# XVI.—Astronomy and Geography in Macrobius

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Although Macrobius' *Commentary* was one of the leading source books of information on astronomy and geography in the Middle Ages, modern studies of the *Commentary* deal only superficially with these subjects. The framework of Macrobius' cosmography resembles that of Plato's *Timaeus*, his alleged authority, but his discussion presents many parallels to passages in extant works of *Platonici* and Neoplatonists. The assumption of Dreyer and Heath that Macrobius is adopting the Heraclidian theory for the revolutions of Venus and Mercury about the sun is not upheld by the text. The map of the world accompanying Macrobius' text was to become the archetype of one of the commonest styles of medieval *mappae mundi* cartography.

That the astronomical and geographical section of Macrobius' *Commentary on Cicero's Somnium Scipionis* [1] proved more interesting to readers than any other portion of his work and gained for the author ranking as one of the leading authorities on these subjects in the Middle Ages is amply indicated by evidence at hand.[2]

[1] 1.14.21–2.9. I have chosen to follow the text of L. von Jan (Quedlinburg and Leipzig, 1848), altering the punctuation where necessary to make it conform to present standards. This text offers a fuller collation than Eyssenhardt's Teubner text (Leipzig, 1893). The latter work is marred by inconsistencies in punctuation and typographical errors.

[2] That this was by far the most popular portion of the *Commentary* will be seen from a perusal of the descriptions of important MSS furnished by L. von Jan in his (1848) edition. A number of MSS (e.g.: C, F, $E^1$, $E^2$, $H^1$) are excerpts containing the astronomical and geographical section. $R^1$, containing a complete text of the *Commentary*, has on the title page, added by a later hand: *Macrobius in astronomia.* T, also containing a complete text, has in the margin of 1.14.21: *Nunc tractat de astronomia.* In fact, marginal notice at the beginning and end of the astronomical and geographical section is so common that von Jan has called attention to the instances where it is not found. No other subject received similar attention in the MSS.

Macrobius is frequently found listed among the three or four most important authorities in the Middle Ages. See Pierre Duhem, *Le Système du Monde* (Paris, 1913–17) 2.411; J. L. E. Dreyer, *History of the Planetary Systems from Thales to Kepler* (Cambridge, 1906) 207; *Studies in the History and Method of Science*, ed. by C. Singer (Oxford, 1921) 2.103; C. R. Beazley, *The Dawn of Modern Geography* (London, 1897) 1.343; J. K. Wright, *The Geographical Lore of the Time of the Crusades* (New York, 1925) 11, 366–67; G. H. T. Kimble, *Geography in the Middle Ages* (London, 1938) 11; G. Sarton, *Introduction to the History of Science* (Baltimore, 1927) 1.385; C. H. Haskins, *Studies in the History of Mediaeval Science* (Cambridge, 1924) 88; R. T. Gunther, *Early Science in Oxford* (Oxford, 1923) 2.24; L. Thorndike, *A History of Magic and Experimental Science* (New York, 1923) 1.544; *The Cambridge Medieval History* (Cambridge, 1926) 5.790.

Despite its importance since the early Middle Ages, this section has received scant attention from modern investigators of the *Commentary*.[3]

Macrobius' popularity as a writer in this field may be attributed to his didactic instincts—he never loses sight of the reader and is careful to be explicit at all times and to avoid difficult technical discussions [4]—and to a practice of introducing *mirabilia* which more scientific authors would regard as too extraordinary or conjectural to be included in their sober handbooks. He offers a lengthy account of an "ancient Egyptian" method of measuring the sun's orbit and diameter and another of the way they marked off the twelve signs of the zodiac, and is quite absorbed with celestial phenomena. In geography, too, he ranges about with abandon, informing the reader that there must be four inhabited quarters of the globe separated by an equatorial and meridional Ocean, and that there is a sea in the south temperate zone of the eastern hemisphere corresponding to the Mediterranean![5]

## I. Astronomy

The main framework of Macrobius' cosmography resembles that of Plato's *Timaeus*. Whether he obtained his knowledge of Platonic conceptions from studying the original dialogue or from reading a

[3] Of the two modern scholars who have made extensive studies of the *Commentary*, M. Schedler, *Die Philosophie des Macrobius und ihr Einfluss auf die Wissenschaft des christlichen Mittelalters* (Münster, 1916), offers nothing more than a bare outline of the astronomical and geographical material (98–102); K. Mras, "Macrobius' Kommentar zu Ciceros Somnium," *SPAW, Phil.-Hist. Klasse* (1933) 232–86, generally avoids astronomical and geographical material, contenting himself with pointing out Neoplatonic parallels to a few Macrobian passages. Nearly all the significant contributions to our knowledge of Macrobian astronomy and geography have appeared in general histories of those subjects.

[4] There is a revealing passage near the close of his discussion of the harmony of the spheres (2.4.11–12) in which Macrobius affirms that if he were to discuss the *nete* and *hypate* and the subtle points about tones and semitones, he would be showing off his knowledge rather than teaching. One can hardly escape the conviction, however, that he omits technical details not only out of consideration for his readers but because he himself has not mastered the more difficult points. Features which he omits in arithmetic, music, and astronomy are found in even the most concise treatments of those subjects.

[5] The attraction which these discussions held for readers may be seen from the frequent occurrence of the following marginal notations in the MSS described by von Jan: *De differentia stellarum et siderum; De decem circulis; De solis magnitudine.* On the verso of folio 17 of Harleian MS 647, immediately under the last line of Cicero's translation of Aratus, begins an excerpt from the *Commentary* with the following caption in uncials: AMBROSII MACROBII THEODOSII DE MENSURA ET MAGNITUDINE TERRAE ET CIRCULI PER QUEM SOLIS ITER EST.

Neoplatonic commentator on the *Timaeus*, as some would have it,[6] he claims to be upholding Plato where he finds divergences of opinion.[7] He is also familiar with many advances made since Plato, as we shall see.

The spherical earth is situated in the exact center of the universe. It is encircled by the seven planetary spheres, and above the last of these, the sphere of Saturn, lies the celestial sphere or ἀπλανής. The celestial sphere makes a complete rotation from east to west every twenty-four hours, dragging along with it the seven planets lying beneath; but the planets have independent revolutions from west to east (1.18.2). Their periods vary according to their distances from the earth: Saturn thirty years, Jupiter twelve years, Mars two years, Venus, Mercury, and the sun one year, and the moon twenty-eight days (1.19.3–5). All planets travel at the same rate of speed; the outer planets have greater orbits to traverse, and this alone is responsible for the difference in their periods (1.14.27, 21.6).[8] In their eastward course Macrobius has the planets keep within the zodiac, but he allows for inclinations of their orbits to the ecliptic (1.14.25); whereas the *Timaeus* has them all (circle of the Other) traveling in the same plane, diagonally to the plane of the circle of the Same.[9]

[6] In one of Macrobius' rare citations (1.13.5–8) he gives the reader to understand that he is drawing from the *Phaedo*, but F. Cumont, "Comment Plotin detourna Porphyry du suicide," *REG* 32 (1919) 114, believes that he did not consult the dialogue but obtained his material from Porphyry. Linke and Schedler were of the opinion that Porphyry's lost commentary on the *Timaeus* was the source of practically all of Macrobius' *Commentary*, a view which was successfully refuted by Mras, *op. cit.* (see note 3) 280–84. It is highly probable, however, that Porphyry's lost commentary was his chief source. Macrobius' relation to *Platonici* and Neoplatonists will be reconsidered in the introduction and notes to a translation of the *Commentary* which is being prepared.

[7] On one occasion (1.19.1) he finds himself in the embarrassing position of having to make a choice between Cicero and Plato. Like other late Latin commentators, he has the attitude that a select group of preeminent classical authors are omniscient and infallible.

[8] A. E. Taylor, *A Commentary on Plato's Timaeus* (Oxford, 1928) 173, has called attention to the gross incompatibility here. Macrobius explicitly states on many occasions that the sun's sphere is beneath those of Mercury and Venus, which would necessitate different orbits for each, and yet all have periods of one year. Cicero is guilty of a deception which is just as bad when he attempts to produce the seven notes of the heptachord from the eight revolving spheres (*Somn. Scip.* 5.2). To force the desired result he baldly asserts that two planets, Mercury and Venus, have the same speed. But he has just called Mercury and Venus *comites* of the sun, and accordingly there should be six and not seven notes. Macrobius, in commenting on this passage, repeats the fallacy (2.4.9).

[9] 36B–D.

The secret of the diurnal rotation of the celestial sphere is explained by referring to the Neoplatonic hypostases. The Soul, whose essence is in motion, first created from itself the celestial sphere, and accordingly motion first passed to the celestial sphere from the realm of incorporeality.[10] This force, undiminished and abiding, impels the celestial sphere in rotary motion because a sphere which embraces the universe must rotate if it is to have any motion at all. The sphere seems to be pursuing the Soul; "it would come to rest if it should ever find the Soul resting, but since the latter, leading the chase, is ever pouring itself into the universe, the body [of the universe] is ever commingling with it." [11] These, Macrobius acknowledges, are the teachings of Plotinus.[12]

The celestial sphere is studded with configurated stars (*sidus*, ἄστρον) and lone stars (*stella*, ἀστήρ).[13] Some authorities maintain that the stars are fixed in the celestial sphere, others that they have independent motions. Macrobius favors the latter view and explains that because of the vast dimensions of the celestial sphere, ages past belief are required for the completion of their revolutions (1.17.16).

Altogether there are eleven great circles girding the celestial sphere: the Milky Way, the zodiac, and nine others which are nothing more than mathematical lines. Ignoring the fabulous causes for the existence of the Milky Way, Macrobius presents the scientific explanations of Theophrastus, Diodorus, Democritus, and Posidonius (1.15.4–8). He would have the Milky Way crossing the zodiac at Capricorn and Cancer (1.12.1) instead of at Gemini and Sagittarius, where they actually intersect. This error he has undoubtedly repeated from Porphyry since there is close correspondence between 1.12.1–3 and passages in the *De Antro Nympharum* 20, 22, 28.[14] The zodiac is bisected by the ecliptic, so-

[10] 1.17.9: Nam cum animae, quae incorporea est, essentia sit in motu, primum autem omnium caeli corpus anima fabricata sit, sine dubio in corpus hoc primum ex incorporeis motus natura migravit, cuius vis integra et incorrupta non deserit, quod primum coepit movere.

[11] 1.17.10–11: Staret enim, si umquam stantem animam repperiret; cum vero illa, ad cuius appetentiam trahitur, semper in universa se fundat, semper et corpus se in ipsam et per ipsam retorquet.

[12] Cf. 2.2.1.

[13] About one-tenth of the 1022 stars listed by Ptolemy were ἀμόρφωτοι, i.e., not included in his 48 constellations. Macrobius does not conform with the classical distinction between ἄστρον and ἀστήρ. See L. Edelstein, "The Philosophical System of Posidonius," *AJPh* 57 (1936) 297–98.

[14] Porphyry's error results from his attempt to make the portals of souls correspond with Homer's description of the doors of the Ithacan cave (*Od.* 13.109–12).

called because an eclipse occurs only when the sun and moon are both traveling on this line at the same time. The sun can only be eclipsed on the thirtieth day of the moon, and the moon on the fifteenth day (1.15.10–11). There is no mention of the regression of the lunar nodes.

Of the nine remaining great circles there are five so-called parallels (celestial arctic and antarctic circles, two celestial tropics, and the celestial equator), two colures, and the meridian and horizon. Directly beneath each of the celestial parallels lie terrestrial parallels, mathematical circles on the earth's sphere corresponding exactly to the parallels on the celestial sphere. Thus each terrestrial zone is directly beneath and conforms with its corresponding celestial zone. The upper air lying within the sector of the celestial torrid zone is scorching hot because the sun confines its course within the tropics. Climate on earth is regulated by the climate of the celestial sphere. The more remote a region is from the path of the sun, the colder is its climate (2.5.11–15, 7.2–6). The two colures are great circles crossing the celestial north pole at right angles, dividing each of the parallels into four equal parts, and intersecting the zodiac at Aries and Libra, and Capricorn and Cancer. Macrobius takes the term *coluri* (*κόλουροι*) too literally, for he says: sed ad australem verticem non pervenire creduntur (1.15.14). The meridian and horizon change with the observer owing to the earth's sphericity. The meridian is a great circle going about the celestial poles and passing through the observer's zenith (1.15.16). At this point Macrobius confuses the visible horizon with the celestial horizon. Intending to complete the list of celestial circles, he here describes the visible horizon,[15] which he informs us is a circle three hundred and sixty stades (about thirty-five miles) in diameter.[16] In progressing in any direction, as much visibility as is gained ahead is lost behind (1.15.17–18).

The problem of the order of the planets, which troubled nearly all the ancients who attempted to locate them, receives special attention from Macrobius (1.19.1–10). Although Macrobius' view

[15] In surviving discussions of the celestial circles clear distinction is made between the celestial horizon (*ὁρίζων θεωρητός*) and the visible horizon (*ὁρίζων αἰσθητός*), or else the visible horizon is omitted.

[16] Assuming that Macrobius means Eratosthenes' stade, as he does on other occasions when he uses the word (1.20.20, 2.6.3–5). Modern estimates of the length of Eratosthenes' stade are: 148.8 meters (Lehmann-Haupt); 157.5 (Tannery, Dreyer, Heath); 168 (Thalamas).

that all planets travel at the same rate of speed does not seem to have been widely expressed by ancient astronomers,[17] they did arrange the planets according to their periods. Such a practice would fix the locations of the superior planets Saturn, Jupiter, and Mars, in descending order, and would place the moon at the bottom. About the positions of these "planets" in the geocentric system there was no disagreement. But since Mercury and Venus become satellites of the sun in a geocentric orientation and all three would accordingly have annual or approximately annual periods, the question of placing them correctly vexed all astronomers who did not adopt the Venus-Mercury theory of Heraclides Ponticus or the true heliocentric system of Aristarchus of Samos.[18] One school insisted that the orbits of Mercury and Venus were above the sun (Platonic order); the other just as firmly maintained that they were beneath the sun (Ciceronian or Ptolemaic order).[19] When Macro-

[17] Obviously this view was not original with Macrobius, but I have not come across this statement in other authors.

[18] Heraclides Ponticus made the discovery that Mercury and Venus revolve about the sun, but, like Tycho Brahe, he supposed that the sun revolved about the earth. Aristarchus' heliocentric system seems to have passed out quickly and is mentioned by classical authors only in derogatory terms. For some explanations for the sudden demise of Aristarchus' theory see Dreyer, *op. cit.* (see note 2) 148; Sir Th. L. Heath, *Aristarchus of Samos* (Oxford, 1913) 308. It is not easy for us to understand why either hypothesis did not receive more general acceptance among ancient astronomers since the differences of opinion regarding the order of the planets would thereby be immediately removed.

[19] From the surviving lists of the order of the planets it appears that the view that placed Mercury and Venus above the sun prevailed in the early period and that the other was a later adoption or gradually superseded the early view. Plato's order (*Ti.* 38D; *R.* 616E) was moon, sun, Venus, Mercury. This is also given by Aristotle (*Metaph.* 1073B) and Chrysippus (Stob. 448). Eratosthenes improved the Platonic order by inverting the positions of Mercury and Venus (Theon of Smyrna *Expositio*, ed. by Hiller, 142; Chalcidius *In Platonis Timaeum Commentarius* 73). Macrobius adopts the Platonic order (1.19.7–10), but a little later (1.21.27) gives Plato's order as moon, sun, Mercury, Venus (a bit of evidence in support of those who hold that he did not consult the *Timaeus*). Still later (2.3.14), in explaining why Platonists rejected Archimedes' figures for the distances of the planets, he gives the correct Platonic order. The other order, which placed Mercury and Venus beneath the sun, seems to have grown more popular after the second century B.C. It is the one given by Cicero (*Somn. Scip.* 4.2; *Div.* 2.91); Geminus (*Elementa Astronomiae* 1.27); Cleom. (*De Motu Circulari Corporum Caelestium* 1.3); Vitruvius (*Arch.* 9.5); Ptolemy (*Syntaxis Mathematica* 9.1). I should not hesitate to speak of Plato's order as the early one and Ptolemy's as the late one were it not for the fact that Ptolemy (*loc. cit.*) refers to the infra-solar order as the early one and the supra-solar order as the late one. He says that he prefers to go back to the old order because he cannot see that the contention of later writers (possibly Eratosthenes) that Mercury and Venus must be above the sun because their transits had never been observed is valid since they could be traveling in different planes.

bius finds Cicero differing from Plato about the correct order, he feels obliged to explain how the confusion arose. He attributes the Platonic order to the Egyptians and the Ciceronian order to the Chaldeans, and unequivocally states that the Platonic order is the correct one (1.21.27).

Although Macrobius' discussion obviously deals only with the order of the planets, Dreyer [20] and Heath [21] have attempted to interpret his words as referring to the Heraclidian system, in which Venus and Mercury revolve about the sun. But in such a system there could of course be no fixed order for Mercury, Venus, and the sun. If Macrobius had this system in mind, he certainly would not have been so explicit in stating his preference for the Platonic order. It is true that this erroneous view was prevalent before Dreyer and Heath, and since it seems to be gaining currency through their reaffirmation of it, it might be well to examine the passage carefully.[22]

At the opening of the nineteenth chapter Macrobius points out that Plato placed the sun just above the moon, whereas Cicero placed it above Mercury and Venus. Cicero belongs to the school of the Chaldeans and Archimedes; Plato followed the Egyptians, who preferred to locate the sun between the moon and Mercury, but at the same time detected and made known the reason why some supposed that the sun was above Mercury and Venus. The error of the latter group was not a grievous one, and is easily explained:

> Ciceroni Archimedes et Chaldaeorum ratio consentit; Plato Aegyptios omnium philosophiae disciplinarum parentes secutus est, qui ita solem inter lunam et Mercurium locatum volunt, ut rationem tamen et deprehenderint et edixerint cur a nonnullis sol supra Mercurium supraque Venerem esse credatur.[23] Nam nec illi qui ita *aestimant* a specie veri procul aberrant; opinionem vero istius permutationis huiusmodi ratio *persuasit* (1.19.2).

[20] *Op. cit.* (see note 2) 129–30.

[21] *Op. cit.* (see note 18) 258–59.

[22] Cf. Delambre's view cited in *The Encyclopaedia Britannica*, 11th Ed. (Cambridge, 1911) 22.622; Duhem, *op. cit.* (see note 2) 3.51–52; Haskins, *op. cit.* (see note 2) 88. From a statement made by Dreyer, *op. cit.* (see note 2) 129, it appears that the misinterpretation of Macrobius' words is very old: "For ages this system, in which Mercury and Venus alone move about the sun, has been known as 'the Egyptian,' on the authority of . . . Macrobius."

[23] Heath confuses *ut* and *ita* and the moods of *volunt*, *deprehenderint*, and *edixerint* in his translation.

Then follows the explanation. The positions of Saturn, Jupiter, and Mars are easily determined since the distances of their orbits are in direct proportion to their periods. The moon, too, is undoubtedly the lowest of all planets, having a period so much shorter than the others. But inasmuch as Mercury, Venus, and the sun have almost the same period, great confusion has arisen about placing them. At this point is found the passage which, according to Dreyer and Heath, refers to the revolutions of Venus and Mercury about the sun:

> Horum vero trium sibi proximorum, Veneris Mercurii et solis, ordinem vicinia confudit, sed apud alios; nam Aegyptiorum sollertiam ratio non fugit, quae talis est. Circulus per quem sol discurrit a Mercurii circulo, ut inferior ambitur; illum quoque superior circulus Veneris includit, atque ita fit ut hae duae stellae, cum per superiores circulorum suorum vertices currunt, *intellegantur* supra solem locatae, cum vero per inferiora commeant circulorum, sol eis superior *aestimetur*. Illis ergo, qui sphaeras earum sub sole dixerunt, hoc visum est ex illo stellarum cursu qui nonnumquam, ut diximus, *videtur* inferior; qui et vere notabilior est, quia tunc liberius apparet. Nam cum superiora tenent, magis radiis occuluntur;[24] et ideo *persuasio* ista convaluit, et ab omnibus paene hic ordo in usum receptus est (1.19.5–7).

There is no mistaking the meaning of his explicit language. He repeats the statement made above that the Egyptians, whom Plato followed, held the correct view. They understood that the sun's *orbit* [not the sun] was encompassed by the orbits of Mercury and Venus, and that the true positions of Mercury and Venus above the sun were recognized when those planets were in the upper reaches of their tracts, even though they appeared to be beneath the sun when they were passing through their lower reaches. The words *aestimare* and *persuasio* are clearly used of "erroneous opinion" and "fallacious inclination," as they are in the first passage cited; *videtur* also indicates the error of those who differ with the Egyptian-Platonic system, while *intellegantur* is used to express the correct view. It is obvious that Macrobius intends to keep Mercury and Venus above the sun at all times. To be consistent in his interpretation of *circulus* as "epicycle," Heath assumed that Macrobius was adopting an epicyclic motion for the sun, a most

[24] The reason given is incorrect. Venus and Mercury are less brilliant when they are near superior conjunction because of their greater distance from us. Greatest brilliancy of Venus is attained 36 days before or after inferior conjunction, at which time she is $2\frac{1}{2}$ times as brilliant as at superior conjunction.

extravagant supposition in the case of an author as elementary as Macrobius.

What misled Dreyer and Heath was Macrobius' statement that Mercury and Venus at times course through the upper reaches and at times through the lower extremities of their orbits. It certainly does appear that Macrobius is alluding to epicycles for these planets since he nowhere else mentions high and low courses for planets and since discussions of epicyclic motions for Mercury and Venus occur repeatedly in the ancient handbooks. In fact some understanding of the behavior of one of these planets can be traced all the way back to Pythagoras, who was aware that Venus was both the Morning and Evening Star. Macrobius' range of astronomical information is sufficiently comprehensive so that he could hardly have been without some knowledge, however vague and garbled by tradition, of one of the ancient theories accounting for the peculiar motions of Venus and Mercury. But we cannot accept the assumption of Dreyer, Heath, and Duhem that Macrobius is transmitting the Heraclidian system because he is so painstaking and explicit in defending the Platonic system.

This leaves us with the following alternatives. If we credit Macrobius with an understanding of the operations of epicycles,—assuming there is no subterfuge involved—his epicycles will have to be about mathematical points on deferents which are beyond the sun's orbit, just as Ptolemy had the epicycles of Venus and Mercury revolve about deferents which were beneath the sun's orbit. If on the other hand we assume that Macrobius has only a vague and confused notion of epicycles, it is possible to suppose that he is associating solar epicyclic motions with Venus and Mercury without realizing that this would bring them beneath the sun half of the time. That such an assumption is not too unlikely is seen from his limitations in handling other difficult matters. When he reaches any point that is the least bit complicated in his discussions of arithmetic, music, astronomy, and geography, he calls a halt, declaring on one occasion, as we have seen, that it is the part of the pedant showing off his knowledge to proceed farther. The alternative which the present writer is inclined to favor is that Macrobius is aware of the impossibility of maintaining a fixed order of the planets while adhering to the system of solar epicycles for Venus and Mercury, but that as a devoted Neoplatonist, and admirer and defender of Plato at all times, he has only one purpose in presenting

his discussion here: to reaffirm the Platonic order against the now prevailing Ptolemaic order. Accordingly he is explicit in championing the Platonic order, but is vague in alluding to the peculiar motions of Mercury and Venus. In any case we do not have an exposition of the Heraclidian system here. In the light of the passage immediately following, which Dreyer and Heath ignored, their position becomes still more clearly untenable:

> Perspicacior tamen observatio veriorem ordinem deprehendit, quem praeter indaginem visus haec quoque ratio commendat, quod lunam, quae luce propria caret et de sole mutuatur, necesse est fonti luminis sui esse subiectam. Haec enim ratio facit lunam non habere lumen proprium, ceteras omnes stellas lucere suo, quod illae supra solem locatae in ipso purissimo aethere sunt, in quo omne, quicquid est, lux naturalis et sua est, quae tota cum igne suo ita sphaerae solis incumbit ut caeli zonae quae procul a sole sunt perpetuo frigore oppressae sint, sicut infra ostendetur;[25] luna vero, quia sola ipsa sub sole est et caducorum iam regioni luce sua carenti proxima, lucem nisi de superposito sole, cui resplendet, habere non potuit (1.19.8–10).

To remove all doubt that the planets Mercury and Venus are above the sun, Macrobius points out that the moon is the only planet which has to borrow its light, lying, as it does, beneath the sun. All the other planets, being situated above the sun, are in the region of natural light. This last statement is reminiscent of the opinion of Aristotelians who, deriving αἰθήρ from αἴθεσθαι, supposed that the upper air was ablaze with perpetual radiance.[26] If Mercury and Venus were revolving about the sun in Macrobius' system, they would be "shining with their own light" only while they were above the sun's orbit.

A little later (1.21.24–27) Macrobius remarks that at the hour of the birth of the universe the planets were found lying in succession along the signs of the zodiac "in the order which Plato assigned to their spheres." Then, with reference to the passages discussed above, he says: sed sine huius tamen rationis patrocinio abunde Platonicum ordinem prior ratio commendat. It seems clear that Macrobius' only intention in discussing the order of the planets was to reaffirm the Platonic order in the face of almost universal opposition to it, as he himself admitted in the closing remark of the second passage transcribed above. That Ptolemy's authority was even

[25] 2.7.

[26] Cf. Ps.-Arist. *Mu.* 392A. Vitruv. *Arch.* 9.1.16 explains that the flames of fire rise and hence the ether above the sun is scorched and set afire.

at that early date beginning to exert its weighty influence and was responsible for the passing of the Platonic order may be inferred from a passage in Proclus.[27] Such a trend must have irked Macrobius, an outspoken champion and worshiper of Plato throughout the *Commentary*.

Macrobius' statement regarding the relative distances of the planets has become a most important *locus classicus* in the age-old attempt to arrive at Plato's meaning in the passage in which he speaks of the double and triple intervals of the circle of the Other.[28] Early in the *Commentary* Macrobius employs the so-called lambda diagram, popular with commentators on the *Timaeus* since Crantor, arranging the numbers used in the construction of the Soul on either side of the capital lambda: 2, 4, 8 on one side, 3, 9, 27 on the other, with 1 at the apex (1.6.46). Later he explains that the ratios arising from these numbers produce the harmony of the revolving spheres (2.2.15–23). Then he asks whether these ratios also govern the distances between the planets. Archimedes, he reports, supposed that he had calculated in stades the distances of each of the planets and of the celestial sphere as well. But Archimedes' figures were not acceptable to the *Platonici* because he had not adhered to the numerical ratios of the *Timaeus*. Then Macrobius affirms, on the authority of Porphyry's commentary on the *Timaeus*,[29] that the distance from the earth to the sun is twice as great as from the earth to the moon, that the distance from the earth to Venus is thrice as great as from the earth to the sun, and so on, using the numbers of the *Timaeus* in their given order as multipliers to determine the distances of each of the planets (2.3.12–14).[30]

Though a confirmed Neoplatonist, Macrobius does not take a direct stand against the astrologers. He attempts to explain why some regard the influence of the planets Saturn and Mars as baneful "despite the fact that there is only one nature in things divine." A possible reason is found in only one work to his knowledge, Ptolemy's *De Harmonia*, and involves the Pythagorean-Platonic

[27] *In Ti.* 258A–C.

[28] *Ti.* 36D. This is not the place to allude to the difficulties involved. See Taylor, *op. cit.* (see note 8) 161–64.

[29] 2.3.15. Macrobius' only reference to this lost work which is generally regarded as the most important source of his *Commentary*.

[30] With reference to his earlier diagram, by alternating from one side of the lambda to the other, the order of the multipliers thus becomes: 2, 3, 4, 9, 8, 27.

ratios of the sesquitertian, sesquialter, super-octave, double, triple, and quadruple. The sun and moon are the principal guardians of our lives. In fact, in our associations and activities we rely as much upon them as upon the other five planets combined. Now Venus and Jupiter are favorably aspected to the sun and moon (i.e., in accordance with Pythagorean ratios), whereas Saturn and Mars are not (1.19.19–26).[31] He then cites Plotinus on the effect of the planets. That revered authority maintains that while the planets do not exert a direct influence upon the individual, his allotted fate is revealed to him by the way the seven planets aspect each other, just as birds in flight or at rest unwittingly indicate future events by their direction or cries (1.19.27).[32]

The twenty-second chapter of Book I is devoted to proving that the earth is in the center of the universe. Of all the matter composing the universe ether,[33] the purest and clearest, holds the highest position; air has settled beneath it because it has some slight weight and a certain amount of impurities; then follows water, which is indeed still clear but which the sense of touch demonstrates is corporeal; at the bottom is the earth, a vast, impenetrable solid, the dregs and offscourings of the purified elements. (This tradition became popular with the Neoplatonists.) Macrobius, following the Varronian derivation of *terra* from *terere*,[34] suggests that the earth was given the name *terra* because it became so hardened. The atmosphere close to the earth is condensed by its chill. This mighty belt, exerting equal pressure on all sides, keeps the earth in place in the universe. Or perhaps a geometrical reason is responsible: if the earth should abandon the midpoint, it would no longer be equidistant from any point on the celestial surface.[35] Furthermore, the lowest point of a sphere is its center, and weights naturally tend downwards. Therefore the earth is located in the center of the universe.[36] The argument of rainfall will remove all doubt. Air, condensed by the earth's chill, is formed into clouds which

[31] Cf. Ptolemy *Harm.* 1.7, 3.16.

[32] Cf. Plot. 2.3.3, 7. Macrobius undoubtedly had a great deal to do with the spread of this Plotinian attitude in the Middle Ages. For its popularity see L. Thorndike, *op. cit.* (see note 2) 1.302, 306–7.

[33] Akin to fire, if not fire. Cf. Theon of Smyrna *op. cit.* (see note 19) 149.

[34] *Ling. Lat.* 5.21.

[35] Cf. Parmenides and Democritus, cited by Aetius *Placita* 3.15.7 (Diels, *Doxogr. Gr.* 380); Plato *Phd.* 108E–9A; Aristotle *Cael.* 295B.

[36] These arguments appealed to the Middle Ages. See Wright, *op. cit.* (see note 2) 154–55.

send down rain upon all quarters of the globe except those regions constantly parched by heat. If anyone is unwilling to admit this, he must suppose that rain which does not fall upon the upper side of the earth continues on down until it reaches the lower depths of the celestial sphere—an assumption too ridiculous to discuss. Moreover, the earth is stationary because every sphere must have a stationary center about which it rotates (1.22.3).[37]

In comparison with the dimensions of the celestial sphere the earth is but a geometrical point.[38] It must therefore be smaller than the sun since the sun occupies a determinate part of the measurement of its orbit while the earth, being a geometrical point, is too small to be a part; it is regarded merely as a symbol by geometricians.[39] Furthermore, the planets above the sun must also be larger than the earth since they, too, are parts of their orbits and their orbits are greater than the sun's. Even the remote stars are larger than the earth, for they occupy a portion of celestial arc (1.16.10–13). By such reasoning the moon, too, ought to be considered larger than the earth. Inasmuch as Macrobius begins with the sun and notes that it and the bodies above it are larger than the earth, taking care to exempt the moon, it seems reasonable to assume that he was aware, directly or indirectly, of the estimates for the dimensions of the moon given by Hipparchus and Ptolemy.[40]

With a novice's yearning to impress his readers with his attainments, Macrobius introduces two subjects which, as we have seen, had much to do with his reputation as an authority in the Middle Ages: the measurement of the sun's diameter and orbit, and the method used to mark off the signs of the zodiac. His calculations in millions of stades must have had an effect upon the medieval mind similar to the effect that calculations in light years have had upon us. That he anticipated that his discussion would fill his readers with amazement and admiration may be seen from his

[37] Cf. Theon of Smyrna *op. cit.* (see note 19) 149, 188; Chalcidius *In Platonis Timaeum Commentarius* 76.

[38] This assertion was frequently made in antiquity: e.g., Aristarchus of Samos, cited by Archimedes *Arenarius* 1; Euclid *Phaenomena* 1; Theon of Smyrna *op. cit.* (see note 19) 120, 128; Cleom. *De Motu Circulari Corporum Caelestium* 1.11; Geminus *Elementa Astronomiae* 16.29; Chalcidius *In Platonis Timaeum Commentarius* 59, 64.

[39] Cf. Nicomachus Gerasenus *Introductio Arithmetica* 2.7.1; Ps.-Iamb. *Theologoumena Arithmeticae*, ed. by De Falco, 1.

[40] Their figures for the distance and diameter of the moon differ only slightly from actuality. See Dreyer, *op. cit.* (see note 2) 184–85; Heath, *op. cit.* (see note 18) 349–50.

words which introduce the subject: Sed quaeso, si quis umquam tam otiosus tamque ab omni erit serio feriatus ut haec quoque in manus sumat, ne talem veterum promissionem quasi insaniae proximam aut horrescat aut rideat. Etenim ad rem quae natura inconprehensibilis videbatur viam sibi fecit ingenium; et per terram qui caeli modus sit repperit (1.20.13). In order to elevate his standing as an investigator in the estimation of his readers, he purposely attributes to the Egyptians astronomical operations which he must have known were performed by Greeks (1.20.11). It is more reasonable to suspect him of downright dishonesty here, as elsewhere, than to suppose, as Heath did, that the traditions of Egyptian and Alexandrian astronomy had coalesced and were confused in his mind.[41] The source of the method described by Macrobius, though obviously not Egyptian, is unknown.

He opens with a bald declaration that the cone of the earth's shadow extends sixty earth diameters and that the apex of the cone just reaches the sun's circle.[42] This figure happens to be approximately twice as great as the figures of Hipparchus and Ptolemy for the distance of the moon, and Macrobius, as we have seen, followed the *Platonici* in believing that the sun's distance was twice as great as the moon's. It would appear that the authority that Macrobius is using arrived at his figure in that manner. One wonders why it did not occur to Macrobius (or his authority) that

[41] *Op. cit.* (see note 18) 311, referring back to 259. In reporting the "Egyptian method" of determining the sun's orbit and diameter, Macrobius begins with Eratosthenes' figure of 252,000 stades for the earth's circumference, neglecting to mention Eratosthenes' name. Moreover, he has just referred to Eratosthenes' *Libri Dimensionum* only to censure that worthy for using an impossible demonstration (1.20.9–10). It is hard to believe that he is innocently confusing Greeks and Egyptians. Other examples of Macrobius' deliberate falsification of his references are: 1.8, where he cites Plotinus but is clearly indebted to Porphyry's *Sententiae;* 1.13.6, where he attributes a doctrine of Porphyry to Plato; 1.21.27, where he claims to be following Plato but is obviously not (see note 19); 2.14, where he pretends to be quoting Aristotle directly. These alleged quotations, however, have no regard for the context or sequence of the original and seem to have been selected merely because they could be most effectively undermined. He admits that his refutation of Aristotle was drawn from the clichés of *Platonici* who had contradicted Aristotle before him (2.15.2); and it is probable that these were also the source of his version of the Aristotelian arguments. In each of the cases noted above Macrobius has referred to an early author and used a later one. Apparently he felt that this would make him appear more learned.

[42] 1.20.18: Sciendum et hoc quod umbra terrae, quam sol post occasum in inferiore hemisphaerio currens sursum cogit emitti, ex qua super terram fit obscuritas quae nox vocatur, sexagies in altum multiplicatur ab ea mensura quam terrae diametros habet; et hac longitudine ad ipsum circulum per quem sol currit erecta, exclusione luminis tenebras in terram refundit.

if the earth's shadow extended as far as the sun's orbit and the sun in its revolutions described a perfect circle about the earth, the sun's diameter would then be twice as great as the earth's. A familiarity with the simplest rudiments of geometry would have enabled him to realize this.[43] Instead he takes us through his tedious operations, occupying the remainder of the chapter, and achieves a result which is far from accurate when compared with the result he should have obtained by geometry.[44] Unaware of his elementary oversight, Macrobius conducts his readers through investigations which he must have felt would astound them, and is evidently quite pleased with himself.

The earth's circumference being 252,000 stades "according to most obvious and incontrovertible methods of measurement," its diameter will of course be 80,000 stades, or slightly more.[45] Sixty earth diameters, or 4,800,000 stades,[46] measure the full extent of the earth's cone, which, as we saw, is also the distance to the sun's orbit. Double the distance from the earth to the sun and the diameter of the sun's orbit is calculated to be 9,600,000 stades. Accordingly, by multiplying by $3\frac{1}{7}$, the sun's orbit will be found to be roughly 30,170,000 stades.

At this point Macrobius interrupts his computations to describe the σκάφη, a hollow hemispherical bowl with a vertical γνώμων, by means of which the Greeks were able to ascertain among other things the dimensions of the earth, the latitude of a given locality, and the apparent diameters of the sun and moon. Macrobius' σκάφη has twelve demarcations, marking the twelve daylight hours as the sun passes from horizon to horizon. If it is set up on the day of the equinox in a perfectly level position in a location where there is an unobstructed view of the horizon, the sun's apparent diameter may be determined by measuring the shadow in the bowl at the moment when the full orb first comes into view and is just resting upon the horizon. The shadow will be found to extend

[43] Cleom. *De Motu Circulari Corporum Caelestium* 2.1.78 uses this very demonstration.

[44] Instead of finding the sun's diameter to be twice the earth's, his figure for the sun's diameter is 140,000 stades as compared with 80,000 stades for the earth's diameter.

[45] In accordance with the ratio of $3\frac{1}{7}$, determined by Archimedes *Dimensio Circuli* 3.

[46] This figure is suspiciously close to the estimate (4,080,000 stades) attributed to Eratosthenes, as given by Stob. 566; Aetius *Placita* 2.31.3 (Diels, *Doxogr. Gr.* 362–63); Lydus *De Mensibus* 3.12. Tannery and Heath reject this figure for Eratosthenes. See Heath, *op. cit.* (see note 18) 340.

over 1/9 of one of the twelve sections of the bowl. Thus the apparent diameter of the sun is 1/108 of the distance it traverses in its journey from horizon to horizon, or 1/216 of its entire orbit.[47] Dividing the length of the sun's orbit by 216, we obtain a figure slightly less than 140,000 stades for the sun's diameter. This is almost twice as great as the earth's diameter! Now we learn from geometry that when the diameter of one sphere is twice as great as that of another, the first sphere is really eight times as large as the second.[48] Thus Macrobius concludes that the sun is eight times as large as the earth (1.20.18–32). His result was widely adopted in the Middle Ages.[49]

Continuing his prolix style into the next chapter, Macrobius tediously explains why planets are said to "be in" or to "pass through" the signs of the zodiac, although the signs are set in the celestial sphere. A planet is said to be in a certain sign when it is traveling within the boundaries of the sector marked off by that

[47] We do not know who is responsible for Macrobius' grossly excessive figure. Aristarchus (Archimedes *Arenarius* 10) estimates the sun's apparent diameter to be 1/720 of its orbit; Cleom. *De Motu Circulari Corporum Caelestium* 2.1.75, 82 has 1/750; Mart. Cap. *Nupt. Phil. et Merc.* 860 has 1/600. Thus Aristarchus observes that the sun occupies ½ degree of celestial arc, Cleomedes slightly less, but Macrobius 1⅔ degrees. The mean apparent size of the sun actually amounts to slightly more than ½ degree.

| | |
|---|---|
| *Actual mean apparent size:* | *31′ 59″* |
| Cleomedes' figure | 28′ 48″ |
| Aristarchus' figure | 30′ |
| Capella's figure | 36′ |
| Macrobius' figure | 1° 40′ |

How Aristarchus obtained his figure is not known but it is likely that he used the σκάφη since he is credited with inventing it by Vitruvius, *Arch.* 9.8.1. The figures of Cleomedes and Martianus Capella were obtained through the use of a water clock which indicated what part of twenty-four hours intervened between the appearance of the sun's first rays and of its full orb on the horizon. There is still another figure given by Aristarchus but it is so inaccurate that it is not certain whether he meant to have this estimate (2°) taken as a serious value or whether he was assigning a purely arbitrary figure for the purposes of his calculations. Heath is of the opinion that the work in which Aristarchus gives his estimate of 2°, the *De Magnitudinibus et Distantiis Solis et Lunae* (his only extant work), was an early one written before he had obtained the nearly correct figure given above. But that part of Tannery's explanation in which he conjectures that Aristarchus' figure was not meant to be taken seriously seems quite plausible since it is hard to imagine how a man of Aristarchus' ability could have arrived at so poor a result from observation. See Heath, *op. cit.* (see note 18) 312.

[48] According to Euclid's theorem (*Elementa* 12.18) that two spheres are in the same proportion as the cubes of their diameters.

[49] See Helpericus of Auxerre *De Computo* 20; Honorius of Autun *De Solis Affectibus* 3; William of Conches *De Philosophia Mundi* 2.32.

sign which is directly above it, that is, when it is projected against the background of that sign. Strangely enough, he feels the need of supplementing his wordy discussion with a diagram, one of the five which accompanied the material on astronomy and geography (1.21.1–4). Hereupon a diligent investigator will be curious to know who first marked off the signs of the zodiac. Once again it is the Egyptians who have merited the gratitude of the human race.[50] Being favored by continually clear skies and an unobstructed view of the heavens, they were the first to notice that the stars were fixed in the firmament and that seven planets alone wandered about. They also observed that these wanderings were confined within a belt, which they later called the zodiac, running diagonally across the celestial equator. Accordingly they endeavored to establish demarcations along this belt in order to be able to report to each other the locations of the planets at any time and to hand down their records to posterity (1.21.8–12).

They constructed two copper vessels, one with a perforated bottom like that of a clepsydra. The perforated vessel, filled with water but with the hole closed, was placed over the empty vessel. At the moment when a conspicuous star was rising above the horizon, they removed the stopper and allowed the water to flow into the lower vessel. The flow continued through the following day until that moment in the following night when the same star again returned to the horizon. The water in the lower vessel was then divided into twelve equal parts. Next they procured two more vessels, each with a capacity of one of the twelve parts of water. Then they poured all twelve parts of water back into the original container and placed one of the two small containers beneath it. When the configuration which they later called Aries first began to appear, they let the water flow into the small container. At the moment when this became filled, the empty one was substituted and notation was made of the conspicuous star that was rising above the horizon. In this way they were able to mark off six divisions in the belt of configurated stars that appeared in the sky at that season. In order to mark off the other six divisions they had to repeat the process on another evening just six months later (1.21.12–22).

[50] This time Macrobius is not alone in attributing a discovery to the Egyptians. Cleom. *De Motu Circulari Corporum Caelestium* 2.1.75 also gives them credit for devising the apparatus here described.

The Egyptians also divulged the reason for the tradition which assigned first place to Aries in the order of the planets: on the day of the creation it was at the summit of the universe (1.21.23).[51] From them we learn, too, how the planets came to be considered lords of the signs associated with their influence: on the natal day of the world the moon was in Cancer, over which it was lord, the sun was in Leo, Mercury in Virgo, Venus in Libra, Mars in Scorpio, Jupiter in Sagittarius, and Saturn in Capricorn. In the second allotment the order was reversed: Aquarius was assigned to Saturn, Pisces to Jupiter, Aries to Mars, Taurus to Venus, and Gemini to Mercury. The sun and moon each had to be content with one sign (1.21.24–26).[52]

## II. Geography

Macrobius was no less esteemed as an authority on geography in the Middle Ages. Although it is safe to say that he did not make a single original contribution and although much of the Macrobian material discussed here is frequently found in other classical authors, it is the opinion of recent authorities, as we shall see, that it was largely through Macrobius that the popular doctrines embraced by him were transmitted to the Middle Ages.

Here, too, his lucidity must be regarded as a chief factor in securing his high position as a geographer. He takes great pains in explaining the correspondence between the celestial and terrestrial zones and the reasons for differences in temperature, and to assist the reader's understanding of this relatively simple subject he introduces two diagrams (2.5.13–15, 7.4–6).

The sun regulates the temperature of the sky, and consequently of the earth. In its annual course it keeps within the tropics, turning southwards when it reaches Cancer and northwards when it reaches Capricorn. A belt on the celestial sphere lying directly over the zone bounded by these solstitial points is constantly scorched by the sun beneath it. Two belts about the celestial poles are always stiff with cold because they are farthest removed from the sun's path. In between are two temperate celestial belts, chilled on the one hand and warmed on the other. The upper air and atmosphere conduct to the earth the temperature of the region directly above in the sky (2.5.9–12, 7.2–8).

[51] Cf. Firm. Mat. *Matheseos Libri* 3.1.17–18; Proclus *In Platonis Timaeum Commentaria* 30A.

[52] Cf. Porphyry *Antr. Nymph.* 22.

The effect on climatic conditions of the sun's diagonal course across the heavens may perhaps be more clearly understood by observing the relation between the direction of the sun's rays and the temperature. A γνώμων located at Syene, which lies directly under the Tropic of Cancer,[53] will cast no shadow on the day of the summer solstice. (The poet Lucan is therefore inaccurate in his statement

atque umbras numquam flectente Syene.) [54]

In the north temperate zone shadows will never fall towards the south because the sun's course is always to the south of us. As soon as one crosses over into the torrid zone, however, he will find that shadows are cast towards the south when the sun is at or near the summer solstice. At this time we in the north temperate zone are passing through the summer season because the sun is nearest to our own latitudes. Inhabitants of the south temperate zone are then experiencing the rigors of winter. We have winter when the sun is at or near Capricorn, the season when they are enjoying summer weather. Our north wind becomes a hot wind after it crosses the torrid zone, while Auster, which is a chill wind for the inhabitants of the south temperate zone, is warm to us. Climatic conditions in southern Europe are ideal; but as one approaches the regions bordering upon the frigid zone, namely, the Sea of Azov,[55] the Don and Danube basins, and the lands lying beyond Scythia, or enters those parts of Egypt, Arabia, Lybia, and Ethiopia border-

[53] Syene (Assuan) actually lies 37 miles to the northward. Eratosthenes, however, assumed that it was precisely beneath the tropic, and by measuring the sun's zenith distance at Alexandria he was able to determine the measurement of the earth's circumference with slight error. Although his method was correct he was fortunate to achieve his result. Aside from the limitations of his instrument, he had no knowledge of the earth's oblateness and could not obtain an accurate figure of the distance between Syene and Alexandria. His errors seem to have canceled each other rather than to have accumulated. The account of his operations is given by Cleom. *De Motu Circulari Corporum Caelestium* 1.10. If Newton had been aware of Eratosthenes' figure and its equivalent in miles, it is quite possible that he would not have had to put aside his gravitational theory for twenty years or more. Newton was basing his investigations on erroneous figures prevailing up to his time which underestimated the earth's circumference by about one-sixth.

[54] 2.7.16. Cf. Lucan *Bell. Civ.* 2.587.

[55] The notion that the Sea of Azov extended deep into Russia and that it and its environs bordered upon the frigid zone was an old and persistent one. Strabo 2.1.12 places the mouth of the Dnieper in the latitude of the northern coast of France. Plin. *Nat.* 4.78 nearly doubles the true length of the Sea of Azov. Ptol. *Geog.* 2.8 places the mouth of the Rhine at the fifty-third parallel and *ibid.* 5.8 the upper reaches of the Sea of Azov above it at the fifty-fourth.

ing upon the torrid zone, he finds conditions that are almost intolerable. In the southern lands the atmosphere has become so rarefied because of the intense heat that it is seldom or never condensed into clouds. Inhabitants of distant northern regions are subjected to low temperatures which prevail through almost the entire year "so that it is not easy to determine how much harm they suffer from such extreme conditions." The frigid zones are uninhabited, but it is possible for human life to exist within the borders of the torrid zone, as he explains later (2.7.9–21).

Of the five zones two afford agreeable habitation. The inhabitants of the known part of the earth, Romans, Greeks, and *barbari*, occupy roughly only one-quarter of the globe's habitable area, the north temperate zone in the eastern hemisphere. It is reasonable to assume that the other three quarters are also inhabited, but verification will never be possible because of the impenetrable barriers interposed. The mean temperatures of the northern and southern temperate zones are identical even though the seasons are opposite. Since animal life thrives on the same climate that sustains plant life and since conditions are similar for the same latitudes, whether on the upper or lower sides of the globe, there can be no reason for refusing to believe that both temperate zones are inhabited over their entire circuits (2.5.11–12, 16–17, 22).

There follows a passage which, because of its striking interest, it might be well to translate here. "If life is possible for us in this quarter of the earth which we inhabit because we tread on the ground and look up at the sky overhead, and thrive upon the abundant air that we inhale, and because our sun rises and sets for us, why should we not assume that there are men living there as well where similar conditions always obtain? We must agree that the men who are supposed to be dwelling there breathe the same air as we since each zone has a temperature that does not vary over the whole circuit; the same sun will of course be setting for them when it is rising for us and will be rising for them when setting for us; they will tread the ground as well as we and above their heads will always see the sky. Have no fear that they will fall off the earth into the sky, for nothing can ever fall upwards. If for us *down* is the earth and *up* is the sky—to affirm it is to be jesting—then for those people as well *up* will be what they see above them, and there is no danger of their falling upwards. I can assure you

that the uninformed among them think the same thing about us and believe that it is impossible for us to be where we are; they, too, feel that anyone who tried to stand in the region beneath them would fall.[56] But just as there has never been anyone among us who was afraid he might fall into the sky, so no one in their quarter is going to fall upwards since we saw from a previous discussion that all weights are borne by their own inclination towards the earth" (2.5.23–26).

To dispel any doubt that it is possible for men to be standing in regions that are opposite each other, Macrobius points out that it is already a known fact that the east and west are inhabited in much the same way, and diameters drawn in any part of the globe are equal (2.5.27).[57]

The people who are assumed to be living in the south temperate zone of the eastern hemisphere are called by the Greeks ἄντοικοι; proceeding around the globe, those living diametrically opposite Europeans and Asiatics come next [ἀντίποδες]; these are in turn separated by their torrid zone from their ἄντοικοι [περίοικοι] (2.5.33).[58]

That Macrobius' statements about the earth's *habitationes* were of considerable importance in fostering the passion for exploration and discovery in the fifteenth century is undoubtedly true. There is also a reasonable possibility that Macrobius may have had an influence upon Columbus' decision to make his first westward voyage.[59] Moreover, it is worth remembering that his reputation as an authority was eminent, and that three editions of his work had appeared by 1485.

In giving the dimensions of each of the five zones, Macrobius follows Eratosthenes' practice of dividing the earth's circumference

[56] Lucr. *Rer. Nat.* 1.1052–82 and Plu. *De Facie in Orbe Lunae* 924A–C scoff at the idea of antipodes. Belief in antipodeans became heretical. See the attitudes of Lact. *Div. Inst.* 3.24 and August. *Civ. Dei* 16.9.

[57] Ptolemy greatly overestimated the dimensions of the known portion of the earth. He placed the Fortunate Isles (the Canaries) on the prime meridian and the city of Sera in China on the 180th meridian. The distance is in reality about 130 degrees. His overestimate of the extent of land in the eastern hemisphere became a doctrinal tradition in the late Middle Ages and had an encouraging influence upon Columbus. See G. E. Nunn, *The Geographical Conceptions of Columbus* (New York, 1924) 29–30.

[58] Cf. Geminus *Elementa Astronomiae* 16.1; Cleom. *De Motu Circulari Corporum Caelestium* 1.2.

[59] Macrobius and Martianus Capella were responsible for the belief in the antipodal regions in the Middle Ages. See Wright, *op. cit.* (see note 2) 160, 258. That the currency of this belief was a factor in the discovery of America is evidently true. See M. Cary and E. H. Warmington, *The Ancient Explorers* (London, 1929) 192.

into 60 intervals instead of using Hipparchus' division into 360 degrees. The whole circumference measures 252,000 stades,[60] and accordingly each interval measures 4,200 stades. The torrid zone comprises eight intervals, four on each side of the equator, and is 33,600 stades broad. The breadth of our temperate zone is five intervals, or 21,000 stades. The frigid zone, from the arctic circle to the north pole, extends six intervals, or 25,200 stades. The dimensions of the zones about the rest of the globe of course correspond (2.6.3–6).[61]

A narrow area within the torrid zone is known to be inhabited. Macrobius locates Meroe at 3,800 stades south of the tropic and estimates that the Cinnamon-producing Country is still 800 stades farther south. No one can pass beyond this point because of the intense heat (2.8.3).[62] Inasmuch as the northern border of the torrid zone supports human life, there is no doubt that a corresponding amount of space along the southern extremity of the torrid zone also admits habitation (2.8.4).[63]

Macrobius is puzzled by a passage in Vergil's *Georgics* in which the poet seems to say that the zodiac "cuts across" both temperate zones.[64] Is this an example of the grand epic style (*poetica tuba*) and does Vergil merely mean that the torrid regions on either border are like the temperate zones in that they permit habitations? Or is he indulging in poetic license and substituting one particle (*per*) for another (*sub*)? Homer often did this and Vergil was his

[60] Macrobius and Martianus Capella were responsible for the wide adoption of Eratosthenes' figure in the Middle Ages. See Kimble, *op. cit.* (see note 2) 9, 24; Wright, *op. cit.* (see note 2) 55, 155.

[61] The degrees and dimensions of the breadth of the zones coincide with those given by Geminus *Elementa Astronomiae* 5.45–46, 16.7–8, and the degrees with those of Theon of Smyrna *op. cit.* (see note 19) 202–3. Hipparchus placed the Tropic of Cancer at 16,800 stades north of the equator (Strabo 2.5.7), as did Macrobius, but he set the northern habitable limit roughly at 22,200 stades beyond the tropic (Strabo 2.1.13, 5.7), whereas Macrobius' limit would be at 21,000 stades.

[62] Eratosthenes placed Meroe at 10,000 stades south of Alexandria and the limit of the οἰκουμένη at 3,400 stades south of Meroe (Strabo 1.4.2). We saw above that Eratosthenes estimated the distance between Alexandria and Syene (directly beneath the tropic) to be 5,000 stades so that he would place Meroe at 5,000 stades south of the tropic. Hipparchus also placed Meroe at 5,000 stades south of Syene (Strabo 2.5.7), but placed the Cinnamon-producing Country 3,000 stades south of Meroe (Strabo 2.1.13).

[63] This hypothesis is ascribed to Crates by Geminus *Elementa Astronomiae* 16.26–27.

[64] 1.237–39:

> duae mortalibus aegris
> munere concessae divom, et via secta per ambas,
> obliquus qua se signorum verteret ordo.

imitator in all respects.[65] Or is *per* here the equivalent of *inter* as it is in another passage?[66] If it is, Vergil's lines are perfectly intelligible. This tedious discussion, reminiscent of the curious exegetical disquisitions to be found in his *Saturnalia* and in the works of other late Latin commentators, occupies the whole of the eighth chapter of Book II.

The next chapter, the last in Macrobius' section on cosmography and geography, contains two doctrines which were destined to become leading views in the Middle Ages, namely, an equatorial and meridional Ocean dividing and separating the four inhabited areas, and the so-called *refusiones* underlying the phenomena of the tides.[67]

The first doctrine, which, if it was not originated by Crates himself, is always associated with his name,[68] maintains that the Ocean forms two great circles about the globe, one running around the equator and the other, at right angles to it, separating the eastern and western hemispheres. Macrobius informs us that the "truer bed of the Ocean" is the equatorial one, and that our Ocean, which is generally supposed to be the only one, is really a secondary body. The proof of the existence of an equatorial Ocean is given later as the teaching of natural philosophers: since ethereal fire requires moisture for nourishment, nature placed the broad belt of the Ocean directly beneath the sun's course (2.10.10).[69]

His explanation of the tides, which is also attributed to Crates,[70] is as follows. The main Ocean flowing about the equator divides in the east and west. Great streams issue forth towards the north and south from either extremity. The two turning northwards and the two turning southwards meet at the poles and collide with such impact that a remarkable ebb and flow of the Ocean is produced which is perceived in every basin connected with the Ocean (2.9.2–3).

At this point Macrobius refers to a map, accompanying the text, which was to become the archetype of one of the commonest

[65] Cf. Macr. *Sat.* 5.14.1, 16.5.

[66] *Georg.* 1.245. Cf. Serv. *ad loc.*

[67] On the popularity of the doctrine of an equatorial and meridional Ocean (also held by Mart. Cap.) see Wright, *op. cit.* (see note 2) 18–19, 56, 158–60, 187–88. On the popularity of the *refusiones* see *ibid.* 27, 62, 173, 190, 192–94.

[68] See *RE* s.v. "Krates" 11.1637.

[69] Cf. Cleom. *De Motu Circulari Corporum Caelestium* 1.6.33; Porph. *Antr. Nymph.* 11; Stob. *Eclogae* 526.

[70] See Aetius *Placita* 3.17.7 (Diels, *Doxogr. Gr.* 383).

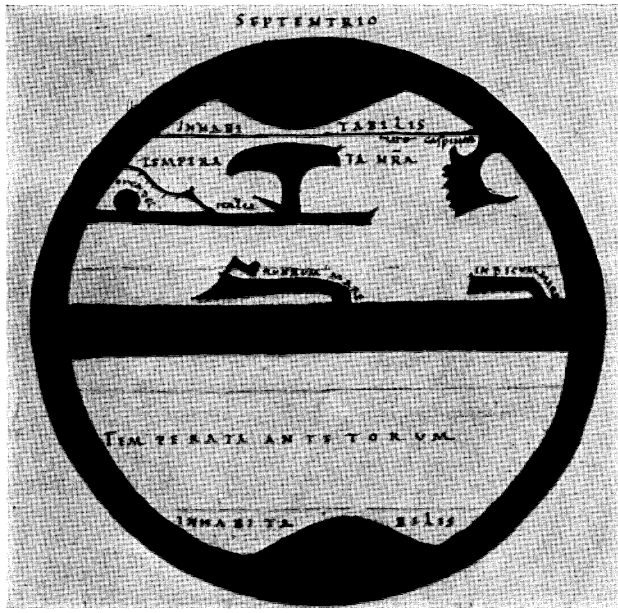


Fig. 1. Macrobius, *Comm. in Somn. Scip.* B. M. Harl. MS. 2772 9th cent. (*Archaeologia*, LXXV, Plate X)

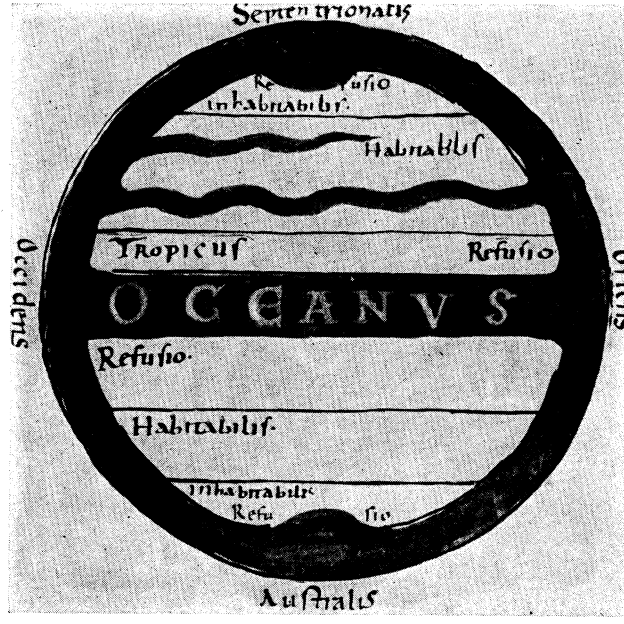


Fig. 2. Macrobius, *Comm. in Somn. Scip.* c. 1100.


Fig. 3. Macrobius, *Comm. in Somn. Scip.* 1485

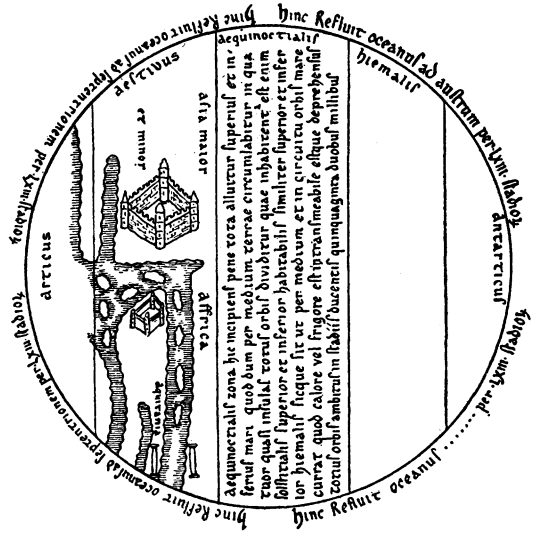


Fig. 4. Beda. c. 1100. (Miller, *Mappaemundi*, III, Fig. 58)

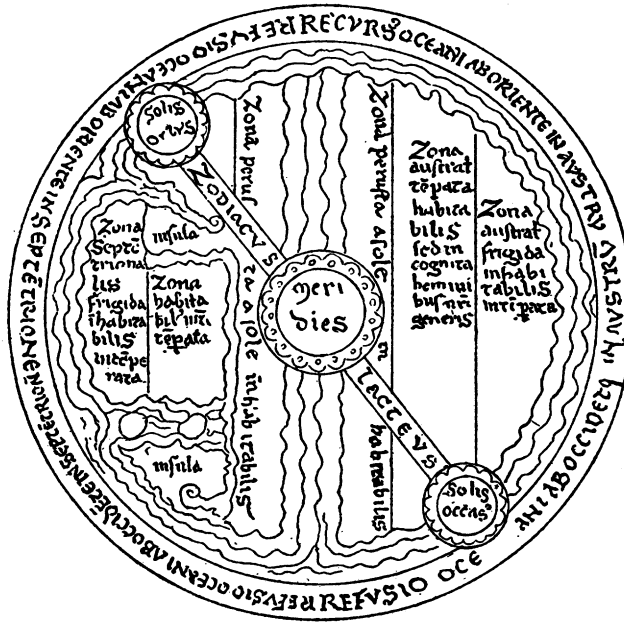


Fig. 5. Lambert of St. Omer, *Liber Floridus*. (*Ibid.*, Fig. 59)

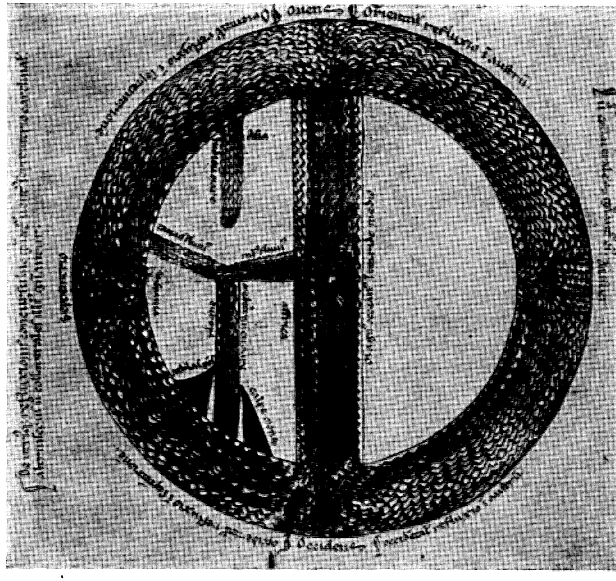

Fig. 6. William of Conches, *Dragmaticon*. Montpellier, Bibl. de l'Université, Cod. H. 145 13th cent. (*Archaeologia*, LXXV Plate IX)

styles of medieval *mappae mundi* cartography.[71] Figures 1 and 2 are facsimiles of MS maps and Figure 3 a facsimile of the map in the 1485 edition, the first printed edition to contain illustrations. The MS facsimiles show the bays at the poles where the meridional streams collide. Figure 2 has the word *refusio* written at the four cardinal points and Figure 3 has statements of the *refusio* doctrine written on the circumference. Figures 4–6 are maps showing Macrobian influence, taken from works by other authors. Figure 4 has the distance from pole to equator, 63,000 stades, written on the circumference, the distance given by Macrobius (2.6.3). From existing copies in the MSS and early printed editions it is to be assumed that the original map was rather crudely drawn. Macrobius calls attention particularly to the source of the Atlantic and the origins of the Red Sea and Indian Ocean. Regarding the age-old question of whether the Caspian is an inland body of water or whether it empties into the eastern Ocean, Macrobius is aware of the lake theory, but his diagram will show where it connects with the Ocean.[72] Still more presumptuous is his assurance that there is a sea corresponding to the Mediterranean in the temperate zone of the southern hemisphere, even though lack of evidence does not permit him to mark it off on the map (2.9.7).[73]

The map will also reveal why the ancients said that our inhabited quarter was like an outspread chlamys.[74] Inasmuch as the tropic is greater than the arctic circle, our zone is contracted as it extends northward (2.9.8).

[71] Wright, *op. cit.* (see note 2) 121–22, lists the Macrobian type first among four groups. See also M. C. Andrews, "The Study and Classification of Medieval Mappae Mundi," *Archaeologia* 75.71.

[72] Hecataeus believed that the Caspian Sea emptied into the eastern Ocean. Herodotus and Aristotle made it a closed body, but Alexander the Great, according to Arr. *An.* 7.16.1–2, had in mind sending a fleet along its shores to settle the question. Strabo revived the Hecataean view. Plin. *Nat.* 6.58 records the remarkable voyage of Seleucus and Antiochus around India into the Caspian. Ptolemy again closed the Caspian but it was frequently reopened thereafter. See H. F. Tozer, *A History of Ancient Geography* (Cambridge, 1897) 367. The ignorance of Macrobius and others regarding the Caspian is not so appalling. Ptolemy represented its long axis as running east and west, and this error persists in maps at least into the seventeenth century.

[73] It appears that the basis for this assumption is the desire to achieve a symmetrical scheme, as seems to be the case with Crates. The Mediterranean (including the Euxine) bisects the western part of the known οἰκουμένη. Possibly the Caspian was regarded as the counterpart on the east.

[74] Popularly known as "Strabo's cloak" although he was not the first to draw the comparison. See Strabo 2.5.6, 14; 11.11.7.