# PYTHAGOREANS AND THE DERVENI PAPYRUS

## The "Pythagorean Question"

What we are concerned with in this chapter is the early phase of Pythagoreanism, starting at the turn of the sixth and fifth centuries BCE with Pythagoras himself, and ending with the fourth century when the original Pythagorean communities, founded by Pythagoras, ceased to exist. This means that I shall not discuss in any detail the philosophical strand, sometimes referred to as New Pythagoreanism (Kahn 2001), which started among Plato's immediate disciples at the Academy, re-surfaced in a somewhat recast form around the first century BCE, and then merged with mainstream Platonism around the third and fourth centuries CE, to remain integral part of the most influential philosophical tradition of Late Antiquity. Although this current has deep continuities with what I have termed the "early phase," it can be more aptly discussed in the context of the Platonic tradition in so far as it was fundamentally shaped by a specific interpretation of Plato's late metaphysics (cf. Bonazzi and Karamanolis in this volume).

The principal methodological difficulty we have to face in trying to reconstruct and evaluate the pre-Platonic phase of Pythagoreanism, and in particular the contribution of Pythagoras himself, stems exactly from the enormous influence of New Pythagoreanism. Our Hellenistic and especially late antique sources abound in expositions of the teaching of Pythagoras and his early followers, yet the vast majority of this body of evidence is seriously suspect. For one operative assumption of New Pythagoreanism consisted in the claim that Pythagoras, this semi-divine sage, was the principle source of everything that was worthwhile in Greek philosophy and science. This assumption resulted not only in attributing to Pythagoras patently Platonizing views, but also in forging under the names of Pythagoras and his historical and fictional pre-Platonic followers treatises which were heavily influenced by the philosophy of Plato and Aristotle, or were in effect paraphrases of their most influential works (Thesleff 1965). Eventually, Pythagoras became not merely the ultimate originator of all the major intellectual achievements of the Greeks, but the one who had given a full exposition of everything that is valuable in philosophy, mathematics, and the sciences. Iamblichus' statement in his *Life of Pythagoras* (4th c. CE) is highly characteristic of this reverential stance:

> These [i.e. the writings of Pythagoras and his disciples], then, transmit from high above the science of intelligible beings and of gods. After that, he gives a superior instruction about the whole of physics, completing ethics and logic, and transmits all sorts of studies and excellent sciences, so, that, on the whole, there is nothing pertaining to human knowledge about whatever subject that is not discussed minutely in these writings (*VP* 29).

All modern commentators would of course agree that this is absurdly exaggerated. What remains nonetheless contentious is that if we peel off the layers of New Pythagorean aggrandizement, and the Platonizing reinterpretation, how much we are left with as the early Pythagoreans' original contribution to the history of Greek philosophy and science. And, indeed, on the basis of what criteria can we tell what is genuine and what is later addition and distortion? This is the daunting methodological problem that is sometimes labelled the "Pythagorean Question" (Kahn 2001: ch. 1; Zhmud forthcoming: Introduction, and Huffman 2011: section 1). What makes this problem so formidable is an unhappy confluence of several factors. First, it is now generally accepted that Pythagoras was one of those sages who did not write a philosophical or scientific treatise—so Iamblichus' testimony is misleading even in this respect. Moreover, in the case of other Presocratics, we can, with due caution, rely on later summaries transmitted in the so-called doxographical literature (see Palmer in this volume). Now the main bulk of doxographical reports ultimately goes back to a work called *Physical Tenets* by the first generation Peripatetic philosopher Theophrastus. The trouble is that there is clear evidence to the effect that Theophrastus' account of the Pythagoreans was already moulded by New Pythagoreanism (cf. *Met.* 11a27-b17). Thus, the reports on Pythagoras and the early Pythagoreans will be slanted in this way even outside the Platonist tradition. Finally, apparently none of Pythagoras' immediate disciples wrote anything either, and did not record Pythagoras' teaching as for instance Plato and Xenophon did for Socrates, and Timon for Pyrrho; indeed, it was apparently prohibited for them to divulgate their master's tenets. So if the reconstruction of the philosophy of Socrates is sometimes considered to be "beyond the reach of historical scholarship" (Kahn 1992: 240; cf.

Bryan in this volume), the prospects for a historical reconstruction of the philosophy of Pythagoras look even less promising.

We have however some scraps of evidence apparently untainted by New Pythagorean distortion. The most important source of information is probably Aristoxenus, another first generation Peripatetic. He came from the Southern Italian Tarentum, an important Pythagorean center, and was then taught by the Pythagorean Xenophilus in Athens before joining Aristotle's school. Aristoxenus wrote extensively on the Pythagoreans, and although none of these treatises survived, we have reason to believe that his works were used by our Neoplatonist sources, including Iamblichus. The difficulty, once again, is how to separate the information coming from Aristoxenus from the New Pythagorean reinterpretation.

Apart from his disciples, Aristotle, too, is an important source. He wrote treatises on individual Pythagoreans, and general works with the titles *On the Pythagoreans* and *Against the Pythagoreans*. Unfortunately only scarce fragments remain from these texts. Aristotle, however, also makes repeated references to the Pythagoreans—although never to Pythagoras himself—in his surveys of the views of earlier philosophers in his extant works. In these contexts and on occasion he explicitly makes a distinction between the teaching of the Pythagoreans on the one hand, and Plato's late metaphysics and the views of Plato's Pythagoreanizing disciples on the other. Indeed, Aristotle had good reasons clearly to distinguish between Preplatonic Pythagoreanism and its Platonist reinterpretation in so far as his principal philosophical opponents were exactly those philosophers at Plato's Academy who claimed Pythagoras' authority for their own version of Platonic metaphysics. However, this very polemical context could not leave his presentation and assessment of early Pythagoreanism completely untouched. All in all, even if Aristotle's testimonies are invaluable, we need to take them with some critical distance as well.

## Early evidence about Pythagoras

The figure of Pythagoras got cloaked in many fanciful stories already by the time of Aristotle; so it was claimed that, being more than a simple human, he was endowed with superhuman qualities, enabling him, among other marvellous deeds, to be present at two different places at the same time, to converse with beasts and rivers, and to sport a golden thigh as a sign of his divinity. His biographies present a further stratum that record historically possible, albeit unverifiable episodes. The most notable among these relate his early travels to the East—primarily to Egypt, but perhaps also to Babylonia and Phoenicia. This detail, historical of fictitious, will become especially significant for those authors who wanted to claim that all wisdom, and especially mathematics, arrived from the East. Finally, the skeleton of his biography can nonetheless be established with a fair amount of certainty on the basis of the three most important extant accounts of his life, by Diogenes Laertius, Porphyry, and Iamblichus. According to these accounts, he grew up on the island of Samos during the second half of the sixth century BCE. Then, around 530, he moved to the Southern Italian city of Croton, where he rapidly acquired an extraordinary repute, gathering around himself men and women who decided to lead a special lifestyle according to the precepts and taboos set down by him. Such closed societies were subsequently founded all around Magna Graecia, with their members also playing prominent roles in local politics. Their power, exclusivity, secretiveness, and the proverbially strong personal bonds among them created rancour and lead to hostilities against them; already Pythagoras was apparently forced to leave Croton, and we have reports about a large-scale massacre of Pythagoreans in Southern Italy, and the burning of their communal places, from around the middle of the fourth century (Polyb. 2.39.1-2).

The precepts around which the life of Pythagoras' followers was organized focused primarily on ritual activities, such as the correct way of performing sacrifices, and burying the dead (Hdt 2.81). There are however other rules the religious, or indeed any, significance of which is far from transparent—for instance that fire is not to be poked with a sword, and whether the right or left sandal is to put on first; such rules naturally invite allegorical explanations. All our sources emphasize, moreover, that dietary rules were central to the Pythagorean way of life. Some injunctions, such as the prohibition on eating beans, are customarily mentioned, whereas the evidence is contradictory as to whether a Pythagorean was allowed to eat any kind of meat, or what species, or what parts of animals were taboo.

It is eminently likely, although never clearly stated in the early sources, that the restrictions on eating meat were connected to Pythagoras' eschatological doctrines—in fact, his primary claim to fame in the early period seems to be exactly his tenets about the fate of the soul. As Dicaearchus, yet another one of Aristotle's disciples, wrote

> What [Pythagoras] told to his audience no one can tell with certainty; for they were required to keep it in silence. It nevertheless became known to everyone, first, that he taught that the soul is immortal, and, next, that it transmigrates into all kinds of animals, furthermore, that with certain periodicity the same things happen again, and nothing is new absolutely, and that we should consider all ensouled beings akin. (Porph., *VP* 19)

This report is also fully consistent with our earliest evidence, the anecdote recorded by Pythagoras' contemporary Xenophanes:

> Once he passed by as a puppy was being beaten,
> the story goes, and in pity he said these words:
> "Halt, don't beat him, for it is the soul of a man, a friend of mine,
> I recognized it when I heard it crying" (DK 21B7).

As other sources intimate, Pythagoras taught that one's soul was supposed to receive a better or worse lot depending on the life one was leading. (Ion of Chios DK 36B4). If so, Xenophanes' gibe receives a strong critical edge: Pythagoras' friends can expect to be reincarnated in such unenviable life forms.

The spiteful denouncement by Heraclitus of Ephesus, however, evinces that Pythagoras must have been known for a wider range of doctrines already in his lifetime:

> Pythagoras, son of Mnesarchus, practiced inquiry most of all men and by selecting these things which have been written up, made for himself a wisdom, a polymathy, an evil conspiracy" (DK B129, trans. Huffman).

This fragment, and especially the reference to "inquiry," has been taken to imply that Pythagoras expounded also an Ionian type of cosmology (Kahn 2001: 16-7). Carl Huffman has however persuasively argued that we do not need to suppose that, and the set of pithy sayings attributed to Pythagoras, known as *akousmata* ("things heard"), could well fit the bill (Huffman 2008). Often formulated in a question-and-answer format, the *akousmata* indeed cover a wide range of subjects, declaring, for instance, that the Islands of the Blessed are the sun and the moon, that the oracle at

Delphi is the *tetraktus*, i.e. the sequence of numbers 1-2-3-4 to which the Pythagoreans attributed a special mathematical and religious significance (Iambl., *VP* 18).

It seems to me that the very existence of the *akousmata* make it unlikely that Pythagoras put forth a comprehensive theory parallel to them. The power of the *akousmata* resides precisely in their enigmatic nature—a power that they would lose had they been complemented by a detailed, explicit account. Moreover, Heraclitus' criticism might be understood as claiming precisely that Pythagoras hoarded these disconnected pieces of purported wisdom from different sources, without creating a coherent theory out of them. On the other hand, these puzzling sayings naturally invite interpretation. Thus, someone who accepted Pythagoras' authority and had a more inquisitive mind could mobilize also his or her acquaintance with Presocratic theories in trying to understand what the master could have meant when he proclaimed, say, that "harmony is the finest" and that "number is the wisest." The *akousmata* could accordingly serve as starting-points for theory building.

## Early Pythagorean philosophers: who are they?

The first generations of Pythagoreans were thus characterized by three related features. First, a membership to Pythagorean associations; second, an adherence to a certain way of life involving ritual and dietary prescriptions; and, third, an acceptance of the doctrine of reincarnation and the truth of a set of enigmatic sayings attributed to Pythagoras. It is unclear whether the latter two were codified and uniform across all Pythagorean communities, or—as some evidence suggests—different groups could accept somewhat different rules and taboos, and could at least offer different interpretations to the *akousmata*.

It is important to recognize, however, that the terms "Pythagorean philosopher" or "Pythagorean mathematician" are inherently ambiguous. For a philosopher or a mathematician can belong to a religious community, and lead his or her life according to that creed, without this fact defining or distinctively marking his or her intellectual achievements. To use a modern analogy, one can be the member of the academic community, regularly publish philosophical and scientific papers in professional journals, and be a practicing Buddhist, regularly meditating, observing the diet that his or her chosen school requires, believing in reincarnation and so forth—yet this fact may not leave any recognizable mark on the content of one's academic output. One can think, for example, of the famous mathematician L.E.J. Brouwer whose mathematical achievements can be understood and assessed without reference to his deep Buddhist convictions. On the other hand, a philosopher or scholar can be a practicing Buddhist and take his or her main intellectual task to be the philosophical exposition and analysis of Buddhism (think, for instance, of D.T. Suzuki). In a similar fashion, the fact that someone was a Pythagorean might or might not have been essential or explanatory to his or her philosophical or mathematical interests and achievements.

At the end of Iamblichus' *Life of Pythagoras* we find a list of Pythagoreans, probably going back to Aristoxenus, with the names of 218 man and 17 women (*VP* 36). In the vast majority of cases, the items are mere names to us, and there is thus no telling whether, say, Damotages of Metapontum ever engaged in any serious intellectual study. Second, to some people on the list important philosophical or mathematical achievements can be attributed on the basis of independent evidence, but who are not customarily treated as Pythagoreans in other sources. This is the case for instance of the philosophers Alcmaeon, Parmenides, and Melissus, and the mathematician Theodorus of Cyrene. It is perfectly conceivable that Aristoxenus or some later author inserted their names with the aim of boosting the Pythagorean contribution to Greek intellectual life. Yet, it is just as well conceivable that some of them were, so to speak, Brouwer-type Pythagoreans, and so the majority of our sources do not label them Pythagoreans simply because it was irrelevant to the assessment of their accomplishments.

The most complex case is certainly that of Empedocles, who is often treated in the ancient tradition as a Pythagorean. Indeed, in Empedocles' poems we find an expression of all the eschatological tenets that Dicaearchus attributes to Pythagoras, together with comparable dietary taboos, and a cyclical cosmogony. Moreover, all these tenets form the backbone of a grand and detailed cosmological theory. So if by "Pythagorean philosopher" we mean someone who offers a philosophical exposition and elaboration of the principal doctrines that are safely attributable to Pythagoras, then Empedocles would seem to be the paragon. Yet, the majority of historians of philosophy resist this conclusion. I think it would however not suffice to point out that "whatever the initial Pythagorean influences, he developed a philosophical system that was his own original contribution" (Huffman 2010: 3.1), for this will be true also of at least some of those who *are* generally treated as Pythagorean philosophers and whom we shall consider in the next section. The difference, I suggest, is rather that instead of being a follower of Pythagoras, Empedocles presented himself as a second Pythagoras, claiming to himself comparable semi-divine status, charismatic powers, and prodigious deeds.

Finally, a handful of names scattered on Iamblichus' list appear to create a cluster. Members of this group are often—although by no means uniformly—identified as Pythagoreans in other sources as well. More important, there is a common thematic thread joining their work that, as we shall see, might also be traced back to the earliest stratum of Pythagoreanism. At the same time, it is noteworthy that the religious and eschatological aspects of Pythagoras' teaching left no discernible trace on their intellectual pursuits.

## Hippasus, Philolaus, Eurytus, Archytas

Philolaus is the first philosopher who is customarily called a Pythagorean by our sources and who demonstrably wrote a philosophical treatise (see e.g., Diog. Laert. 8.85; for counterarguments, see Zhmud 1998). Nonetheless, we have to face the problem of later forgeries and spurious attributions of doctrines in his case as well. Indeed, for a long time it was assumed that we have no reliable information about Philolaus at all, but well-nigh each of the fragments transmitted under his name are from pseudepigrapha and all the testimonies anachronistic. However, in his groundbreaking study on early Pythagoreanism Walter Burkert (Burkert 1972) has conclusively shown that about a dozen centrally important fragments are free from later distortions and most probably come from Philolaus' book. Carl Huffman subsequently offered a meticulous re-examination of the relevant texts in his masterful monograph, and his results largely reinforce Burkert's conclusions (Huffman 1993). Just as important, Burkert has demonstrated that although Aristotle refers to Philolaus by name only once in his extant works (*Eth. Eud.* 2.8 1225a30 = F16), Philolaus' book was Aristotle's primary source for his reports on the views of the "so-called Pythagoreans" (for counter-arguments, once again, see Zhmud 1998). Thus, Aristotle's testimonies can supplement in crucially important ways the verbatim fragments. From this new appraisal, Philolaus has emerged as a thinker of considerable philosophical interest, who takes up the major themes of Presocratic natural philosophy but develops them in original ways by employing some fresh arguments and novel explanatory concepts.

There is, however, some evidence to the effect that Pythagoreans prior to Philolaus also advanced physical and cosmological theories. Most prominent among these is the fifth century Hippasus, who, according to some later testimonies, created a split among the Pythagoreans precisely by conducting and encouraging original scientific and mathematical research, instead of simply accepting the received wisdom of the *akousmata* (Iambl., *De Comm. Math. Sc*. 76.19 with Burkert 1972: 192-208). Given the extreme scarcity of the evidence, it is hard to evaluate exactly how far Philolaus could build on this scientifically oriented tradition within Pythagoreanism, and on Hippasus' research in particular.

As transpires from the fragments and testimonia, Philolaus' work covered the standard Presocratic topics starting from an account of the generation and structure of the cosmos, continuing with embryology, human physiology and pathology, and comprising also a fairly detailed philosophical psychology, distinguishing among the psychic faculties of different kinds of living beings.

In good Presocratic fashion, Philolaus built up his cosmology from a set of basic constituents. It will be worthwhile to quote *in toto* the three principal fragments (translation based on Huffman 1993):

> (B1) Nature in the cosmos was fitted together both out of things-that-are-unlimited and out of things-that-are-limiting, both the cosmos and all the things in it.
>
> (B2) It is necessary that the things that are be all either limiting, or unlimited, or both limiting and unlimited, but they could not always be unlimited alone. Since, then, it is manifest that they are neither from things-that-are-limiting, nor from things-that-are-unlimited alone, it is clear then that the cosmos and the things in it were fitted together from both things-that-are-limiting and things-that-are-unlimited. And this is made clear also by the way things function. For

> some of them, from things-that-are-limiting, limit, others from the things-that-are-limiting and the things-that-are-unlimited, both limit and do not limit, and yet others, from things-that-are-unlimited, are evidently unlimited.
>
> (B6) Concerning nature and fitting-together (*harmonia*) the situation is this: the being of things, which is eternal, and the nature [of things] in itself admit of divine and not human knowledge, except that it was impossible for any of the things that are known by us to have come to be, if the being of the things from which the cosmos came together, both the things-that-are-limiting and the things-that-are-unlimited, did not pre-exist. But since these starting points (*arkhai*) pre-existed, and were neither alike nor of the same stock, it would have been impossible for them to be arranged in a cosmos, if fitting-together had not supervened, in whatever way it came to be. Like things and things of the same stock had no need of fitting-together in addition, but things that are unlike and not even of the same stock … [text uncertain] it is necessary that such things be bonded by fitting-together, if they are going to be held together in a cosmic order.

From these sentences we learn, first of all, that the cosmos had a temporal beginning. This was a contentious point in Presocratic philosophy, and Philolaus does not seem to offer any argument for his position. Second, that certain things must have existed before the birth of the cosmos; Philolaus calls these entities starting points or beginnings (*arkhai*). That there must have been some pre-existent things is unsurprising in so far as *creatio ex nihilo* had never been a live option in the Presocratic context. Yet, in contrast to the general practice of his predecessors, Philolaus does not say *what* these pre-existent things are; rather, he specifies the basic *functional attributes* that the starting points must possess so that the cosmos and the things it contains can acquire the form they have now; thus, the starting points must either be such that they limit other things, or such that they are not limited in and of themselves, but can be limited by instances of the first type.

B2 appears to take for granted that things-that-are-unlimited are among the starting points. This move might be explained by reference to the fact that many Presocratic cosmogonies presupposed an unlimited, spatially and/or qualitatively indeterminate pre-cosmic mass (cf. Palmer in this volume). This, however, raises the following question: what else is needed so that the ordered cosmos can emerge from this initial indistinct mass. One possible solution consists in saying that we need a motive force that initiates changes which will then bring about the currently existing cosmic arrangement. This is the route Anaxagoras opted for. Philolaus seems to have taken another avenue. He appeals to our experience of the world, and points out that the world as we know it consists of things that are distinct and marked out by fairly stable contours. There must therefore be things that delimit, and thereby individuate and structure, what was originally indistinct and formless. In so far as things don't just pop into existence, we need to assume that the original ontological furniture of the world contained also things that are capable of limiting those things that are unlimited in and of themselves.

The generation of the cosmos is thus described as the outcome of a process through which things-that-are-unlimited get limited by things-that-are-limiting, and thereby form a third type, a combination of the two primary types. Starting points are therefore primary not only temporally, but also in the sense that instances of the third type can be analysed into them. Note, however, that none of this necessitates that instances of the two primary types must themselves be basic. Indeed, B6 also speaks about the combination of things belonging to the same type. If, for instance, we accept that shapes are among the things-that-are-limiting (cf. Barnes 1982: 388), it is easy to see that complex shapes, analysable into simpler shapes, can also function as limiters.

It is important to note that Philolaus' *arkhai* are not a pair of abstract metaphysical principles, but a classification of necessary pre-existent things according to a pair of attributes. In conformity with this, he consistently employs the plural in speaking about both primary kinds and the compounds of them. (He uses neuter plural forms in a quasi-terminological manner that I have rendered, somewhat awkwardly, by hyphenated periphrastic expressions.)

Philolaus, however, hastens to add that on top of the two primary types we need a further factor to explain the generation of items belonging in the combined category. He calls this further factor *harmonia*. The customary meaning of the Greek word is simply "fitting-together," but by the time of Philolaus it had already acquired the more technical meaning of (musical) harmony. Both the general and the more technical meanings seem to be in play in Philolaus' text. Some commentators call *harmonia* a third principle, but this might be deceptive. For although a necessary explanatory item, *harmonia* is not on a par with the two primary types. It is not a pre-existent thing, or category of things, but a relation that emerges between pairs of starting points and, as we shall see, also among beings of the third type.

*Harmonia* appears already in B1 and B2, but its function gets described only in B6. As the latter part of B6 explains, it is both a precondition for the combination of specific pairs of the two primary types, and also a force that creates a bond between them, so that the compounds remain steady. This double role might, I suggest, be accounted for in the following way. On the one hand, things that belong in the two primary types must possess certain properties which enable them to combine with certain members of the other kind—not every pairing is possible. On the other hand, when such a pair actually form a compound, their fitting and harmonious combination may create a force that can then hold the compound together. This can explain that some, but not all, possible pairings will result in steady compounds.

Philolaus is apparently very reluctant to identify specific instances of the two primary types. As Huffman has argued (Huffman 1993: 41-2) the most promising text in this respect is B7 describing the beginning of cosmogony:

> The first thing to be fitted together—the one, in the center of the sphere—is called the hearth.

As can be seen from other fragments, the term "hearth" refers to a distinctive item in Philolaus' highly original and bold astronomical system. This is the so-called "central fire" around which the heavenly bodies revolve in ten concentric circles. Starting from the periphery, first come the fixed stars, then the five planets (in the correct order), then the sun and the moon, and finally the earth and a hypothesized tenth heavenly body, the so-called "counter-earth." The "cosmogonic moment," then, is the formation of the central fire around which the whole structure is to develop in the later stages of the process. The fitting together of the central fire apparently involves two components. A certain mass of fire, formless and unbounded in and of itself, receives a definite position and a well-defined shape in the center of the would-be cosmos. By being confined to this specific position and with this specific shape, the central fire is the first distinct, unitary thing to be formed.

The fragment, however, speaks not merely about the birth of *a* thing, or the *first* unitary thing, but appears to call the hearth *the one*. This startling claim is borne out by Aristotle's testimony according to which the Pythagoreans think that the one and the successive members of the series of natural numbers are constituted through the formation of the astronomical system (cf. *Met*. N3 1091a13-22; *Phys*. 4.6 213b22-7).

We hear for instance that seven is where the sun is—remember that the sun revolves on the seventh concentric circle counting from the outer sphere (Alex., *in Metaph.* 38.20–39.1).

This means that numbers are not instances of the starting-points, but are generated together with the combined type. More precisely, in so far as the central fire *is* also the number one, the numbers are generated *as* the physical beings of the third type. This identification of numbers and cosmological entities appears rather mysterious (for an attempt to save Philolaus from this counter-intuitive thesis, see Huffman 1993: ch. 2). Malcolm Schofield has nonetheless recently conclusively shown that the evidence is too strong and consistent to be discarded (Schofield 2012). I would argue, moreover, that this is fully congruous also with what Aristotle takes to be the decisive difference between the Pythagoreans and Plato, i.e., that in contrast to Plato the Pythagoreans do not separate numbers from things (*Met*. A6 987b30). If so, the one cannot exist prior to, and independently of, a thing that is one. Therefore, it comes into being together as the first unitary thing—the hearth—comes into being. Note also, that for the Greeks the "numbers" were primarily *that* which one counted, not *by what* one counted. If so, in so far as the constituents of the cosmic structure were the first unitary things to come into being, and thus make up the first countable numerosity, it becomes less surprising that the numbers are thought to emerge through the cosmogonical process. This consideration might also explain a further reason why Philolaus posited ten heavenly bodies apparently on *a priori* grounds: he might have considered not only that this is necessary for the perfection of the cosmic system, but found it important also that the basic set of numbers emerge in the same, cosmological, context.

Surely, even if this reconstruction is along the right lines, we would still need an explanation of the relationship between the cosmological (first instantiations of) numbers, and the later instantiations of them in other collections of things and in arithmetic. All the metaphysical differences notwithstanding, an examination of this question might of course be of particular interest for a Platonist in his attempts to work out the relationship between Platonic forms and instantiations of the relevant properties. Note moreover that if, following Barnes and Huffman, we accept that shapes were among the pre-existent limiters, we have to face the following question:

how could shapes exist before limiting something, that is before being the shapes of something?

In fr. 6a, apparently a direct continuation of fr. 6, Philolaus gives a detailed account of the diatonic scale in terms of numerical ratios. There is some evidence to the effect that Philolaus could be drawing on the results of Hippasus also in this sphere. For Hippasus is the first to be credited with a physically feasible method of showing that the numerical ratios 2:1, 3:2, and 4:3 correspond to the fundamental musical intervals of the octave, the fifth, and the fourth respectively. According to the information recorded by Aristoxenus (fr. 90 Wehrli), Hippasus created four bronze disks of equal diameters, and of different thicknesses corresponding to the above numerical ratios; when struck, such disks can actually produce the appropriate concords.

At any rate, Philolaus explicitly takes these ratios to be instances of *harmonia*. We have seen that fr. 6 ends by claiming that *harmonia* is necessary for building up the cosmic order. We have also seen that the numbers that enter into the ratios are to be understood cosmologically. It is therefore tempting to take the musical scale to apply to the interrelations among the structural elements of the astronomical system, either the heavenly bodies or possibly the concentric orbits of them. This view might naturally be developed into the famous theory of the "music of the spheres," although it is not certain that Philolaus himself actually subscribed to it.

This reconstruction is however noteworthy for other reasons as well. For notice that we originally understood fitting-together as a relation between pairs of instances of the two primary types—fitting-together was necessary to combine the two different characters. Here, however, the numerical ratios that express the relation between the elements of a harmonious musical scale hold between items of the same type: pitches or the constituents of the astronomical system, which themselves are combinations of limiters and things-that-are-unlimited. If so, fitting-together appears to be a more complex issue. It does not merely enable pairs of instances of the two primary types to combine, but also ensure that the compounds thus formed enter in a fitting relation to other compounds. The structural parts of the astronomical system can be stable not only because they are individually fitting combinations, but also because they are in a harmonious relation with one another, and thus jointly build up a stable structure.

This consideration at the same time reinforces the connection between things and numbers. If the prime example of fitting-together is musical concordance expressible in numerical ratios, then it is fundamental to a thing's relation to other things what number it is.

B4 shows that numbers have a key epistemological role as well:

> And indeed all the things that are known have number. For it is not possible that anything whatsoever be understood or known without this.

Note that Philolaus in this context does not speak about "being a number," in other words he does not seek to identify things that are knowable with numbers. It remains however unclear what Philolaus exactly means by "having number" and how it is supposed to be a precondition of acquiring knowledge of a thing. One possibility might be that, for instance, the cosmos is knowable because and to the extent as its constituents form a structure that is expressible in terms of numerical ratios. At any rate, an important consequence of the view is that in so far as numbers are posterior to the two primary types, instances of the primary types will not be knowable. We can perceive instances of fire, and we might even have knowledge of the heavenly bodies as combinations of chunks of fire and limiters, but we cannot know what fire itself is. The fact that numbers are posterior to the primary types might well be the reason behind the epistemological stricture in the first sentence of B6 (for a different interpretation of the epistemological role of number, see Nussbaum 1979).

Limitations of space prevent us from discussing the ways in which Philolaus applies the theoretical framework of the starting-points, *harmonia,* and number to other topics, such as embryology and psychology. Hopefully, the above will suffice to indicate that Philolaus' can offer a fresh take on standard Presocratic themes by the application of these central explanatory concepts. On the other hand, these very concepts are documented in the wider Pythagorean context. For instance, his cosmology and epistemology might be considered as an unpacking, in terms of Presocratic cosmology, of *akousmata* we have already mentioned: "What is the wisest? Number" and "What is the finest? *Harmonia.*" Similarly, Philolaus' two starting-points are clearly connected to the so-called Table of Opposites that Aristotle explicitly ascribes to a different school of Pythagoreans and which comprises the following pairs: limit–unlimited, odd–even, one–plurality, right–left, male–female, resting–moving, straight–curved, light–darkness, good–bad, square–oblong (*Met*. A5 986a22-26). It is crucial to see, however, that Philolaus introduces and applies all these concepts by way of arguments and not as pieces of a Pythagorean catechism.

Eurytus, reportedly Philolaus' disciple, carried on his teacher's project of establishing connections between things and numbers by a strikingly elementary method. According to Archytas' testimony (Theophr., *Metaph*. 6a18-22), Eurytus set out a certain number of pebbles and declared that *this* is the number of human being, and *that* is the number of horse. Aristotle's reference to Eurytus' practice (*Metaph*. 14.5 1092b9-13) indicates that this was conceived as an extension of the mathematical method by which we can define a geometrical figure by a fixed number of points arranged in a specific way. Three points arranged in a certain way is necessary and sufficient to define a triangle, four to define a quadrangle, and so forth. Eurytus could then ask how many points (represented by pebbles) will be needed to define human being and how many will define horse (Guthrie 1962: 274).

Eurytus' method might be compared to those puzzles in children's magazines in which the young are presented with a number of dots and if they connect them in the correct order a picture emerges. His research project might then be paraphrased thus. What is the minimal number of dots required so that when a kid joins them up in the appropriate order we get the desired reaction: "Look, Dad, it's a horse!". Yet, Eurytus was obviously on to something more ambitious, for he was not speaking merely about recognizable images of things, but about things themselves. His procedure therefore reveals a considerably more robust theoretical position, probably inherited from Philolaus, and according to which (types of) physical beings are—and can be treated—on the same footing with geometrical figures. Eurytus could think along the following lines. All agree that such spatially extended objects as triangles, quadrangles, tetrahedra, and so forth, can be defined by a specific number of points arranged in a certain way. Indeed, this is *the* way to define them. If so, one should also accept that other spatially extended objects, such as horses and human beings, can and should have a specific number, i.e. the number of points by which they can be demarcated in a similar way. At this point, Eurytus' project starts to appear much less inane than it incipiently did. For in order to refute it, the opponent needs to come up with a substantive theory about the difference between geometrical and physical objects to show why we cannot apply the same method to horses and human beings that we apply to triangles and cubes.

Note that neither of our sources say that Eurytus wanted to *define* horse or human being simply by a number; Aristotle and Theophrastus agree that all he said was that *this* is the number of human being, and *that* is the number of horse. This formulation does not hinder that more than one (type of) thing has the same number; after all even in geometry 8 is the number of both the octahedron and the cube. Indeed, we do have evidence that the Pythagoreans (we don't know exactly who) had no qualms ascribing the same number to different things. For instance, 3 could be the number of whole, of the heaven, of the male, and of opinion (Aristotle, *Metaph*. 1.8 990a27-29). The inclusion of opinion also shows that not only physical objects had numbers. In the case of non-physical things, the determination of their number could operate along a different logic. Thus, 5 could be the number of marriage, because 3 is the number of male, whereas 2 is the number of female, and 4 could be the number of justice because it is the first square number.

It is a further question what the epistemic gain of determining in this way the numbers of things. Thus once we have fixed, by different methods, that both $A$ and $B$ has the number $n$ (or is $n$), will it tell us anything about the relationship between $A$ and $B$? And if we establish further that $C$ has the number $m$, will the mathematical relationship between $n$ and $m$ tell us anything about the relationship between $A$, $B$, and $C$? This is where things become hopelessly muddy.

The specific way in which Eurytus sought to carry on Philolaus' project is ultimately a dead end. Yet, Philolaus' scheme could spark more promising and progressive results as well, as is shown by the remarkable scientific achievements of Archytas, apparently also one of Philolaus' disciples (Cic., *Orat.* 3.34.139). Literary sources remember him primarily as the one who saved Plato when his life was in peril at the court of Dionysus II, the tyrant of Syracuse. Yet, just as important, Archytas was undoubtedly one of the most impressive scientific minds and political figures of his age. As an outstandingly successful military leader, he had considerable influence also on the political life of his native Tarentum, a major political and military power in Southern Italy. At the same time, Archytas' scientific results in geometry, music theory, and optics have been hailed by scientists and historians of science, ancient and modern. In particular, his brilliant solution to the "Delian problem"—i.e., determining the length of the side of the cube the volume of which is the double of a given cube—has been lauded as one of the finest mathematical achievements of antiquity.

In the first of his four preserved fragments, Archytas expresses his credo by praising the epistemic power of the four "sister" sciences, astronomy, geometry, the science of numbers, and music theory. This list is echoed, with the addition of stereometry, in the educational curriculum of the guardians in Plato's *Republic* (*Resp*. 7, 530d) and will be known in the middle ages as the *quadrivium*. In B4, however, Archytas singles out one science, *logistikê*, which, as he argues, is fundamental to other sciences, including geometry. Huffman has maintained that this science is identical with the science of numbers from B1 (Huffman, 2005: 68-76). There are nonetheless reasons to think that *logistikê* is the science of proportion and ratio more generally, applicable in all four of the sister sciences. (For one, Archytas' solution to the Delian problem is built on ratios among quantities without however expressing them numerically). Archytas' interest in ratios is obviously most palpable in his harmonic theory, in particular in his famed proof that superparticular ratios (i.e. of the form $n+1 : n$) cannot be divided into two equal parts. This is a crucial result in so far as the ratios in the Philolaic diatonic scale are precisely of this form. There are, moreover, clear indications that Archytas took proportion, and more broadly analogy, as explanatory to a wide range of phenomena from an account of natural motion to meteorology and to law (Arist., [*Probl.*] 16.9 915a25-32; *Rh*. 1142a11-18; *Met*. 8.2 1043a14-26 with *Top*. 1.18 108b24-7). He seems to have built also his ethics and social theory on the distribution of goods according to due proportion (B3).

Reliable ancient sources call Archytas a Pythagorean, thus we have reason to think that he ascribed to the Pythagorean way of life and accepted the central Pythagorean tenets, including the transmigration of the soul. All this has however left no noticeable trace on anything that we know about his intellectual achievements. Yet, by seeing him against the backdrop of Philolaus, we can point out the continuities and the recurrence of such themes as number, proportion, and harmony. But yet again, there is no evidence that Archytas would have made much use of Philolaus' two starting-points (*contra* Huffman 2005: 66-7), or more generally the Pythagorean Table of Opposites. Similarly, the somewhat hazy Philolaic *harmonia* has been replaced by a more properly mathematical application of ratios on the one hand, and the use of analogy as a heuristic device on the other. Finally, Archytas' solution to the doubling of the cube might seem to be the most dazzling scientific result issuing from this intellectual context. Yet it is a telling fact that Archytas also in that specific case was building on the results of Hippocrates of Chios, a non-Pythagorean mathematician, who had already showed that the geometrical problem can be reduced to finding two mean proportionals between a given quantity and its double. Working with proportions and ratios was thus not a prerogative of Pythagoreans. On the other hand, a Pythagorean disciple of Philolaus might have been particularly intrigued and inspired by problems and solutions involving ratios as instances of an all-encompassing structuring feature of the world.

The only pupil of Archytas about whom we have any knowledge is Eudoxus of Cnidus. In his case, we don't even have any clear evidence whether or not he was a Pythagorean; what we do know, however, is that he was the most remarkable mathematician and astronomer of his generation. The Philolaus–Archytas–Eudoxus succession conveys with particular sharpness how the Pythagorean element gradually fades out of the intellectual achievements of this line of the tradition.

As far as we can see from the available evidence, Archytas was not much interested in cosmology. (He is only noted in this sphere for his powerful thought experiment arguing for the infinity of the cosmos: "If I arrived at the extremity of the heavens, can I extend my arm or staff into what is outside, or not?" Eudemus fr. 65 Wehrli). On the other hand, Philolaus' program of introducing number into a Presocratic type of cosmology, his insistence that numerical ratios that also express musical harmonies create bonds between the elements of the physical world, as well as the idea that shapes can impose limits upon an intrinsically formless material continuum, were taken up by Plato who built them into the imposing and tremendously influential edifice of the *Timaeus*. Nevertheless, Plato's whole cosmological account starts with, and is founded on, an emphatic distinction between the created physical world and eternal, non-physical realities that can function as starting points. In a similar manner, Philolaus' two pre-existent types are clearly in the background of the theory of principles in Plato's *Philebus*, roughly contemporary with the *Timaeus*. But, once again, Philolaus' things-that-are-limiting and things-that-are-unlimited are replaced by the abstract metaphysical principles of the Limit and the Unlimited. The new phase of Pythagoreanism was born when Plato's disciples started to claim that the separation of layers of reality and positing a pair of abstract ultimate principles are not the innovations of Plato, but belong to the very core of Pythagoreanism.

## The Derveni papyrus

Although not part of the Pythagorean tradition, a number of structural and thematic features connect this fascinating, but baffling document to our topic. The text, completely published only recently (Kouremenos & all. 2006), was preserved on a charred papyrus scroll that was discovered in 1962, near Thessaloniki, among the remains of a pyre on which a well-to-do Macedonian was cremated sometimes around the end of the 4th century BCE. The first columns, even more fragmentary than the rest, give a rationalistic explanation of a series of rites, sacrifices and libations, that presumably formed part of a funerary ritual, and offer an account of various eschatological agents that can punish or help the soul of the deceased. The mention of initiates—who are said to follow the practices of *magoi* (either Persian priests or Greek religious practitioners who claim their authority from their Persians colleagues)—points to the context of mystery religions. In the second, longer part of the extant text, we get an elaborate allegorical interpretation of a hymn in hexameter to Zeus. The poem focuses on the way Zeus obtained royal power among the gods with the help of the primordial goddess Night, but makes reference also to the succession of divine kings preceding Zeus, and to the later phases of Zeus' reign. Some peculiar details of the story are known from later versions of the Orphic theogony, such as the bizarre episode according to which in order to make his dominion stable, Zeus had to swallow the primary source of generation (a primeval divinity called Phanes or the phallus of Ouranus) so that by this act all the divinities prior to him get inside his belly, from which he can then bring them to light again. The author of the papyrus asserts that in this seemingly outlandish narrative Orpheus effectively reveals the most important truths, yet expresses himself in riddles that only a few will understand (col. 7). The Derveni author himself is, of course, in a position to unravel Orpheus' real meaning; the outcome of his verse-by-verse exegesis is a cosmological theory that integrates elements from different Presocratic theories from Heraclitus to Anaxagoras and Diogenes of Apollonia, but is not without originality (Betegh 2004: ch. 7-9). In particular, the author argues that all the divine characters of the poem are just names of a single cosmic god and designate the different cosmological functions and actions of this one god. In its physical aspect, the god can also be identified with the element air, that is at the same time the bearer of intelligence, and is able to manipulate the brute, motive force of fire.

None of the various attempts at identifying the Derveni author with known figures of the late Presocratic period has received wider acceptance. More striking, interpreters disagree also on the professional identity and basic aims of the author. For some, he is a sophist who wants to display his interpretational ingenuity without any ideological agenda (Obbink 2010: 19). For others, he is a natural philosopher who strives to dissipate the superstitious eschatological beliefs of the adepts of mystery religions, and offer a naturalistic and secular interpretation of a text considered to be sacred by them (Kouremenos 2006). For yet others, he is one of those priestly figures who, in Plato's words, try to "make it their concern to provide an account of their practices" (*Meno* 81a) and offer a teaching about the fate of the soul. If this last interpretation is correct—as I am inclined to think—than when the Derveni author endeavored to render the sacred text of Orpheus compatible with the latest intellectual movements, he was doing something comparable with what, as I suggested, at least some Pythagorean philosophers were doing: they took a set of enigmatic texts that they considered to come from a semi-divine figure, an utmost authority in religious and cosmological matters, and tried to make sense of them in the paradigm of Presocratic natural philosophy.

At any rate, the allegorical exegesis of Orphic poems remained a live form of philosophizing until the very end of the Greek philosophical tradition. What is more, in the eyes of the late Neoplatonists, Orpheus was not merely an authority equal, or almost, to Pythagoras and Plato; they were convinced also that these three sages professed one and the same divine wisdom. Syrianus, Proclus, and Damascius wrote formidable treatises to demonstrate that in those curious episodes relating the family life of gods, explicated also by the Derveni author, Orpheus expressed exactly the same intricate metaphysical system that Pythagoras taught to his disciples in Croton and Plato wrote about in his splendid dialogues.

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