

5586

5586 pdf
COMFORD, F. M.
1923



Mysticism and Science in the Pythagorean Tradition (Continued)

F. M. Cornford

The Classical Quarterly, Vol. 17, No. 1. (Jan., 1923), pp. 1-12.

Stable URL:

<http://links.jstor.org/sici?sici=0009-8388%28192301%291%3A17%3A1%3C1%3AMASITP%3E2.0.CO%3B2-J>

The Classical Quarterly is currently published by The Classical Association.

T. 1 ~~Pythagorean~~ MYSTICISM AND SCIENCE IN THE PYTHAGOREAN
TRADITION
(2)

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/about/terms.html>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/journals/classical.html>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is an independent not-for-profit organization dedicated to and preserving a digital archive of scholarly journals. For more information regarding JSTOR, please contact support@jstor.org.

THE CLASSICAL QUARTERLY

JANUARY, 1928.

MYSTICISM AND SCIENCE IN THE PYTHAGOREAN TRADITION.

(Continued from Vol. XVI., p. 150.)

WE can now approach the interpretation of the famous symbol called the *Tetractys* or *Tetrad*, which is a compendium of Pythagorean mysticism. The tetractys is itself a system of numbers. It symbolizes the 'elements of number,' which are the elements of all things. It contains the concordant ratios of the musical *harmony*. It might well be described in the Pythagorean oath as 'containing the root and fountain of everflowing Nature.' In one of the *acousmata* preserved in Iamblichus it is identified with the cosmic *harmony*.¹ It was also called *κόσμος, οὐρανός, πᾶν*.² Theon says it was held in honour because it contained the nature of the universe.³

The tetractys, also called the Decad, consists of the first four integers ($1 + 2 + 3 + 4 = 10$), represented in the old fashion by pebbles or dots arranged in an equilateral triangle . It 'represents all the consonances,' in the sense that these four numbers are those which occur as terms in the concordant ratios discovered by Pythagoras in the musical scale. It is 'perfect,' and 'embraces the whole nature of number,' because all nations count up to ten and then revert to one; all the other numbers are obtained by repetition of the decad.⁴ Further, the component numbers symbolize the 'elements of number.'

'It is clear,' says Aristotle,⁵ 'that the Pythagoreans regard number both as the matter of things and as their properties and states. The elements of number are the even and the odd, of which the even is unlimited, the odd limited. The One (or Unity) consists of both, for it is both odd and even. Number (proceeds) from the One, and numbers, as has been said, are the whole Heaven.'

¹ Iambli. V.F. 82 *τί ἐστι τὸ ἐν Δελφοῖς μαντεῖον*; *τετρακτύς, ὅπερ ἐστὶν ἡ ἁρμονία ἐν ᾗ αἱ Σειρήνες*. Diels, *Vors.*³ 45c 4.

² Plut. *Is. et Os.* 75.

³ Theon Smyrn. π. *τετρακτύς*, 154 (ed. Dupuis).

⁴ Ar. *Met.* A 5, 986a 8. Aet. I. 3. 8. Hippol. Ref. VI. 23. Ten is the perfect number to Pythagoras, τὰ γὰρ ἑνδεκα καὶ δώδεκα προσθήκη

καὶ ἐπαναποδισδρὸν τῆς δεκάδος, οὐκ ἄλλου τινὸς ἀριθμοῦ γέννησιν τὸ προστιθέμενον.

⁵ *Met.* A 5, 986a 15. Τοῦ δὲ ἀριθμοῦ στοιχεῖα τὸ τ' ἄρτιον καὶ τὸ περιττόν (τούτων δὲ τὸ μὲν ἀπείρουν, τὸ δὲ πεπερασμένον), τὸ δ' ἐν ἐξ ἀμφοτέρων εἶναι τούτων (καὶ γὰρ ἄρτιον εἶναι καὶ περιττόν). τὸν δὲ ἀριθμὸν ἐκ τοῦ ἐνός, ἀριθμοῦς δὲ, καθάπερ εἴρηται, τὸν δλον οὐρανόν.

This obscure statement can be interpreted with the help of other authorities.

First, there is the identification of the Even with the Unlimited, the Odd with the Limited, or Limit.¹ Euclid's definitions of Even (Book VII., *def.* 6 ἄρτιος ἀριθμὸς ἐστὶν ὁ δίχα διαιρούμενος) and Odd (*def.* 7 περισσὸς δὲ ὁ μὴ διαιρούμενος δίχα) seem to be derived from the Pythagorean definitions given by Aristoxenus:² τῶν δὲ ἀριθμῶν ἄρτιοι μὲν εἰσιν οἱ εἰς ἴσα διαιρούμενοι, περισσοὶ δὲ οἱ εἰς ἄνισα καὶ μέσον ἔχοντες. Plutarch explains further: 'Since even numbers start with 2, odd numbers with 3, and 5 is generated by the combination of these, 5 has rightly received honour as the first product of first principles, and has been named 'Marriage,' because the even is like the female, the odd like the male. For when numbers are divided into equal parts, the even is completely parted asunder, and leaves within itself as it were a receptive principle or space, whereas, when the odd is treated in the same manner, there is always left over a middle (μέσον), which is generative (γόνιμον).'³ And again, 'when numbers are equally divided, in the uneven number a unit is left over in the middle, while in the even there is left a masterless and numberless space, showing that it is defective and imperfect.'⁴

Thus the Dyad, as the first even number, stands for the female receptive field, the void womb of unordered space, the evil principle of the Unlimited. The Triad is its opposite, the good principle of Limit, the male whose union with the Unlimited produces the Limited. As Aristotle says:⁵ 'The Universe and all things (in it) are limited or determined by three' (the Triad). The numbers 5 ($2 + 3$) and 6 (2×3) are both symbols of the marriage of Even and Odd, Unlimited and Limit.

Such are the two opposite 'elements of number' and of all things. In the Monad they are not yet differentiated; it 'consists of both,' is both odd and even, or, in mythical language, male and female (ἄρσενόθηλυς), like the Orphic Phanes. The Monad, so conceived, is not the first in the series of numbers; indeed, it is not a number at all, but ἀρχὴ ἀριθμοῦ.⁶ It is the

¹ *Met.* A 5, 990a 8, has πέρας (not πεπερασμένον) and ἀπειρον as the equivalents of περιττόν and ἄρτιον. Πέρας (περαῖον, Philolaus) is correct.

² Diels, *Vors.*³ 45 B 2, who compares *Ar. Met.* M 8, 1083b 28, ἐν αὐτῇ τριάδι αὐτῇ (μονάδες) πῶς; μία γὰρ περιττή. ἀλλὰ διὰ τοῦτο ἴσως αὐτὸ τὸ ἐν ποιοῦσιν ἐν τῷ περιττῷ μέσον. For explanations and other definitions see Heath, *The Thirteen Books of Euclid's Elements* (1908), Vol. II., p. 281. The curious and unique use of ἰσοκελῆς = ἄρτιος and σκαληνός = περιττός in Plato *Euthyphron* 12 D may be explained by the diagrams ·|·, ·|·, ·|·, etc., and ·|·, ·|·, ·|·, etc., which show even numbers when divided as 'equal-legged,' odd numbers as having one leg longer than the other.

³ *de E. ap. Diels*, 388 A. On this subject see W. A. Heidel, πέρας and ἀπειρον in the Pythagorean philosophy, *Arch. Gesch. Phil.* N.F. VII. 384.

⁴ Plutarch (Diels, *Dox.* 96) ap. Stob. *Ecl. Phys.* I. 1. 10, p. 22, Wachsmuth.

⁵ *Ar. de caelo* I. 1. 268a 10 καθάπερ φασὶ καὶ οἱ Πυθαγόρειοι, τὸ πᾶν καὶ τὰ πάντα τοῖς τρισὶν ὀρίσται· τελευτὴ γὰρ καὶ ἀρχὴ τὸν ἀριθμὸν ἔχει τὸν τοῦ παντός, ταῦτα δὲ τὸν τῆς τριάδος. Aristoxenus (Stob. I. 1 pr. 6) οὕτως ἐν περισσοῖς ἡμέραις αἱ κρίσεις τῶν νοσημάτων γίνεσθαι δοκοῦσιν καὶ αἱ μεταβολαί, ὅτι ὁ περιττός καὶ ἀρχὴν καὶ τελευτὴν καὶ μέσον ἔχει, ἀρχῆς καὶ ἀκμῆς καὶ παρακμῆς ἐχόμεναι. This sounds primitive.

⁶ Aristoxenus ap. Stob. I. 1 pr. 6. Diels, *Vors.*³ 45 B2.

original undifferentiated unity, from which emerge the two opposite principles Limit and Unlimited, the elements of number and of all things.

In this interpretation of the Monad in the tetractys I have taken the view that the Monad is prior to, and not a resultant or product of, the two opposite principles, Odd or Limit, and Even or Unlimited.¹ In favour of this view the position of the Monad at the head of the tetractys seems to be decisive. As Theon, discussing the properties of the numbers in the tetractys, says: ἡ μὲν γὰρ μονὰς ἀρχὴ πάντων καὶ κυριωτάτη πασῶν . . . καὶ ἐξ ἧς πάντα, αὐτὴ δὲ ἐξ οὐδενός, ἀδιαίρετος καὶ δυνάμει πάντα, ἀμετάβλητος, μηδεπώποτε τῆς αὐτῆς ἐξισταμένη φύσεως κατὰ τὸν πολλαπλασιασμόν (i.e. $1^n = 1$).² This view has also the advantage that it brings the Pythagorean scheme of thought into line with the other early systems, both mythical and scientific. The abstract formula which is common to the early cosmogonies is as follows: There is (1) an undifferentiated unity. (2) From this unity two opposite powers are separated out to form the world order. (3) The two opposites unite again to generate life. This formula is stated clearly by Melanippe the Wise (Eurip. frag. 484 N²): 'The tale is not mine; I had it from my mother: (1) that Heaven and Earth were once one form, and (2) when they had been sundered from one another, (3) they gave birth to all things and brought them up into the light, trees, and winged things, and creatures that the salt sea breeds, and the race of mortal men.'³ The same formula, stripped of the mythical imagery of sex, fits the cosmogony of Anaximander. He has (1) the primal undifferentiated ἀπειρον, containing in complete fusion the opposites which are to be separated out of it;⁴ (2) the separating out of these opposites in two pairs—first the Hot (fire) and the Cold (air), and later the Wet (water) and the Dry (earth)—to form the world order; (3) the reunion of the opposites (conceived, not as marriage, but under the alternative symbol of the warfare and aggression of the opposite powers invading one another's provinces unjustly) to form those temporary combinations which are living things. The Pythagorean Monad similarly symbolizes the primal undifferentiated unity, from which the two opposite principles of Limit (physically, light or fire) and the Unlimited (space, air, 'void') must, in some unexplained and inexplicable

¹ Hence in the above passage from Aristotle (*Met.* A 5, 986a 19) I translate τὸ δὲ ἐν ἐξ ἀμφοτέρων εἶναι τούτων 'the One consists of both of these' (odd and even), not (with Ross, e.g.) 'the 1 proceeds from both of these.' [So Alexander (on 985b 26, p. 30, 16 Bz.): τῶν δὲ ἀριθμῶν τὴν μονάδα ἀρχὴν εἶναι, σὺ γὰρ κείμενη ἐκ τε τοῦ ἀρίθμου καὶ περιττοῦ· εἶναι γὰρ τὴν μονάδα ἀμα ἀριθμοειρήντων, ὅ ἐδεικνυν διὰ τὸ γεννητικὴν αὐτὴν εἶναι καὶ τοῦ περιττοῦ καὶ τοῦ ἀρίθμου ἀριθμοῦ]. It is true that 'proceeds' is appropriate to the following words, τὸν δ' ἀριθμὸν ἐκ τοῦ ἐνός, but in any case the relation here expressed by ἐκ cannot be the same as in ἐξ ἀμφοτέρων εἶναι. It may, however, be doubted whether Aristotle himself clearly understood.

² Ed. Dupuis (1892), p. 164.

³ Cf. Apoll. Rhod. I. 494, 'Ορφεύς . . . θείδεν δ' (1) ὡς γαῖα καὶ οὐρανὸς ἡδὲ θάλασσα | τὸ πρὶν ἐπ' ἀλλήλοισι μὴ συναρρηρότα μορφή | (2) νεῖκεος ἐξ ὀλοοῦ διέκριθεν ἀμφὶ ἕκαστα· | ἡδ' ὡς ἐμπεδον αἰὲν ἐν αἰθέρι τέκμαρ ἔχουσιν | δόστρα σελήνηαί τε καὶ ἡελίοιο κελαινοί· | οὐρεὰ θ' ὡς ἀνέτειλε, καὶ ὡς ποταμοὶ κελάδοντες | αὐτῆσιν νόμφησι (3) καὶ ἐρπετὰ πᾶσι· ἐγένοντο. For the separation of Father Heaven and Mother Earth out of a primal unity and their subsequent marriage see Tylor, *Primitive Culture*⁴ (1903) I. 325 (parallels from New Zealand, China, etc.), and A. Grimble, *Myths from the Gilbert Islands*, Folklore xxxiii. (1922), 91 ff.

⁴ So Aristotle, *Phys.* a 4, 187a 20, οἱ δὲ ἐκ τοῦ ἐνός ἐποῦσα τὰς ἐναντιότητας ἐκκρίνεσθαι, ὥσπερ Ἀναξίμανδρος φησι.

way, be derived. The union of the two opposites, as Plato explains in the *Philebus*, generates τὸ μικτόν, when 'the equal and the double and whatsoever puts an end to the mutual disagreement of the opposites, by introducing symmetry and concord, produce number' (25 D).

The parallel with Anaximander suggests that, for the interpretation of the fourth number in the tetractys, we may use the identification of 4, as the first square number, with Justice.¹ In the third stage of the cosmogonical formula above stated, the combination of the sundered opposites to generate life is represented in mythical terms either as a marriage or as a warfare. In the Euripides fragment we have the immemorially ancient symbolism of the marriage of Heaven and Earth, mediated (in the Orphic cosmogony, as in Hesiod) by Eros or Phanes, and, in physical terms, by the rain, the seed of the Sky-father.² The marriage symbol is appropriate to the elemental forms arranged in concentric regions in the order of space. The two extreme elements, heavenly fire and earth, are united by the intermediate element, water or 'air' (mist, etc.) or τὸ μεταξύ. The alternative symbol of warfare, on the other hand, fits the same elemental forms (Hot, Cold, etc.), conceived rather as the seasonal powers in the order of time, in which each prevails successively and yields in turn to its antagonist.³ The principle of justice is preserved by this balanced alternation of advance and retreat. As Anaximander says, 'Things pay to one another the penalty of their injustice according to the order of time.' Now it can hardly be accidental that in the Pythagorean number-symbolism, after the undifferentiated Monad and the numbers 2 and 3 representing the opposites, female and male, the next two numbers, 4 and 5, symbolize Justice and Marriage. Justice, τὸ ἀντιπεπονθὸς ἄλλω, according to the law of Rhadamanthys,⁴ completes the tetrad, and assures that the opposite tensions of the contraries shall be held together in harmony.⁵ It is easy to see why later authorities also identify the square number with φιλία.⁶

Such is the meaning of this extraordinary symbol, the tetractys, which both contains the elements of number and of all things, and, as 'the fountain of everflowing Nature,' symbolizes also the evolution of the many out of the One, the cosmogonical process. How was this process conceived?

We have hardly any information about the earliest Pythagorean cos-

¹ [Ar.] *M. Mor.* α 1. 1182a 11, ἡ δικαιοσύνη ἀριθμὸς ἰσάκεις ἴσος. This interpretation of 4 in the *Decad* occurs in a Paris MS. published by Delatte, *Études sur la lit. Pyth.* p. 167, ἡ τετρίψ δικαιοσύνη διὰ τὸ ἰσάκεις ἴσος.

² Aesch. *Danaïds* 44, Νῆ, ἐρῶ μὲν ἀγνὸς οὐρανὸς πρῶτα χθόνα, | ἔρως δὲ γαῖαν λαμβάνει γάμου τυχεῖν· | δμβρος δ' ἀπ' εὐνατήρος οὐρανοῦ πεσὼν | ἔδενσε γαῖαν· ἡ δὲ τίκεται βροτοῖς | μῆλων τε βοσκάς καὶ βίον Δημήτριον.

³ Cf. Empedocles 17. 26 of his elements: ταῦτα γὰρ ἰσά τε πάντα καὶ ἡλικά γένναν ἔασι, | τιμῆς δ' ἄλλης ἄλλο μέδει, πάρα δ' ἦθος ἐκάστω, | ἐν δὲ μένει κρατέουσι περιπλομένοιο χρόνῳ. Alex. Poly-

histor ap. Diog. L. VIII. 26 (Pythagorean doctrine): ἰσομοιρά τ' εἶναι ἐν τῇ κόσμῳ φῶς καὶ σκότος, καὶ θερμὸν καὶ ψυχρὸν καὶ ξηρὸν καὶ ὑγρὸν· ὧν κατ' ἐπικράτειαν θερμοῦ μὲν θέρους γίνεσθαι, ψυχροῦ δὲ χειμῶνα, ξηροῦ δ' ἔαρος, καὶ ὑγροῦ φθινόπωρον. ἔαν δὲ ἰσομοιρῇ, τὰ κάλλιστα εἶναι τοῦ ἔτους . . .

⁴ Ar. *E.N.* E 5, 1132b 21.

⁵ Cf. Plato's description of δικαιοσύνη above quoted (Vol. XVI., p. 147).

⁶ Alex. on Ar. *Mct.* 987a 9 (p. 36, 18 Bz). The saying φιλότης ἰσότης is attributed to Pythagoras by Iambli. *V.P.* 162 and Porphyry *V.P.* 20 (probably following Timaeus, Delatte, *Études sur la lit. Pyth.* 253).

mogony. Pythagoras was the discoverer of the world of mathematics, which was to be conceived later as a supersensible world of concepts related in an infinite system of eternal truths—a timeless world in which no change or process can occur, and which is unaffected by the existence, becoming, or perishing of any sensible thing. But Pythagoras was still far from realizing the nature of this new world of thought. To him numbers and their relations were not only invested with a halo of divine and mysterious properties, but were also implicated in the sensible world, serving as the substructure of reality within that world and occupying space. He could not yet distinguish clearly between a purely logical ‘process’ such as the ‘generation’ of a series, and an actual process in time such as the generation of the visible Heaven, which ‘is *harmony* and number.’ The cosmogonical process was thus confused with the generation of numbers from the One, and will appear to us as a transcription of this (really logical) process into physical terms. The physical system will be determined by the way in which the generation of numbers is conceived. It was at this point, I believe, that the two schools of Pythagoreans—the original sixth-century mystics and the fifth-century mathematicians—parted company. They took very different views of the nature of the Monad, and consequently of the generation of numbers and things.

We have seen how, in the primitive symbolism of the tetractys, the Monad was the divine,¹ all-inclusive unity, containing both the opposites, male and female, Limit and Unlimited. According to the old cosmogonical scheme, from the undifferentiated unity emerge the two opposite principles, and these are recombined to generate determinate (limited) things—the series of numbers and the things which represent or embody (*μυεῖσθαι*) numbers. Thus any determinate thing will, like the Orphic soul, contain both principles, good and evil, light and darkness.

How this process was construed in physical terms is obscure. The Unlimited was evidently the unmeasured field of space, which, though called ‘the void,’ was filled by ‘air,’ the circumambient envelope of the limited Heaven, the breath of the living world. It is the primeval ‘Night’ of the Orphics. The opposite principle of Limit is manifest to sense as light or fire. The product of the two principles is the cosmos or Heaven. As the unlimited range of musical sound is marked off by consonant numbers into the definite intervals of the musical scale, so the blank field of darkness is marked off by those boundary points of heavenly light, sun, moon, and planets, whose orbits (still conceived as material rings) are set at musical intervals to form the celestial *harmony* or scale, bridging and binding together the visible order from earth at the centre to the outermost sphere of the fixed stars. How this

¹ I agree with O. Gilbert (*Arch. Gesch. Phil.* XXII. 153) against Zeller that to the mystical Pythagoreans the Monad was God (Aetius I. 3. 8).

majestic order was evolved we cannot say. There is no sign that the earliest Pythagoreanism went further.¹

The geometrical character of Pythagorean arithmetic must, of course, not be forgotten. Indeed, we are told that Pythagoras identified geometry with science (*ιστορία*) in general.² In the unlimited darkness of night all objects lose to the eye their colours and shapes; in the daily renewed creation of the dawn of light they resume their distinct forms, their surfaces and colours (*χροία* in Pythagorean language means both). Thus in the physical world light, the vehicle of knowledge, acts as a limiting principle, which informs the blank darkness with bodies bounded by measurable planes and distinguished by all the varieties of colour. A body is thus a visible thing in which two opposite principles meet—the Unlimited (darkness, 'air,' void, space) and Limit, identified with the coloured surface (*εἶδος, ἰδέα, μορφή, σχῆμα*). True to its mathematical character, Pythagoreanism tends to conceive a sensible body as essentially a geometrical solid, whose surfaces are ultimately reducible to numbers and their relations. It is the mode of conception applied in Plato's *Timaeus* to the atoms of the four elements. In this way things 'represent' numbers.

Now in this system of thought the most obscure and inexplicable moment is the evolution, out of the primal unity, of the two opposite principles, the elements of number and of all things.³ The lucid and logical mind of Parmenides fastened upon this point. He accepted the premisses (ultimately dictated by religious preconceptions) that Limit, Unity, Rest are good, and therefore attributes of the real. But, with a logic that seemed unanswerable, he exposed the latent contradiction in sixth-century Pythagoreanism, which had sought to combine these monistic premisses with a dualistic system of Nature.⁴ If the real is indeed one, Nature cannot be a battle-ground of two opposite powers, good and evil, light and darkness, equally real. If the one is at rest—motionless and immutable—it cannot become two, and then many; it must always be one. Plurality, becoming, motion, and change must be in some way unreal. We must choose between monism and dualism.

Parmenides' own choice is not that of a man of science, prepared to accept and explain the obvious facts presented by the natural world. His preference for unity, rest, limitation (perfection), can be ultimately explained only by the value, and consequent reality, ascribed to these conceptions as divine attributes. Rather than surrender these attributes, he is prepared to set

¹ Aristotle's obscure remark as to the Pythagorean *κοσμοποιία* (*Mét.* N. 3 1091a 12) refers, I believe, to the later system of Number-atomism discussed below, see p. 9. At 990a 8 Aristotle remarks that, though the Pythagoreans *γεννώσι τὸν οὐρανόν*, they have no explanation how there is to be motion when only Limit and Unlimited or Odd and Even are posited.

² Iambli. *V.P.* 89 *ἐκατέτο δὲ ἡ γεωμετρία πρὸς Πυθαγόρου ἱστορία*.

³ Later mysticism regards the emergence of the Dyad as an act of rebellious audacity: *Theol.*

Arith. II. 10 *πρώτη γὰρ ἡ διὰς διεχώρισεν αὐτὴν ἐκ τῆς μονάδος, ὅθεν καὶ τόλμα καλεῖται*. So Plotinus, *Enn.* V. 1. 1, ascribes the fall of the soul to *τόλμα*. Proclus on Plato, *Alcib.* I. 104 *ε* attributes this use of *τόλμα* to the Pythagoreans.

⁴ Simplicius, *Phys.* 181 (quoting Eudorus): 'According to their highest teaching we must say that the Pythagoreans hold the One to be the principle of all things; according to a secondary teaching (*δευτέρος λόγος*) they hold that there are two principles of created things, the One and the nature opposed to it.'

all common sense at defiance. Hence it is in the Eleatic school that the distrust of the senses, so immensely important in later thought, first emerges. This doctrine was indeed latent in the other-worldliness of the Pythagorean type of religion, in the condemnation of the body as a dark prison hiding the light of truth from the soul. Like the appetites, the senses were regarded as bodily and inseparably connected with pleasure, which ascetic religion suspects and denounces. But the philosophic conclusion that the senses are false witnesses to the external reality they profess to show us was new. It was destined to lead, later on, to the scepticism of the Academy. Thus the first parent of scepticism was not science, but religion.

Here, however, we are not concerned with these developments, but only with the light thrown by Parmenides' criticism upon the character of the original Pythagorean system. The first part of his poem leaves the divine Monad incapable of generating a pair of opposites, and through them the world of appearances. The second part contains a cosmogony on the traditional lines, vitiated by its dualism. In neither part is there any trace of the pluralist system next to be considered.

II. THE SCIENTIFIC SYSTEM, NUMBER-ATOMISM.

The logic of Parmenides laid in ruins both the great sixth-century systems—the Milesian and the Pythagorean—and indeed denied *a priori* any possible cosmogony. The science of Nature, as then conceived, could not advance a step until some answer had been found, and the remaining presocratic systems were contrived in order to restore to the real world plurality and motion. The pure Ionian tradition found, in the next generation, a leader in Anaxagoras, the typical man of science. Between the Ionian and Italian traditions, Empedocles, in the same generation, tried to effect a compromise by reconstructing the system of Anaximander in such a way as, first, to accommodate the propositions Parmenides seemed to have established; and, secondly, to provide a scheme of the world's becoming and perishing in conformity with transmigration and all that it implies. It is antecedently probable that the representatives of the pure Italian tradition—the Pythagoreans themselves—would also seek and find an answer. I believe that this answer was provided by the scientific wing of the school, the 'mathematicians,' in the doctrine I have called 'Number-atomism.'

The existence of such a doctrine in the generation after Parmenides is proved by the critical arguments of Zeno. Zeno did not, like Parmenides, attack the dualistic doctrine of two opposite forms, or the inconsistency of this doctrine with monistic premisses. His criticism is directed solely against the pluralist view that a manifold world and motion, denied by Parmenides, can be restored by regarding the real as composed of a plurality of units or monads moving in space. He deduces the absurdity of the hypothesis *εἰ πολλά ἔστιν* in that sense. This is not the hypothesis of primitive Pytha-

goreanism, nor yet the developed atomism of Leucippus. It appears to be an inchoate form of atomism, a reinterpretation of the doctrine of numbers, designed to obviate Parmenides' criticism.

Most of Aristotle's allusions to the doctrine of 'the Pythagoreans' refer to this system. At *Met. M.* 6, 1080b 16, for instance, he attributes to them the theory that (1) there is only one kind of number—namely, mathematical number. (2) This number does not exist separately, but sensible substances are composed of it; indeed, the Pythagoreans construct the whole Heaven of numbers. (3) These numbers do not consist of abstract units, but the units are conceived as having spatial magnitude. (4) They are described as 'indivisible magnitudes' (*ἄτομα μεγέθη*, 1083b 13). (5) Things (*τὰ ὄντα*) or bodies (*σώματα*) are identified with numbers composed of these indivisible magnitudes or monads; 'at any rate, they apply their propositions to bodies as if they consisted of those numbers' (1083b 12 sqq.). (6) The Pythagoreans regarded numbers as generated—the process of generation being, of course, identical with the physical generation of the sensible world (1091a 17 sqq.).

My contention is that the theory here outlined is not merely not identical with the mystical doctrine reconstructed in the earlier part of this paper, but cannot be reconciled with it. It proceeds from a totally different conception of what is meant by the 'monad,' and of the way in which numbers are generated from it. In the old mystical system the Monad, standing at the head of the tetractys, was the primal all-inclusive unity, both male and female, from which the elements of number, Limit and Unlimited, proceeded before they reunited to generate numbers. Deprived of the mysterious power of generating plurality, this Monad becomes the One Being of Parmenides. It is obviously unique. Numbers cannot consist of a plurality of such units (*πλήθος μονάδων*) merely added together. Numbers are not obtained in that way, but by the union of the Limit and the Unlimited. But now this whole conception of the generation of numbers has been destroyed by Parmenides' logic. The 'mathematicians' with a scientific turn of mind, indifferent to the obscure symbolism of the tetractys and to the religious premisses of the founder's system, accept Parmenides' criticism of it. The Monad, the 'beginning of number,' is divested of its mystical properties. Let it be simply an indivisible unit. There is then nothing to prevent our supposing the existence of an indefinite plurality of such units, and saying that any number is simply a *πλήθος μονάδων*.

On this view, any number is a 'finite plurality' or 'collection of units.'¹

¹ Nicomachus 1, 7, 1 combines several definitions of number: (1) *πλήθος ὠρισμένων* (cf. *Ar. Met.* 1020a 13 *πλήθος τὸ πεπερασμένον*); (2) *μονάδων σύστημα* (cf. *Ar.* 1053a 30 *πλήθος μονάδων*; 1039a 12 *σύνθεσις μονάδων, ὥστερ λέγεται ὑπὸ τινων*; 207b 7 *ἐνα πλεῖω*); (3) *παστέππος χύμα ἐκ μονάδων συγκείμενον* (cf. *Moderatus ap. Stob. Ecl.* 1. 1, pr. 8 *συστήμα μονάδων, ἢ προποδισμὸς πλήθους ἀπὸ μονάδος ἀρχόμενος καὶ ἀναποδισμὸς εἰς μονάδα καταλήγων*).

So also Theon Smyrn. p. 28, Dupuis). Euclid, Book VII. def. 2, has only *τὸ ἐκ μονάδων συγκείμενον πλήθος*. (So Aristoxenus, Diels, *Vors.* 3 45 B 2). The first of the above definitions, *πλήθος ὠρισμένων*, is given as the view of Eudoxus the Pythagorean by Iamblichus (*Comm. on Nicom.* Pistelli, p. 10), who contrasts it with the second, *μονάδων σύστημα*, which he attributes to Thales, following the Egyptian view. It may be sug-

For the process by which numbers are generated we find the expressions 'flow of quantity' (χύμα ποσότητος) and 'progression of multitude from a unit and retrogression of multitude ceasing at a unit.' These are objective terms for the subjective processes of adding and subtracting. Thus Theon, after giving the second of the above definitions, proceeds: 'A unit is a limiting quantity (περαίνουσα ποσότης)—a principle or element of numbers—which, when the multitude is diminished by subtraction (κατὰ τὴν ὑφαίρεσιν), is deprived of all number and takes an abiding position (μονήν) and rest. For the division (τομή) cannot proceed further; for even if we divide one sensible thing into parts, that which was one will become again a multitude or many, and, by subtraction of the parts, one by one, will end in unity. So the one, as one, is without parts and indivisible.' We should say that any number can be obtained by adding one monad to another as often as is required; but the early Pythagorean mathematicians must have confused the generation of numbers with a real process that occurred in time and space, and was identical with the generation of the cosmos containing sensible bodies, which actually *were* numbers. This seems to follow clearly from the passage of Aristotle already quoted (1091a 13 sqq.), where he adds that it is impossible to doubt that the Pythagoreans believed in a generation of numbers, thereby committing the absurdity of holding a becoming of things which are really eternal. 'For their language is clear when they say that when the one' (i.e. 'the first unit having magnitude,' 1080b 20) 'had been constructed, whether out of planes or of surface or of seed or of some (elements) they cannot describe, immediately the nearest part of the Unlimited began to be constrained and limited by the Limit. Since, however, they are describing the construction of the cosmos and mean what they say in a physical sense,' their opinions need not be further examined here, but belong to physics.

It seems clear from this passage that the Pythagoreans had not yet reached the position of fully developed atomism, which postulates an indefinite plurality of atoms or monads as an ultimate and eternal fact. Such a plurality seems to be required if sensible bodies are to be built of monads or indivisible magnitudes, as they were in both systems. A body is a collection of monads, σύστημα μονάδων, and so a number. But is there any sense in which one of the monads composing bodies—a 'first unit'—can be regarded as prior to, or generating, the collection? For atomism, no; but the Pythagoreans confused the physical process with the so-called 'processes' of arithmetical generation and geometrical construction. They had not faced the question which puzzled Socrates: how one and one can 'become' two διὰ πρόσθεσιν, or how σχίσιν can be the cause of one becoming two (*Phaedo* 97 A). Aristotle's mention of 'seed' (σπέρμα) suggests that their thought was governed by the analogy

gested that πλῆθος ὠρισμένον or πεπερασμένον goes back to the characteristically Pythagorean conception of number as the product of the union of πῆρας and ἀπειρον; whereas σύστημα μονάδων is

the crude, and so to say materialistic, view which may well have been shared by the Egyptians and the Pythagorean mathematicians or number-atomists now under consideration.

of the growth of the living body from its 'seed' or 'root': both terms are applied elsewhere to the monad as the principle of number.¹ If the cosmos is a living creature, naturally it also would grow from a seed. This growth is again confused with the generation of the solid by the 'flowing' of the point into a line, of the line into a surface, of the surface into a solid. The first or minimum solid is the pyramid,² which is composed of four points having magnitude, and has four equal triangular faces. This could readily be identified with the atom of fire, the sensible manifestation of the principle of the Limit. So we reach Aristotle's alternative suggestion that the original unit was perhaps 'constructed of planes or surface.' The doctrine, mentioned by Aristotle (*de caelo* III. 5, 304a 7), that Fire is the *only* element and has the pyramidal form must be Pythagorean,³ though how it is related to Number-atomism we cannot say.

On the whole we are left with the impression of an atomistic type of cosmology struggling to free itself from mythical analogies and elementary confusions of thought. It is obvious that a theory of this kind would be immediately suggested by the practice of representing numbers by pebbles or counters arranged in geometrical patterns. The pebbles may stand for a sort of magnified atoms; the space or 'field' (χώρα) between them is analogous to the void. By adding unit to unit a solid body of any size and shape can be constructed. With this simple materialistic conception of a plurality of monads, the old mystical derivation of the world and its harmony from the divine Monad and the 'elements of number' disappears, and with it go all the religious notions of the harmony of warring opposites, good and evil, the correspondence of macrocosm and microcosm, and the ideal of the imitation of God. The real is reduced to discrete quantity with the single purpose of restoring plurality and motion.

Aristotle himself draws attention to the two diverse ways of making numbers 'the causes of substances and being,' which, in my view, are characteristic of the two different schools of Pythagoreans. At *Met.* N. 5, 1092b 8, he remarks that 'it has not been clearly distinguished in which of two ways numbers are the causes of substances and being—whether (1) it is as *terms* (ὅροι), as points are of spatial magnitudes (as Eurytus used to decide what was the number of what—e.g. of man or of horse—by representing the forms of living things with pebbles, as some people bring numbers into the

¹ Plutarch (*Stob. Ecl.* I, pr. 2), ἡ μονὰς γονὴ ὑπὸ Τιμαίου τοῦ Λοκροῦ προσαγορεύεται, ὡς ἀρχουσα τῆς τῶν ἀριθμῶν γενέσεως. *Hermes* (*Stob. Ecl.* I. 10. 15), ἡ γὰρ μονὰς, οὕσα πάντων ἀρχὴ καὶ ῥίζα, ἐν πᾶσιν ἐστὶν ὡς ἀν. ῥίζα καὶ ἀρχή. Cf. also *Ar. Met.* N 5, 1092a 23, τίνα τρόπον ὁ ἀριθμὸς ἐστὶν ἐκ τῶν ἀρχῶν . . . (32) ἀλλ' ὡς ἀπὸ σπέρματος; ἀλλ' οὐχ οἷον τε τοῦ ἀδιαίρετου τι ἀπελθεῖν. Theon (p. 158, Dupuis), ἔκτε δὲ (τετρακτὶς) τῶν φυομένων. τὸ μὲν σπέρμα ἀνάλογον μονάδι καὶ σημεῖω.

² Speusippus (*Theol. Arith.*, p. 61 sqq.; Diels,

*Vors.*³, p. 304, 19), ἐν τε ἐπιπέδοις καὶ στερεοῖς πρῶτά ἐστι ταῦτα στιγμή, γραμμή, τρίγωνον, πυραμῖς.

³ There is no evidence for attributing more than πῦρ ἀρχή to Hippiasus, though the story (countenanced by Heath, *Greek Mathematics*, I. 160) connecting his name with the construction of a regular solid may be recalled. Simplicius, *ad loc.*, does not know to whom to attribute the doctrine mentioned by Aristotle.

figures of triangle or square). Or (2) is it that concord (ἡ συμφωνία) is a *ratio* (λόγος) of numbers, and so is man and everything else?' As an example of the latter view he instances Empedocles' λόγος τῆς μίξεως, and objects that, on this view, it is the ratio itself (e.g. 3 parts of fire to 2 parts of earth) that is the essence, whereas the number is 'matter.' I believe that this second view is the original Pythagorean doctrine, according to which things *embody* or *represent* (μιμεῖται) numbers, not *are* numbers; and the soul, as the essential reality, is a ratio or harmony, not a mere collection of monads. The other is the crude materialistic view of Number-atomism that things *are* numbers, and numbers consist of monads, which are the terms or boundary-stones (ὅροι) marking out the void 'field' (χώρα) in the geometrical patterns of numbers 'figured' by pebbles.¹

The doctrine that the soul is either a *harmony* or a λόγος τῆς μίξεως is also foreign to this system. We should expect to find in it a materialistic conception of the soul approximating to the Atomists'. The soul can be nothing but a set of monads, and its chief function would be to cause motion. Now, among the philosophers who say that soul is primarily τὸ κινεῖν, Aristotle mentions first the Atomists, with their soul consisting of spherical atoms or fire, and then remarks that certain Pythagoreans² held a doctrine which appears to mean the same thing—namely, that the soul is 'the motes in the air,' while others say it is that which moves these motes. It has been observed, he adds, that 'the motes are constantly in motion even in a complete calm' (i.e. as if they had the power of self-motion, which he goes on to discuss as an attribute of soul). I suggest that this view is that of the Number-atomists. It is hard to see how it could possibly be combined with any doctrine of the nature of the soul resting on the old conception of the mixture or harmony of opposites. On the other hand, it could easily be connected with the fire-atom whose pyramidal shape, being *τμητικώτατον*, enables it to penetrate everywhere.³

I need not enter into Zeno's arguments against this view of reality. It is generally admitted that they are directed against 'the Pythagoreans'; and Plato tells us that they were a counter-attack upon the hypothesis εἰ πολλὰ ἐστίν, as held by those who satirized Parmenides' argument and urged that it

¹ The Pythagorean Ecphantus of Syracuse is said to have been the first who regarded the Pythagorean monads as bodily (*σωματικές*) or as *ἀδιάτρετα σώματα* of which sensible things consist (Aet. I. 3. 19; Hippol. Ref. I. 15). His date is unknown; but the testimony supports the view that this number-atomism was no part of the original doctrine, and that the view that things are related to numbers by *μίμησις* is older than the identification of bodies with numbers.

² Themistius observes that he does not know which Pythagoreans are meant (π. ψυχῆς, I. 2,

p. 17, Spengel). The doctrine was evidently obsolete.

³ *At. de caelo* III. 5, 304a 7, ὅσοι δὲ πῦρ ὑποτίθενται τὸ στοιχεῖον . . . οἱ μὲν . . . σχῆμα περιάπτουσι τῷ πυρὶ, καθάπερ οἱ τὴν πυραμίδα ποιοῦντες, καὶ τούτων οἱ μὲν ἀπλουστέρας λέγοντες ὅτι τῶν μὲν σχημάτων τμητικώτατον ἡ πυραμῖς, τῶν δὲ σωμάτων τὸ πῦρ. Cf. *de anim.* 404a 1 sqq. Democritus and Leucippus made soul consist of spherical atoms διὰ τὸ μάλιστα διὰ παντὸς δύνασθαι διαδύναται τοὺς τοιούτους ῥυσμούς.

12 MYSTICISM AND SCIENCE IN PYTHAGOREAN TRADITION

led to ridiculous contradictions.¹ This testimony exactly agrees with the view above advocated, that Number-atomism was the form of pluralism put forward by the Pythagorean mathematicians as a reply to Parmenides.

In trying to distinguish the two divergent schools of Pythagoreans I have naturally stressed the fundamental differences. I do not, of course, wish to imply that, for instance, the method of representing numbers by geometrical patterns was not practised by Pythagoras. But it was the 'mathematicians' who, so to say, took this method as giving a literal picture of the structure of reality, and so gave birth to Atomism, which in the series of philosophical systems stands in extreme contrast to the religious tradition continued by Philolaus and Plato.

F. M. CORNFORD.

TRINITY COLLEGE, CAMBRIDGE.

¹ Plato, *Parm.* 128 c. The imaginary date of the dialogue is about 450 B.C. Zeno is 'about 40 years old' (127 B), and he speaks of his treatise as having been written 'when he was

young' (ὑπὸ νέου ὄντος ἐμοῦ ἐγράφη, 128 D). This suggests a date about 470, which would be too early for an attack on Atomism proper.