of Samos the Ancient Copernicus* (Oxford 1913) 48 ff.; Hugo Berger, "Die Lehre von der Kugelgestalt der Erde im Altertum", *Geographische Zeitschrift* 12 (1906) 20-37; Idem, *Geschichte der wissenschaftlichen Erdkunde der Griechen* (Leipzig ²1903) 171 ff.

² Erich Frank, *Plato und die sogenannten Pythagoreer* (Halle 1923) 184 ff.; W.A. Heidel, *The Frame of the Ancient Greek Maps: With a Discussion of the Discovery of the Sphericity of the Earth* (New York 1937) 63 ff.; Detlev Fehling, "Das Problem der Geschichte der griechischen Weltmodels vor Aristoteles", *RhM* 128 (1985) :3-4, 195-231.

within the universe which goes back to Anaximander.³ As to the point in question, Plato has Socrates remember his expectation to find in Anaxagoras' book a solution to the question of whether the earth is πλατεῖα or στρογγύλη. In the context, στρογγύλη cannot mean a flat round disk. It must mean a sphere⁴ or at least a body with a convex surface. On the other hand, *Phaedo's* picture of the earth in which the world inhabited by us is just one of the numerous hollows on the surface of a huge globe is still unique.

As to the *argumentum ex silentio*, the best effort to answer it has been undertaken by Walter Burkert. He pointed to the implications of the notion of the earth's sphericity in Hippocrates of Chios (c. 430 B. C.) and Empedocles⁵. Nevertheless these implications are not clear enough to bring an end to the old controversy. I adduce here a testimony which, when combined with another text, makes already Anaxagoras argue against the sphericity of the earth⁶.

I will cite first a well known text from the *De Caelo*. Aristotle says *a propos* the shape of the earth: "Some think it spherical, others flat and shaped like a drum. These latter adduce as evidence the fact that the sun at its setting and rising shows a straight instead of a curved line where it is cut off from view by the horizon, whereas were the earth spherical, the line of section would necessarily be curved" (293 b 24 sqq.; Guthrie's translation).

Aristotle does not specify the thinkers who employ such a consideration. Somewhat later, he presents, however, Anaximenes, Anaxagoras and Democritus as the opponents of the sphericity of the earth (294 b 14 sqq.). A testimony from Martianus Capella, overlooked by scholars⁷, lets

³ See my "Ὄμοιος and ὁμοιότης in Anaximander and Thales", *Hyperboreus* 1 (1994) :1, 28–55.

⁴ In the two parallel passages in Diogenes Laertius, both referring to Theophrastus (8. 48 and 9. 21–22), the words στρογγύλη and σφαιροειδής are used interchangeably.

⁵ Walter Burkert, *Op. cit.*, 305. The priority of Parmenides is also accepted by Alexander Zajcev, *Культурный переворот в Древней Греции VIII–V вв. до н.э.* (Ленинград 1985) 197; a German version of this book – *Das Griechische Wunder: Die Entstehung der griechischen Zivilisation* (Konstanz 1993) 184 – makes Zajcev's view unduly vague.

⁶ Anaxagoras' book appeared most likely in the 460 s. See: Malcolm Schofield, *An Essay on Anaxagoras* (Cambridge 1980) 33–35; David Sider, *The Fragments of Anaxagoras* (Meisenheim am Glan 1981) 6–8.

⁷ I mean Diels and Lanza, on the one hand, and those who discussed the discovery of the sphericity of the earth, on the other hand. The text by Martianus Capella is cited

us conclude that the argument mentioned by Aristotle was used – and apparently introduced – by Anaxagoras.

The text runs as follows:

Formam totius terrae non planam, ut aestimant, positioni qui eam disci diffusioris assimilant, neque concavam ... sed quoniam posterior assertio magis despicibilis opinationis cassae vilitate tenuatur, illam priorem, cui etiam physicus Anaxagoras accessit, praestat exigere, quamvis nonnullas credatur astruere rationes; quippe dicit planam terram ortu occasuue solis aut lunae perspicue comprobari, qui, mox primi luminis fulgor emerit, confestim ad obtutus nostros directis lineis diriguntur, quod magis indubitabilis probamenti fiet, si in litore consistentes obstacula montium relinquamus (6. 590–592).

“(Then Geometry will answer that) the earth is not flat, as they who compare it to a vast disk say; nor concave ... The latter theory is more absurd than the former, and it is vitiated because it is based on a worthless, unfounded conjecture. Accordingly it is more profitable to examine the first theory, which even the physicist Anaxagoras held – though indeed he is believed to have provided some proofs for it. He says that the fact that the earth is flat is clearly proved by the rising and settings of the sun or of the moon, which come into view immediately as soon as the first rays emerge and travel in a straight line to the eye. This phenomenon is even more striking as proof if we leave the mountainous regions where our view is blocked and stand on the seashore” (transl. by Gershenson and Greenberg).

It seems that Martianus Capella refers only a part of Anaxagoras' argument and not without confusion⁸. Be that as it may, the key reference to the risings and settings of the sun (and the moon) makes his text clearly parallel to the Aristotelian passage. One has to press this parallelism because the Latin author does not say that Anaxagoras' argument for the flat earth was directed against the doctrine of its sphericity. However, it is very hard to imagine Anaxagoras (or any one) *proving* that the earth is flat unless he was arguing *against* the opposite view. Even taken alone

by Daniel E. Gershenson and Daniel A. Greenberg, *Anaxagoras and the Birth of Physics* (New York, etc. 1964) 208 f., but they do not connect it with the passage from the *De Caelo* and, so to say, make no use of it.

⁸ The sphericity of the earth was a textbook truth for a Latin author of the early fifth century A.D., Martianus Capella was not really interested in discussing the arguments *pro* and *contra* and could easily have confused details. His ultimate source was probably Dicaearchus (fr. 108 Wehrli), who is mentioned in the text omitted from quotation.

Capella's testimony makes plausible what in combination with the *De Caelo* passage it makes certain: already Anaxagoras was familiar with the idea of the earth's sphericity.

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Ввиду скудости античных свидетельств в научной литературе до сих пор не достигнуто согласие относительно того, когда впервые была выдвинута идея шарообразности Земли. Сопоставление сообщений Аристотеля и Марциана Капеллы позволяет заключить, что уже Анаксагор полемизировал с этой идеей.