THE ASTRONOMY OF HERACLEIDES PONTICUS

HERACLEIDES PONTICUS, a pupil of the schools of Plato and Aristotle, who lived from about 390 to 310 B.C., shared the wide interests of many of his pre-Platonic predecessors. Diogenes Laertius gives a long list of his works, many of them now known only by their titles, which he divided into writings on ethics, physics, grammar, music, rhetoric, and history. Like most of his predecessors he gave some attention to the heavens and speculated about the nature of the moon (frg. 114a),[1] comets (frg. 116), the infinity of the cosmos (frg. 112); he was best known in antiquity, in this field, for his suggestion that the phenomena could be saved if the heavens were at rest and the earth revolved about the central axis (frgs. 106, 108).[2] One of two pieces of evidence for his involvement in anything more than this general, inexact speculation in the field of astronomy is contained in the commentary on Plato's *Timaeus* written in Latin by Chalcidius somewhere at the beginning of the fourth century A.D.;[3] it is this passage which this paper will discuss.

The commentary at the point where Chalcidius mentions Heracleides is an exegesis of Plato's meaning when he attributes to Venus and Mercury a force contrary to the sun, in addition to their general yearly movement with the sun.[4] He reports first (cap. 109) the opinion that what Plato means by this obscurity is that the sun on its epicycle is carried around naturally from east to west daily with the whole universe, while in a year it orbits the universe in the opposite direction, but that Venus and Mercury always have a course which is opposed to the universal movement.[5] The proposers of this exegesis thought that Venus and Mercury do not in fact share in the universal motion or, more probably, there is here an obscured reference to the epicyclic theory, that, while the epicycles of the sun and moon revolve about their axes in the direction of the universal motion, from east to west, as they orbit in their proper periods from west to east, the epicycles of the planets revolve on their axes in the opposite direction to the universal motion, from west to east, so that Venus and Mercury have, in this sense, a contrary motion to the sun.[6] There are also those who think that Plato means by the phrase the fact that Venus and Mercury appear, as he puts it, 'to overtake the sun and sometimes they slow down and the sun overtakes them, since they have risings and settings, appearances and disappearances, sometimes in the morning, sometimes in the evening, because they now precede and now are left behind'. He explains the

[1] References are to F. Wehrli, *Die Schule des Aristoteles*, Heft V, *Herakleides Pontikos*, Basle, 1953.

[2] Cf. fr. 107 (Simplicius, *in Aristotelis de Caelo*, 541 Heiberg) for a critical analysis of the difficulties involved in this idea.

[3] *Platonis Timaeus interprete Chalcidio cum eiusdem commentario* ed. Ioh. Wrobel, Leipzig, 1876 (reimp. Frankfurt, 1963).

[4] *Timaeus* 38 d 2 ἑωσφόρον δὲ καὶ τὸν ἱερὸν Ἑρμοῦ λεγόμενον εἰς τάχει μὲν ἰσόδρομον ἡλίῳ κύκλον ἰόντας τὴν δὲ ἐναντίαν εἰληχότας αὐτῷ δύναμιν· ὅθεν καταλαμβάνουσίν τε καὶ καταλαμβάνονται κατὰ ταὐτὰ ὑπ' ἀλλήλων ἥλιός τε καὶ ὁ τοῦ Ἑρμοῦ καὶ ἑωσφόρος.

[5] Cap. 109 'Lucifer et Mercurius contrarios semper motus exerant mundi circumactioni'.

[6] So T. M. Heath, *Aristarchus of Samos* (Oxford, 1913), 257 n. 1.

phenomenon by the fact that the circle of the sun and the circles of both these planets have the same centre.[1] This theory is discussed below.

In the next chapter (110) he continues to a discussion of Venus to which is attached the name of Heracleides.

> Denique Heracleides Ponticus, cum circulum Luciferi describeret, item solis, et unum punctum atque unam medietatem duobus daret circulis, demonstravit ut interdum Lucifer superior, interdum inferior sole fiat. ait enim et solem et lunam et Luciferum et omnes planetas, ubi eorum quisque sit, una linea a puncto terrae per punctum stellae exeunte demonstrari. erit ergo una linea directa ex terrae medietate solem demonstrans, duae vero aliae dextra laevaque nihilo minus directae lineae a sole quidem distantes quinquaginta momentis, a se autem invicem centum quarum altera linea orienti proxima demonstrat Luciferum, cum Lucifer plurimum a sole distabit factus vicinus orientalibus plagis, proptereaque idem Hesperi nomen accipiens, quod in eois vespere postque occasum solis adpareat. altera vero occidenti proxima, cum plurimum distabit idem Lucifer a sole factus vicinus occiduis, proptereaque Lucifer nominatur.

There then follows a diagrammatic exposition of what has just been discussed. Let there be the centre of the universe, the earth, X, and the zodiac circle with points ABC on it. The arcs AB and BC are each 50°. On the radius XB is K which is the point of the sun (*punctum solis*) and this line XKB marks the sun at B on the zodiac. Two other lines XA and XC diverging 50° either side of XKB will then define the greatest elongations of Venus either side of the sun. He adds that this will become clearer if we draw a circle around the line XKB which touches the two lines XA and XC which mark the limit of Venus' elongation from the sun.[2]

The discussion ends in chapter 112 with a further diagrammatic discussion of what Chalcidius thinks Plato's own theory was; along with the more perspicacious examiners of the problem, he thought that Venus moves on an epicycle which is further from the earth than the sun's epicycle (see Diagram (*a*)). With the sun at a point on its epicycle such that it is projected at B on the zodiac, Venus will exhibit maximum elongation at A and C on the zodiac, each 50° from B, when on her epicycle she is at E and F. He adds the information that while Venus' epicycle must circuit the universe from west to east in a year like the sun's, since they both have the same mean position, Venus herself completes the circuit of her epicycle in 584 days.

In chapters 59 to 91 of his commentary Chalcidius had presented an elementary treatise on astronomy which is a translation and précis of the work which Theon of Smyrna had written in the early second century A.D. as an introduction to the study of Plato. With its detailed discussion of the theories of mathematical astronomy on eccentrics and epicycles, the value of either work for understanding Plato is minimal—most of the ideas they discuss were simply not available to him. Chalcidius, as can be seen from the preceding paragraph, makes the assumption, which Theon had,[3] that the idea of epicycles was

[1] Cap. 109 'Quod iis usu accidit ex eo quod una medietas atque unum punctum est tam solstitialis circuli quam cuiuslibet alterius stellarum harum'.

[2] Cap. 111 'Hoc fiet apertius si per XKB lineam circumducatur circulus qui contingat duas a se distantes lineas, id est XA et XC, quae demonstrant modum discessionis a sole Luciferi'.

[3] Theon Smyrnaeus, *Expositio rerum mathematicarum ad legendum Platonem utilium* (ed. Hiller, Leipzig, 1878), 188. 25.

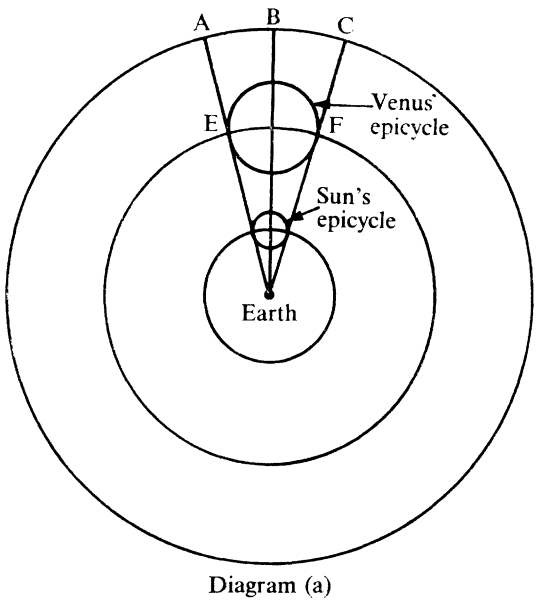

Diagram (a)

available to Plato; there is therefore the possibility that other attributions which he makes may be equally unhistorical. Chalcidius additionally lacks Theon's clear competence in dealing with the ideas which he discusses. In his précis his practice is consistently to omit the difficulties; this is not in itself a sign of incompetence, but the presence of at least one apparent mistranslation of Theon, of an elementary kind, shows that he does lack it. In chapter 71, in a précis of Theon's discussion of the various meanings of *ἀνατολή*, he translates Theon's *ἡ πρώτη φαῦσις ἐκ τῶν τοῦ ἡλίου αὐγῶν*[1] by 'primus splendor solis invehentis diem'. Theon's discussion of risings and settings is, like the discussion in Geminus' *Isagoge* (chapter 13), concerned with the stars and planets; what Theon means to signify here is the first appearance of a planet when its elongation from the sun becomes great enough for it not to be obscured by the rays of the rising or setting sun. He certainly does not mean, as Chalcidius translates, the first appearance of the sun daily. It is possible that the text he was using omitted *ἐκ* but even so, his correct translation a few lines further on of Theon's parallel (*δύσις*) *ὁ πρῶτος ἀφανισμὸς ἄστρου τινὸς ὑπὸ τῶν τοῦ ἡλίου αὐγῶν*[2] by 'prima stellae alicuius obscuratio sole obumbrante' would, if he were truly in control of the ideas he reproduces, have suggested that the parallelism which exists between the other various definitions of *ortus* and *occasus* was missing. His 'slavish' adherence to Theon is also clear; Theon had derived most of his treatise, as he readily admits, from the work of Adrastus, a contemporary Peripatetic philosopher, and Chalcidius equally uncritically reproduces Theon, perpetuating mistakes which by his time had long been recognized, for instance, as concerns us here, that the maximum elongation of Venus is 50° (Ptolemy had corrected the value to 47° 15′) and also that the sun has a slight inclination

[1] Theon, p. 137. 10 Hiller. [2] Theon, p. 137. 17 Hiller.

of ½° to the ecliptic[1] (this had been denied as early as Hipparchus).[2] There is therefore also the possibility, in view of his uncritical acceptance of what Theon says and a suspected unease in dealing with the material, that when Chalcidius is discussing astronomy outside the strict framework of his translation of Theon, even more than within it, he may not be fully in control of what he discusses.

The discussion which concerns Heracleides falls outside this strict framework of translation. What Chalcidius says has long been held to imply that Heracleides put forward the theory that Venus and, by implication, Mercury revolve around the sun rather than the earth.[3] This theory was certainly in existence in antiquity; it is briefly alluded to in Theon, in a long passage which Chalcidius, in his continuous translation, omits.[4] The discussion in Theon concerns what appears to be a later reworking, in the light of the theory of epicycles, of the theory of concentric spheres which had been proposed by Eudoxus. In Eudoxus' scheme, and indeed in the improvements made to it by Callippus and Aristotle, the movements of the planets, sun, and moon were split up into components of motion and each of these was attributed to a sphere; all these spheres, however, were concentric about the earth as the centre of the universe, if we accept the account of the scheme given by the Aristotelian commentator Simplicius, and there is no reason to doubt that in this respect it is correct.[5] In the scheme as Theon reproduces it all the spheres are not concentric about the earth. In his discussion of what he thought Eudoxus' own scheme was, he rightly explains that the three spheres for the sun reproduce the daily movement from east to west, the yearly movement along the ecliptic, and the third, in which the sun is fixed, a supposed movement in latitude of ½°. In the case of the planets Eudoxus had supposed four spheres, one for the daily movement, one for the proper motion west to east along the ecliptic, and the third and fourth, on which the planet is fixed, by a combination of motion, for the reproduction, as Schiaparelli has shown, of the hippopede (a horizontal figure of eight) which as it moves around in the plane of the ecliptic will account for the movement in latitude and, to a certain extent, for the irregularities of motion in longitude which the planets exhibit. Theon supposes, however, that in the case of the planets, three of the spheres are to serve the same purposes as the three for the sun and that the fourth is to account for the movement κατὰ βάθος (distance from the earth), though Simplicius states very clearly[6] that this was one of the phenomena for which the Eudoxan scheme did not account and which led later mathematicians to the evolution of other theories. The idea then that Eudoxus attempted to account for the movement in depth is, if Simplicius' account is accepted, erroneous. It occurs again when Theon attempts to describe diagrammatically what he has just been discussing. Disregarding the first sphere, which in the case of all the planetary bodies reproduces the daily motion from east to west, the sphere of

[1] Sun, Theon, p. 135 = Chalcidius cap. 70. Venus, Theon, p. 137 = Chalcidius cap. 70. Cf. J. L. E. Dreyer, *History of Astronomy from Thales to Kepler*, New York, 1953, p. 127.

[2] Heath, op. cit. 199.

[3] See Heath, op. cit. 255 (and fol. for earlier writers); Dreyer, op. cit. 126; Fabricius, *R.E.* s.v. 'Herakleides' n. 45 viii. 1 (1912) col. 477 and, more recently, Gundel, *R.E.* s.v. 'Planeten', xx. 2 (1950), cols. 2061–2.

[4] Theon, 178. 3–189. 17.

[5] For the extent of Simplicius' misunderstanding see the discussion in Heath, op. cit. 197–9.

[6] Simplicius, *In Aristotelis de Caelo* 504. 16 f., Heiberg.

the ecliptic motion is considered to be hollow, with a depth AE (see Diagram (*b*)) and the sphere of the motion in latitude (i.e. a sphere with its axis at right-angles to the plane of orbit of the planet) EIJK, is also hollow, with a depth EG. Inside this latter hollow sphere is a solid sphere (i.e. one which does not contain another) EFGH, wiih the body fixed on its surface, to reproduce the movement in depth.

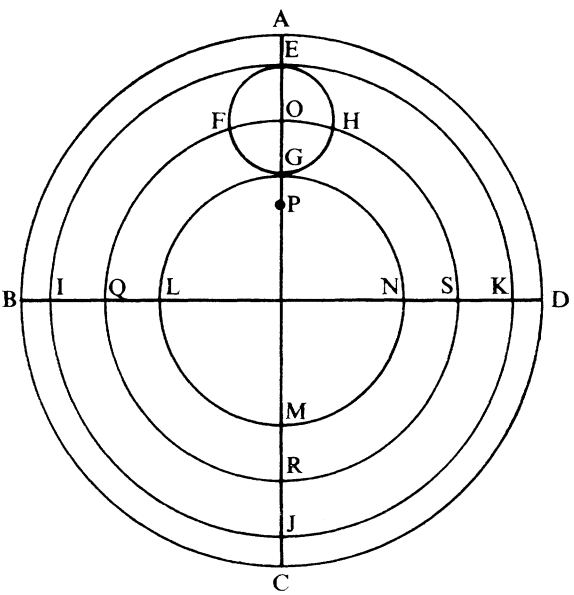

Diagram (b)

In the case of the sun this solid sphere is an addition to the Eudoxan theory and in the case of the planets it stems from a reinterpretation of the purpose of the third and fourth of the spheres which Eudoxus had attributed to them. Theon demonstrates, taking the case of the sun, that since the hollow sphere EIJK/GLMN will revolve in a year from west to east and the solid sphere with the sun fixed at, say, E is carried round in a year and also revolves on its own axis once yearly (since the sun has perigee and apogee at invariable points on the zodiac), the point E will describe yearly a circle eccentric to the earth about a centre P, where P Earth is equal to EG, or that, alternatively, given that the centre O of circle EFGH will describe a circle OQRS about the earth, the solid sphere EFGH can, if we take the central plane of it at right-angles to its axis, be considered as an epicycle orbiting on a deferent OQRS. In this way, Theon points out, we can achieve agreement between the theory of spheres and the theory of epicycles and also with the theory of eccentrics which he has already demonstrated is an accident of epicyclic theory.

After this general discussion Theon adds with regard to the sun, Venus, and Mercury that since their mean positions are the same, the centres of the three solid spheres which actually carry these bodies will all be on a straight line from the earth, and that it is possible as a further refinement of the theory to coalesce the three hollow spheres (i.e. the spheres represented in Diagram (*b*)

by sphere EIJK/GLMN) and have the three solid spheres all revolving about the same centre, the centre of the sphere of the sun, which will be enveloped by the spheres of Mercury and, finally, Venus. The mention of the theory in Macrobius appears to be identical.[1] In both cases the theory is of the revolution of the sun, Mercury, and Venus about a common centre, the centre of the epicycle or sphere of the sun and not of the revolution of Venus and Mercury about the sun itself as centre. This theory, of the sun as centre, is alluded to by Martianus Capella[2] but it is not, I repeat, what Theon is discussing as Heath assumes, making a false interpretation of what Theon means by 'the truly solid sphere of the sun'—as the context makes clear this implies no more than that the sphere which carries the sun really has no sphere inside it whereas, if the spheres of Venus and Mercury in fact envelop the sphere of the sun, they are no longer truly solid in the sense in which Theon is using the term.

The scheme of spheres which we find in Theon is an attempt to answer the complaint which could be made against the eccentric and epicyclic theories, that it is not physical that bodies should be carried in incorporeal circles;[3] corporeal spheres were therefore substituted for the circles. The incorporation into the theory of an attempt to explain the motion in depth and the use of the epicyclic theory to do so show that it is certainly not Eudoxan and must post-date the elaboration of epicyclic theory. All it amounts to, in effect, is that in answer to criticism the epicycles and deferents of the mathematicians have been filled out into spheres and the system made, to an extent, mechanical by the inclusion of the solid sphere which represents the epicycle in the hollow sphere which reproduces the motion of the deferent; since the system was a reinterpretation of Eudoxus, there were also grafted on two spheres to represent the daily motion east to west and the movement along the ecliptic west to east—the two basic universal movements, which Plato in the *Timaeus* had represented as the motion of the Same and the Different, to which any other movements the heavenly bodies may have are additional.

Though Chalcidius does not directly translate this discussion of Theon's in the course of his treatise on astronomy (it would have come between chapters 84 and 85), he was aware of it. As has been discussed, he reproduces in this section dealing with the contrary force of Venus and Mercury Theon's unhistorical remark that Plato supported the theory of epicycles, and his diagrammatic exposition shows that what he assumed Plato supported was the first part of Theon's special discussion of the sun, Venus, and Mercury, that the centres of their epicycles are all on a straight line from the earth but that these epicycles are exclusive. The anonymous theory of the concentricity of the circles of Venus, Mercury, and the sun is also mentioned but not, as Heath and Dreyer assumed, in his discussion of Heracleides; it is clearly what he is alluding to in the second (anonymous) explanation of the contrary force which he gives: 'Quod iis (Mercurio et Veneri) usu accidit ex eo, quod una medietas atque unum punctum est tam solstitialis circuli quam cuiuslibet alterius stellarum

[1] Macrobius *In Somn. Scip.* 1. 19. 5–6, but see W. H. Stahl, 'Astronomy and Geography in Macrobius', *TAPhA* lxxiii (1942), who accepts, p. 237, the attribution to Heracleides of the circumsolar orbit of Venus and Mercury but argues, pp. 238–41, that Heath's and Dreyer's interpretation of the Macrobius passage as similar is false.

[2] Martianus Capella, *De nuptiis Philologiae et Mercurii*, 8. 880.

[3] Cf. Theon, p. 178. 17 *πῶς γὰρ καὶ δυνατὸν ἐν κύκλοις ἀσωμάτοις τηλικαῦτα σώματα δεδέσθαι;*

harum.' Therefore what he reports under the name of Heracleides (which, as his use of *denique* to initiate his discussion of Heracleides' theory implies, is an additional theory to the two he has already mentioned) cannot refer either to the first theory which Theon mentions, that the centres of the three epicycles are on a straight line, or to the refinement of it which made the three epicycles concentric and which Chalcidius reports anonymously at the end of chapter 109. It is probable therefore that, in what he says about Heracleides himself, Chalcidius is not using Theon at all, since he reproduces elsewhere in this section the two theories concerning the sun and the inner planets which he found in Theon. There is the additional point that, since he mentions Heracleides Ponticus by name, he must have access to some source of information other than Theon, who does not mention him, and it seems reasonable to assume therefore that the whole of chapters 110 and 111 come from some other source and are not reproducing directly anything to be found in Theon.

If, then, Heracleides' explanation of the contrary force is not a reproduction of the refinement of the epicyclic theory found in Theon, what is his theory? 'He gave the same centre to the circles of Venus and the sun and showed how Lucifer is sometimes *superior*, sometimes *inferior*, to the sun. He said in explanation of his demonstration that the positions of the sun, moon, Venus, and *all the planets* are defined [*demonstrari*] by a single line from the point which is the earth, through the point which is the star.' It must be assumed that in writing *punctum terrae* and *punctum stellae* Chalcidius meant the same thing by 'punctum' on each occasion and since the earth can only be considered as a point (at the centre of the universe), the *punctum stellae* is similarly the point which, for astronomical purposes, a star or planet is; the word is not equivalent to Chalcidius' almost invariable expression *punctum atque medietas* to signify the centre of a circle and *punctum stellae* does not therefore refer to the centre of the epicycle of any planetary body but to the star itself. The idea then that a line from the earth through a planet will define its position does not refer to the theory in Theon that the centres of the epicycles of the sun, Mercury, and Venus lie on a single straight line; in any case, Heracleides' theory, whatever it was, referred to all the planetary bodies, whereas that of Theon could refer only to the sun and the inner planets which have the same mean positions. Nor can Heracleides mean that a single straight line will define the positions of all the planetary bodies, that they will all lie along it; it is a matter of simple observation that they never do.

Chalcidius uses the term *demonstrare* in the next chapter when he says that if from a point X, the earth and centre of the universe, a straight line is drawn to a point B on the zodiac and there is a point K on this line which is the *punctum solis*, then that line marks the sun at B on the zodiac.[1] His meaning in this chapter is equally simple, that a straight line drawn from the earth through any planet[2] will mark that planet at a point on the zodiac; if therefore, in the case of Venus, we draw a line through the sun and project it to the zodiac, then draw two further lines from the earth to points 50° either side of the solar line where it meets the zodiac and imagine that these lines move round to keep the same relation to the solar line as it revolves from west to east, as Chalcidius assumes it does,[3] we can say that Venus will be found on these lines when she is at

[1] Chalcidius, cap. 111 'Erit ergo linea XKB quae solem demonstrat, id est litteram B'.

[2] Notice 'linea *per* punctum solis exeunte'.

[3] Chalcid., cap. 111 'Tantum autem moveatur haec eadem linea (XKB) quantum sol movetur prope cotidiana momenta singula'.

maximum elongation east or west. This understanding of Heracleides' reported remarks is not affected by his suggestion that it may be the heavens, probably the fixed stars, which are at rest and the earth which revolves; the remark that a straight line from the earth through a planet fixes its position on the zodiac is still valid; in any case, if, as Wehrli has plausibly argued,[1] the suggestion that the earth is in motion is no more than a suggestion put forward as one side of an argument in a dialogue, the work in which the present remarks figured may not have been making that assumption at all. What, as I understand it, Heracleides is saying perhaps seems too simple but since it is impossible to judge the context of the discussion from which Chalcidius' report ultimately stems, the interpretation cannot be rejected on that ground.

Chalcidius' suggestion at the end of the chapter that we draw a circle with its centre on the solar line XKB touching the lines 50° each side, to make the picture clearer, is confusing. It introduces the idea that Venus revolves on a circle which excludes the earth, i.e. on an epicycle, with, it must be presumed, the sun as centre; Chalcidius may well have thought vaguely that Heracleides was using epicyclic theory here but there is nothing in what he reports as Heracleides' remarks about the planetary bodies being marked by a straight line which appears to presuppose this, and these remarks are an integral part of what Heracleides says about Venus. If, further, Heracleides did presuppose an epicyclic path for Venus about the sun it would, from Chalcidius' understanding of the passage, be about the sun *as a point* which is on the line XKB (Diagram (*c*)) and this is quite irreconcilable with his remark at the beginning of the chapter that Heracleides, in drawing the circles of Venus and the sun, gave them the same centre;[2] this implies either that the centre of the two circles is the earth or the imaginary centre of the solar epicycle (Diagram (*d*)).

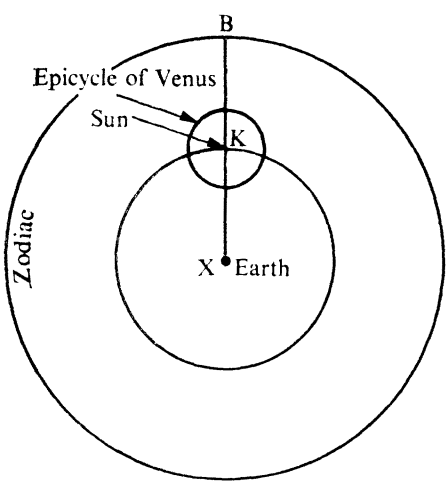

Diagram (c)

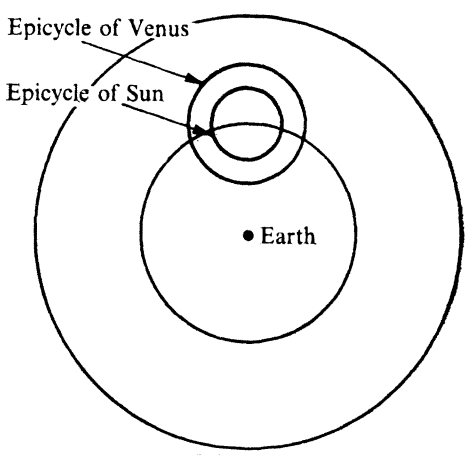

Diagram (d)

To reconcile the second alternative with the revolution of Venus about the sun as a point, it would have to be assumed that the sun's circle can at the same

[1] Wehrli, op. cit., 95–6.

[2] 'Unum punctum atque unam medietatem duobus daret circulis.'

time have and be a *punctum atque medietas*, and that is quite illogical. Therefore, because the second solution involves an attribution to the sun of an epicycle which Chalcidius nowhere else in what he says about Heracleides hints at and because the attribution to Heracleides of a solar epicycle is unacceptable on general historical grounds, it is preferable to assume that when Heracleides drew the circles of Venus and the sun, he imagined them as having their centres at the earth.

There remains the difficulty that Heracleides was held to have shown how Venus is sometimes superior, sometimes inferior to the sun. If, as seems certain, Heracleides considered the orbits of the two bodies to be concentric at the earth, then he could not have shown how Venus is sometimes beyond the sun and sometimes nearer the earth than the sun, which is the natural meaning to give the terms. He had, however, shown that lines could be drawn about the sun to mark the boundaries of Venus' elongation and that therefore the elongations of Venus (and Mercury) are capable of definition in a way in which those of the outer planets, which exhibit every angle of divergence from the sun, are not. Venus and Mercury on the whole accompany the sun, sometimes getting in front of it and sometimes falling behind in a sense in which the outer planets do not, and Heracleides' point in saying that lines could be drawn to mark Venus' maximum elongation was perhaps that this divergence was regular and finite whereas that of the outer planets was, within a term of 180°, infinite; it could range from conjunction to opposition. Heracleides, at least as Chalcidius reports him, does not seem to be saying any more than this; therefore, bearing in mind that he drew the circles of Venus and the sun concentric at the earth, which excludes taking superior and inferior in the usual sense of motion in depth, the terms must be understood in the admittedly unusual figurative sense of 'in front of' and 'behind'; when Venus in its orbit gets in front of the sun it is superior to it and when it gets left behind it is inferior.

Chalcidius, as his attribution to Plato of a knowledge of epicyclic theory shows, exhibits the lack of historical sense which bedevils so much ancient doxography, particularly in the field of astronomy. He probably did think that Heracleides like Plato was aware of the epicyclic theory but, as I hope to have shown, there is nothing in his remarks which presupposes such a knowledge and a great deal which argues against it. It is impossible to suggest Chalcidius' source for them but, while he may not have fully understood them (since it appears both from the obscurities of the chapters under discussion and the errors discussed earlier that Chalcidius' knowledge of astronomy probably did not extend beyond his reading of Theon), it is very probable that he reproduced them, imperfectly understood, very much as he found them, and as they stand (and this is the only basis on which we can judge them) they do not imply what Heath and Dreyer have made them imply, that Heracleides considered Venus to orbit the sun.

It is true that the first remark, that Heracleides gave the same centre to the circles of Venus and the sun could be taken to mean that both these circles are epicycles. That theory does appear in Theon but seems to post-date the elaboration of epicyclic theory. It is mentioned in Chalcidius but before he begins to discuss Heracleides and it is, in any case, inapplicable to him, as Heath has seen; he shows that the epicyclic theory in its real sense is posterior to Heracleides and is probably to be credited to Apollonius of Perge.[1] Heath attempts

[1] Heath, op. cit. 257 and 269–75.

to compromise by assuming that Heracleides considered Venus to revolve around the sun as a point, that is he did not assume an epicycle for the sun; this, to judge from the end of chapter 111, is probably the form in which Chalcidius imagined the theory. In the absence of any other evidence to associate Heracleides with speculation about Venus, this compromise is inadmissible—we cannot say that there is a documented connection of Heracleides with Venus and that, therefore, if what Chalcidius says appears to be unhistorical we must reinterpret it; the tradition must be accepted as it stands if it is to be accepted at all. As it stands, Heracleides either considered that Venus and the sun were both on epicycles, which is historically very unlikely and is unnecessary for the understanding of what follows, or he considered that both the circles had their centre at the earth, which does make sense in the context but makes it impossible that Heracleides considered Venus to revolve about the sun. It must therefore be concluded, regretfully perhaps, that whoever put forward the theory we find in Theon, that Venus and Mercury orbit the sun, it was not Heracleides Ponticus.

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