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(b.Sidon, ca. 150 B.C.; d. Athens, ca. 70 B.C.)

*philosophy, mathematics, logic.*

According to ancient tradition, Zeno of Sidon was a very prolific writer who discussed theory of knowledge, logic, various aspects of ancient atomic theory, the fundamental differences of the sexes (from which it follows that they have different diseases), problems of Epicurean ethics, literary criticism, style, oratory, poetry, and mathematics. Very little is known of the contents of these writings except those on mathematics and logic, which are of great interest.

Epicurus had been a very severe critic of mathematics as a science : but what he said about it is very superficial and shows that he did not understand what mathematics is. This is not at all the case with Zeno's criticism of Euclid's axiomatics. In his commentary on Euclid, Proclus says that Zeno attacked the first theorem of the *Elements* (the construction of an equilateral triangle) on the ground that it is valid only if one assumes that two straight lines cannot have more than one point in common, and that Euclid has not set this down as an axiom. On the same ground he attacked Euclid's fourth postulate, which asserts the equality of all right angles, observing that it presupposes the construction of a right angle, which is not given until I, 11. In addition, Proclus and Sextus Empiricus mention several criticisms of Euclid that they attribute to an unnamed Epicurean and that are similar to Zeno's criticisms: for instance, that there is no axiom establishing the infinite divisibility of curves, which is connected with a discussion of various consequences following from the assumption that curves are not infinitely divisible but, rather, are composed of the smallest units of indivisible lines. There is also a criticism anticipating Schopenhauer's of Euclid's method of superimposition, by which he proves the first theorem of congruence and a few other theorems : namely, that only matter can be moved in space.

On the basis of these criticisms of Euclid's axiomatics, **E. M. Bruins** has claimed that Zeno of Sidon was the first to discover the possibility of [non-Euclidean geometry](#). This claim appears exaggerated, since there is not the slightest tradition indicating that Zeno elaborated his criticism in such a way as to show positively how a non-Euclidean geometrical system could be built up. Zeno's criticisms of Euclid are pertinent, however, and if any of the ancient philosophers and mathematicians who tried to refute them had been able to grasp their full implications, the development of mathematics might have taken a different turn.

Lengthy fragments of a treatise by the Epicurean philosopher Philodemus of Gadara have been found on a papyrus from Herculaneum (no. 1065), and most of those preserved contain a report on a controversy between Zeno and contemporary Stoics over the foundations of knowledge. In this dispute Zeno defended the old Epicurean doctrine that all human knowledge is derived exclusively from experience. What makes it interesting, however is that he bases his defense on a theory that he calls "transition according to similarity" (μετάβασις καθ' ομοιότητα) or "transition from the apparent to the not apparent" (μετάβασις ἀποτῶν Φαινομένων εἰς τὰ ἀΦανή), but that is essentially an anticipation of [John Stuart Mill](#)'s theory of induction.

In contrast to Aristotle's theory of induction, according to which the most certain kind of induction is that in which one case is sufficient to make it evident that the same must be true in all similar cases, and in opposition to the Stoic doctrine that no number of cases ever permits the conclusion that the same must be true in all cases, Zeno insisted that all knowledge is fundamentally derived by inference to all cases from a great many cases without observed counter-instance. He carried this principle to the extreme by asserting that the knowledge that the square with a side of length 4 is the only square in which the sum of the length of the sides (16) is equal to the contents ( $4 \times 4 = 16$ ) was derived from measuring innumerable squares, although here it is evident that the result-insofar as it is correct, one-dimensional measures being equated with two-dimensional measures-can be derived from a simple deduction and that nobody will be so foolish as to "verify" it in innumerable squares. The recent proof by computers that the principle is not altogether applicable to mathematics and [number theory](#) shows that certain theorems of Pólya's that had been considered universally valid because they had been proved up to very high numbers were not valid beyond higher numbers unreachable by human calculation.

The details of the controversy between Zeno and the Stoics is extremely interesting because sometimes the positions become curiously reversed, and because it provides a kind of phenomen-ology of induction going beyond most modern works.

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II. Secondary Literature. See Ludger Adam. "Das Wahrheits- und Hypothesenproblem bei Demokrit, Epikur und Zeno, dem Epikureer" (Ph.D. diss., Göttingen, 1947); E. M. Bruins, *La géométrie non-euclidienne dans l'antiquité*, Publications de l'Université de l'Université Paris, D121 (Paris, 1967); and G. Vlastos. "Zeno of Sidon as a Critic of Euclid," in *The Classical Tradition: Literary and Historical Studies in Honor of Harry Caplan* ([New York](#), 1966), 148–159.

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## Posidonius | Encyclopedia.com

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(b. Apameia, Syria, ca. 135 B.C.; d. ca. 51 B.C.)

*philosophy, science, history.*

Of Greek parentage and upbringing, Posidonius studied at Athens under the Stoic Panaetius of Rhodes and devoted himself to philosophy and learning. On travels in the western Mediterranean region, especially at Gades (Cádiz), he observed natural phenomena. Between 100 and 95 b.c. he became head of the Stoic school at Rhodes, where he at least once held some political office. In 87–86 as ambassador of Rhodes he reached Rome, visited the dying Marius, and was befriended by such conservatives as Publius Rutilius Rufus (a former fellow student), Pompey (Gnaeus Pompeius Magnus), and Cicero, who had heard him lecture at Rhodes and hoped for a historical memoir from him. An admired friend, Pompey also heard Posidonius at Rhodes in 67 and 62 B.C., when Posidonius was crippled but unconquered by gout. He died at the age of about eighty-five. His works have been lost but he was used or mentioned by authors whose writings are extant.<sup>1</sup>

For Posidonius, fundamental principles depended on philosophers and individual problems on scientists; and he believed that, among early men, the philosophically wise managed everything and discovered all crafts and industry. He stressed the Stoic ordering of philosophy—physical, ethical, logical—as a connected entity. For true judgment the standard is right reasoning; but precepts, persuasion, consolation, and exhortation are necessary; and enquiry into causes, especially as opposed to matter, is important.<sup>2</sup>

In scientific philosophy,<sup>3</sup> inspired partly by Aristotle, Posidonius tried to shape the achievements of others into coherent doctrine. He postulated three causing powers: everlasting God, supreme, having forethought or providence and mind or reason, a fiery breath, thinking, penetrating everything, taking all shapes; Nature; and Fate. God, artificer of everything, ordained and manages the Universe, which is His substance pervaded by reason in varying intensity. Of two Stoic principles (unborn, undestroyed, incorporeal), the passive is substance without quality, or (what we can envisage in thought only) matter, and the active is reason, equivalent to God, in matter. Every substance is material. Posidonius alone distinguished three bodily causes: matter, through which something secondary exists; soul, the prime active power; and reason, the principle of activity.<sup>4</sup>

Posidonius described the one spherical universe, set finite within eternal time and indefinite void, as a living, sentient organism endowed with a soul and having “sympathy” throughout; it includes a spherical revolving heaven, which plays a “leading” part, and the minute, spherical, motionless earth. The universe, which as a whole is the “being” of God, developed from pure “fiery nature” into moisture, which condensed into earth, air, and fire. Mixture of these elements—which have always existed, the real first origin—produced all else. He denied the real existence of qualified matter as such and of creation of elements from it. He denied that in the Stoic periodic destruction of the universe—if it occurs—substance (matter) is annihilated.<sup>5</sup>

All heavenly bodies are divine, ether-made, animate, moving, and nourished by the earth. Posidonius made a portable, spherical orrery illustrating the motion of the sun, moon, and five planets round the earth. The spherical sun, a star of pure fire, is about 3 million stades in diameter; the moon about 2 million stades from the earth, which is smaller than the moon and sun, and the sun is 500 million stades beyond the moon. If we assume 8.75 stades as equivalent to the English mile, or ten stades to one geographical mile, these are remarkable estimates, however conjectural, if we can rely on Pliny’s figures.

In *On Ocean* (astronomical, geographical, geological, historical), based on Eratosthenes and Hipparchus and supplemented from his own observations, Posidonius dealt with the entire globe. Disagreeing with Eratosthenes’ excellent calculation of 252,000 stades as the meridian circumference of the earth, he apparently first calculated it at 240,000 from the behavior of the star Canopus; later he preferred 180,000—a figure far too small.<sup>6</sup> It was a disastrous error, which nevertheless encouraged Columbus from the lime he began planning his voyage. Posidonius believed that one deep ocean surrounds the globe and, as indicated by voyages and uniform behavior of tides, its known sling-shaped landmass (Europe, Asia, Africa) and possibly unknown continents. Oceanic transgressions and regressions have occurred, as have terrestrial sinkings and uprisings, of both seismic and volcanic origin. In his theory of tides Posidonius improved on

his predecessors by observation. But, gravitation being then unknown, he said that not the sun but the moon only caused tides by its different positions and phases and by stirring up winds. He criticized the conception of five latitudinal zones projected onto the earth from heaven and favored two additional earthly ones. It would be sensible to divide the known landmass into narrow latitudinal belts, each having uniform characteristics. Posidonius' belief that longitude affects life was wrong, and he overstressed the influence of climate.<sup>7</sup> He speculated fancifully on the effects of the sun and moon on the products of the earth.

In meteorology Posidonius relied greatly on Aristotle. Winds, mists, and clouds reach upward at least four miles from the earth; then all is clear brightness. He discussed winds (believing them to be produced mainly by the moon), rain, hail, and frost. A rainbow, he thought—not knowing it to be a dioptric and not a catoptric effect—is a continuous image of a segment of the sun or moon on a dewy cloud acting as a concave mirror. Lightning is nourished by dry, smoky exhalations from the earth which cause thunder (produced by moving air) if they disrupt clouds. Earthquakes are caused by enclosed air, which produces trembling, lateral tilt, or vertical upjolt, resulting in displacements or chasms. He described an earthquake that nearly destroyed Sidon and was felt over a vast area. Posidonius was interested in volcanic activity and described how a new island appeared in the Aegean. He also studied comets and meteors.<sup>8</sup>

In moral philosophy,<sup>9</sup> like most Stoics, Posidonius arranged ethics into topics: impulse; good and evil; emotions; virtue; the aim of life; primary values and actions; average duties; and inducements and dissuasions. His ethic, confined to mankind, was both psychological and moral. Man's highest good is to promote the true order of the universe, refusing leadership by the irrational, animal faculties of the soul; man's first "art" is virtue within his fleeting flesh—for thither Nature leads. Virtue is teachable and not self-sufficing; one needs health, strength, and means of living. There are various virtues, and animals other than man have some besides emotions. But there is no justice, or right, between men and animals. Evil is rooted in man; not all comes from outside. Average duties, not being part of morals, but indifferent, should be simply concomitants to life's object.

Everyman's soul is a fragment of the universe's warm animating breath, a "form" holding body together as real surface holds a solid. It has three faculties, one being rational, one emotional, and one appetitive; the soul strives not for redemption but for knowledge, the one logical virtue. How far Posidonius believed in the human soul's immortality is uncertain.<sup>10</sup> Unlike other Stoics he did not compare the diseases of the soul with those of the body. His approach to emotions was psychological: their comprehension is the basis of ethics and is closely concerned with the understanding of virtues and vices and the object of life. Like reason, they are real. Posidonius, favoring older views, rejected the Stoic Chrysippus' opinion that emotions are errors of judgment. Not confined to mankind, as Stoics think, they are movements of illogical faculties; uncontrolled, they produce unhappy disharmony through man's inconsistency with his inner "dairnon" (Latin genius). Men who progress morally feel only appropriate emotions. Their intensity of emotions and their characters can be indicated and even caused by bodily features and are affected by bodily condition, country, and education.<sup>11</sup>

Posidonius was no more "mystic" than other Stoics but, unlike Panaetius, regarded divination by man's clairvoyant soul, especially when death is near, as proved by fulfilled oracles and omens. The act of divination manifests Fate (a causing power with God and Nature) in action in an endless chain of causation of future by past and mediates (as dreams do) between gods and men. He also believed, if we can rightly so judge from a passage in [St. Augustine](#) and from more doubtful hints, that configurations of heavenly bodies could affect the futures of children conceived or born under them; but we ought not to conclude that Posidonius encouraged astrology.<sup>12</sup>

Posidonius' great *Histories* described, with much lively detail, events from 146 b.c. to perhaps 63: the subjugation of the Hellenistic monarchies by Rome, the rise of Parthia, the menace of Mithridates VI (Eupator), completion of Roman control throughout Mediterranean areas, the earlier civil wars of Rome, and a new growth of Greco-Roman contacts with backward "barbarians." Critically appreciative of Roman peace and order and desiring to reconcile other peoples to the Romans, Posidonius produced, as part of moral philosophy, contemporary history (Greek-Roman-"barbarian") based on written records and personal contacts. He took special interest in the peoples and products of Spain and Gaul and in wars against slaves

and pirates. He made important contributions to the ethnology of the Germans (Cimbri and Teutones), Celts, and others, and to geography, sociology, anthropology, folklore, customs, and resources. Biased more toward “conservative” than to “popular” politics, he criticized and praised all classes and races.

Posidonius’ narrative became more directly contemporary as it progressed and more personal, perhaps reaching a climax with Pompey. He stressed ethical and psychological motives and other processes as reasons for events, believing in a causal connection between physical environment and national character. His central feeling was that old Roman virtues had languished—hence perfidious and grasping behavior toward other peoples, and civil war. Cruelty begets cruelty. Men should be “decent” and lovers of men. Rule by the bigger and stronger is a habit of other animals, whereas free men are equals.<sup>13</sup>

Strabo, Seneca, Galen, and others testify to Posidonius’ merits.<sup>14</sup> As philosopher or philosopher scientist he was not comparable with Plato or Aristotle. It is wrong to regard him as the chief influence on thought and practice of two centuries; as the source of Neoplatonism; as a deep religious thinker; as a fuser of Greek and Oriental thought; or as an exponent of a philosophy based on sciences. Some of his beliefs were refuted in his own time, and his scientific skill is doubtful. But in following up results of others’ demonstrations and research, and his own, he was better than most Stoics; and without being very original or deeply critical, he was a good thinker, investigator, observer, and recorder. Posidonius up-held the Stoics’ moral dignity but modified their doctrines. In “psychology” (theory of the soul) and ethics he diverged widely from them, his chief differences leading him to a partial return from Chrysippus and even Panaetius to early philosophy.<sup>15</sup> He had a following; but even in his lifetime the influence of the old “Académies” and the Epicureans was greater than the Stoics’, and it was the Old Stoa that became dominant in the first century of the Christian era. His works were neglected and by the fourth century were forgotten; he ended a Greek era and began no new one.

## NOTES

1. These authors are Athenaeus, Cicero, Cleomedes, Diogenes Laërtius, Galen, [Pliny the Elder](#), Plutarch, Priscianus Lydus, Proclus, [Seneca the Younger](#), Sextus Empiricus, Stobaeus, Strabo, and a number of other writers, in varying degree. Our knowledge of Posidonius is incomplete, and (since right attribution, extent, interpretation, and correlation of the materials are sometimes hard) inexact here and there.

2. Posidonius’ attitudes are revealed especially in Diogenes Laërtius, VII. 39, 87, 103, 124, 129; Seneca, *Epistulae*, 83.9–11; 87.31–40; 88.21–28; 90.5,20,30; 92.10; 95.65–67; Sextus Empiricus, *Adversus logicos*, I.19.

3. For the scientific fragments as a whole see L. Edelstein and I. G. Kidd, *Posidonius*, I, The Fragments (Cambridge, 1972), F92–149, pp. 98–137; F195–251, pp. 176–220; and F4–27, pp. 39–48.

4. Diogenes Laërtius, VII. 134, 138, 148; *Scholia in Lucani Bellum Civile*, H. Usener, ed., pars 1, 9.578; Stobaeus, *Eclogae*, I.1.29b; I.5.15; Cicero, *De divinatione*, I.125; Joannes Lydus, *De mensibus*, IV.71.48 and 81.53.

5. Diogenes Laërtius, VII. 134, 138, 139, 140, 142, 143, 148; Stobaeus, *Eclogae*, I.8.42; 11.5c; 18.4b; 20.7; Simplicius, *In Aristotelis de caelo*, IV.3.310b.

6. Sun and the moon: Cleomedes, *De motu circuli corporum caelestium*, Ziegler, ed., I.11.65; II.1.68,79–80; II.4.105; Pliny, *Natural History*, II. 85; Diogenes Laërtius, VII. 144, 145. Planetarium or orrery: Cicero, *De natura deorum*, II.88. Earth: Cleomedes, op. cit., I.10.50–52; Strabo, *Geography*, II.2.2, C95; J. O. Thomson, *History of Ancient Geography* (Cambridge, 1948), 212, 213, 407.

7. Posidonius’ *On Ocean*: Strabo, *Geography*, 11.2.1–3.8. See also Priscianus Lydus, *Solutiones ad Chosroem*, I. Bywater, ed., 69–76; Cleomedes, op. cit., 1.6.31–33; F. Schulein, *Untersuchungen über die*

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8. Seneca, *Naturales Quaestiones*, I.5.10,13; II.26.4; 54.1; IV. 3.2; IV. 17.3–21.2; 24.6; VII. 20.2; 20.4; Diogenes Laërtius, VII. 144, 145, 152–154.

9. For the fragments, see L. Edelstein and I. G. Kidd, *op. cit.*, F29–41, pp. 49–58; F 150a-186, pp. 137–172. Cf. L. Edelstein, “The Philosophical System of Posidonius,” in *American Journal of Philology*, **57** (1936), 305–316; Marie Laffranque, *op. cit.*, 449–514.

10. Each human soul, as a part of that of the universe, would simply be conscious in the human body during the body’s lifetime.

11. Most of our knowledge of Posidonius’ psychological and ethical thinking comes from a score of passages in Galen, *De Placitis Hippocratis et Platonis*. I. Müller, ed. (Leipzig, 1874), supplemented from some other sources. They are all in L. Edelstein and I. G. Kidd, *op. cit.*, 137–172; see also p. xxiv.

12. Cicero, *De divinatione*, I.64 and 129–130; II. 33–35 and 47 (there may be much more from Posidonius in this work and in *De natura deorum*); *De fato*, 5–7; Diogenes Laërtius, VII. 149; Nonnus Abbas, in Migne, *Patrologia Graeca*, XXXVI, 1024; Suidas (“The Suda”), s.v. *Διαίρεσιζοιωνιστικῆς*; Boethius, *De diis et praesensionibus*, 20,77; Augustine, *De civitate Dei*, V. 2–5. In classical times “astrology” usually meant astronomy.

13. Historical fragments are in L. Edelstein and I. G. Kidd, *op. cit.*, F51–79 (or 81), pp. 77–90, and F252–283, pp. 220–252 (see also pp. xxii–xxii and 335–336); and in Jacoby, *op. cit.*, IIA, 225–252 (cp. 252–267) and IIC. The latest datable fragment relates to 83 B. C. See also Marie Laffranque, *op. cit.*, 109–151 and H. Starasburger, “Poseidonios on Problems of the [Roman Empire](#),” in *Journal of Roman Studies*, **55** (1965), 40–53. There is little doubt that the historian Diodorus Siculus used Posidonius, particularly in books V and XXXIV–XXXV, but one cannot extract Posidonian fragments from him.

14. Strabo, *Geography*, II. 3. 5, C102; Seneca, *Epistulae*, 104.22 and 90.20; Galden, *De placitis*, I. Muller, ed., IV. 402–403, p. 376; and *Scripta Minora*, II. 77–78, P. 819.

15. K. Reinhardt, “Poseidonios,” in Pauly-Wissowa, *Real Encyclopaedie der classischen Altertumswissenschaft*, XXII. i, cols. 570–624; L. Edelstein, *op. cit.*, *American Journal of Philology*, **57** (1936), 286–288, 321–325; Marie Laffranque, *op. cit.*, 1–44, 515–518; A. D. Nock, “Posidonius,” in *Journal of Roman Studies*, **49** (1959), 1–15; V. Cilento, “Per una ricostruzione di Posidonio,” in *Annali della Facolta di Lettere e filosofia, Bari, Universita*, **9** (1964), 52–75.

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None of Posidonius’ writings is extant; apparently known titles of them, or their contents, are *Against Zenon of Sidon*, on geometry; *On Average Duties* (or fitting actions); *On Divination (and prophecy)*; *On Emotions*; *Exhortation to Philosophy*; *On Fate*; *On Gods*; *On Heroes and Spirits*; *Histories, of which History of Pompey’s Campaigns in the East may have formed a detailed part and Tactics a small one*; *Introduction to Diction*; *posthumously edited lectures*; *pamphlets, commentaries on Plato, and historical monographs*; *On Meteorology (or Elements of Meteorology)*; *On Ocean*; *On the Soul*; *On the Standard (of truth or judgment)*; *Treatise on Ethic(s)*; *Treatise on Physics*; *Treatise on Virtues*; *On the Universe*; and (doubtful) *On Void*. Titles of other works are recorded, but they probably indicate part of the works here listed.

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