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Richard McKirahan^{*}

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^{*} Pomona College,
Los Angeles.

With an unsurpassed command of primary materials and meticulous scholarship Professor Zhmud gives us a thorough treatment of Pythagoreanism through the fifth century, occasionally ranging into the Pythagoreans of the fourth century as well. He presents a careful treatment of the source material on Pythagoras' life and activities, and takes up the rarely discussed problem of who are to count as Pythagoreans. He proceeds to discuss all things (allegedly) Pythagorean, including *metempsychosis* and vegetarianism, politics and the nature of Pythagorean 'societies', *mathematici* and *acusmatici*, number theory and numerology, geometry and harmonics, cosmology and astronomy, (surprisingly) medicine and the life sciences, and he concludes by examining Pythagorean views on the soul and the doctrine that all is number.

I have the honor to say a few things about Professor Zhmud's recent book *Pythagoras and the Early Pythagoreans*. This is a major revision and expansion of his 1997 book *Wissenschaft, Philosophie und Religion im frühen Pythagoreismus*, a book described by one reviewer as the most important contribution to Pythagorean studies in the previous thirty years. The magnitude of that assessment can be recognized when we bear in mind that that thirty-year period saw the publication of Burkert's *Lore and Science in Ancient Pythagoreanism*, which is widely considered the foundation of modern Pythagorean studies. My assessment of *Pythagoras and the Early Pythagoreans* is that it is even better than Professor Zhmud's previous book.

There is wide agreement that later (that is,

Neopythagorean and Neoplatonic) sources contain far more information than the early sources from the 6th-5th century BCE and that much of this later information is fabricated. Recent treatments of Pythagoreanism present early material, admit that it is too scanty to yield a full picture of Pythagoras and his followers, and then proceed to supplement it by selective use of the later material. Professor Zhmud perforce follows this method, but modifies it in two important ways. First, he is more consistent in rejecting later information that does not have a pedigree going back to the fourth century. This methodological approach considerably reduces what can be safely asserted about Pythagoras and the early Pythagoreans. Second, he infers the interests and activities of Pythagoras from those reliably attributed to his followers, a move that expands what can be assigned to their leader. These twin procedures lead to some surprising conclusions that challenge widely held beliefs. Consider the following examples.

- Pythagoras was not a shaman or a wonder-worker.
- Stories of his travels to Egypt and other lands are probably spurious.
- His success in Croton was probably not instantaneous but attained gradually, over a period of many years.
- No single trait marks all known early Pythagoreans (except that they presumably belonged to Pythagorean societies): some pursued mathematics, others natural philosophy, others medicine, and still others athletics.
- Pythagorean societies were not religious groups or cults.
- The Pythagorean way of life did not include observing a strict code of conduct that regulated every aspect of their life.
- The Pythagoreans were not a secret society; their views were known to outsiders.
- The early Pythagoreans did not attribute their own discoveries to Pythagoras.
- The distinction between *mathematikoi* and *akousmatikoi* was a much later fabrication.
- It is likely that Pythagoras discovered the Pythagorean theorem, the theory of even and odd numbers and the arithmetic, geometric and harmonic means.
- Pythagoras was first to use deductive proofs in number theory.
- Early Pythagoreans and possibly Pythagoras himself made use of experiments to verify their physical theories.
- The *tetraktys* and the ideas associated with it were unknown to early Pythagoreans.
- *Very little is known of Pythagorean contributions to astronomy prior to Philolaus.

- Pythagoras invented the *quadrium*.
- Alcmaeon was a Pythagorean.
- Alcmaeon alone taught that the soul is immortal, a theory that has no connection with *metempsychosis*. It is doubtful that any Pythagoreans believed soul to be a *harmonia*.

These conclusions radically undermine traditional interpretations of early Pythagoreanism. They are founded on close readings of the relevant textual evidence and cannot be overlooked.

The remainder of this review will focus on the *Familienähnlichkeit* that Professor Zhmud finds among the early Pythagoreans, and his conclusions about Pythagoras' mathematical activity, but first a brief remark on Professor Zhmud's view that for Pythagoras *metempsychosis* was a religious doctrine (e.g., p.20). I question the appropriateness of the word "religious" to describe *metempsychosis*. Orphism, from which Pythagoras borrowed the doctrine, was a religion of sorts, but *metempsychosis* does not by itself need to have any religious implications. Professor Zhmud is right to insist that Pythagorean communities were not religious *θιασοί* (144) and that there is no evidence of any special cults or distinctive private worship among the Pythagoreans (144). And for one who believes in *metempsychosis* the idea that a pure life is the ticket to a better next reincarnation may be no different in kind than the idea that a good diet is the ticket to better health in this life.

Unable to find any single common characteristic that applies to all known ancient Pythagoreans from the end of the sixth century to the middle of the fourth, Professor Zhmud applies Wittgenstein's conception of family resemblance as a solution to the problem of Pythagorean identity (111). For Wittgenstein, the way in which family members resemble each other is not through one specific trait but depends on a variety of traits. The members of a family do not all possess any single trait, but they all resemble each other in that each of them possesses at least one of the traits and each trait shows up in more than one member of the family. Thus, we have some Pythagoreans (Hippasus, Theodorus, Philolaus and Archytas) who pursued mathematics, others (Hippasus, Alcmaeon, Philolaus, Menestor and Hippon) who pursued natural philosophy, others (Democedes, Alcmaeon and Iccus) who worked in medicine, and still others (Milo, Astylus and Iccus) who engaged in athletics (111). Crucially, some Pythagoreans engaged in more than one of these pursuits: Hippasus and Philolaus in mathematics and natural philosophy, Alcmaeon and Hippon in natural philosophy and medicine, and Iccus in medicine and athletics. Hence the family resemblance.

But some of this is pretty thin. Was Hippon a

Pythagorean? We have only Iamblichus' word for it. Likewise for Iccus, Asylus, Theodorus and Menestor. And Iamblichus is a suspect source. (Even accepting Professor Zhmud's view that Iamblichus' catalogue goes back to Aristoxenus (111ff.) the early Pythagoreans under discussion lived long before Aristoxenus, plenty long enough for the catalogue to have grown to include notable South Italian figures from earlier times who were not Pythagoreans. If these men are excluded then we have a much smaller list: only Hippasus, Philolaus and Archytas for mathematics, of whom only Hippasus was early; only Hippasus, Philolaus and Alcmaeon for natural philosophy; only Democedes and Alcmaeon for medicine; only Milon for athletics (which removes the pursuit of athletics from the list of family traits ascribable to early Pythagoreanism on the basis of the activities ascribed to known early Pythagoreans). But even of these, Democedes' identity as a Pythagorean may not be assured simply because he had Milon as a father in law, and Alcmaeon's claim to be a Pythagorean is disputed. In fact an important passage in Aristotle seems to tell against it (*Metaph* 986b1). If we reject these men too, then there are no early Pythagoreans left who pursued medicine, leaving only mathematics and natural philosophy (each represented solely by Hippasus).

Milon presents a different problem as well. Granted that that great athlete was a Pythagorean, we may ask whether his athletic prowess had anything to do with his Pythagoreanism. Perhaps he was just an athlete who was also a Pythagorean. A possible point of comparison is the Belleville Church Golf League in rural Illinois, consisting of teams from seven local churches (with names like Pres 1 and Pres 2, representing the local Presbyterian church). Do the golfers see participating in this athletic activity as part of their Christianity? Can we detect a family resemblance between golfers and Christians? This question may sound trivial and even frivolous, but it invites a more serious question: is it possible that the mathematical, scientific, and (for the sake of argument) medical activities characteristic of some known early Pythagoreans were not part of their Pythagoreanism? How can we possibly know?

Here is an opposite-minded alternative view. As long as the Pythagorean societies existed membership was the determining feature (146ff.) During that period various kinds of activities (athletics, mathematics, etc.) were pursued by various Pythagoreans, but not as a requirement of membership. (And we must keep in mind that during the period in question these activities were pursued in the Greek world by men who were not Pythagoreans.) After the upheavals in the mid-fifth century and the subsequent scattering of the survivors, some continued to call themselves Pythagoreans and continued to pursue the same activities as before; if they had followers who did the same, they could be

called Pythagoreans too, but their Pythagoreanism could not have been the same as the pre-diaspora Pythagoreanism.

If neither of these approaches can be accepted without methodological reservations, the best hope for unity might seem to rest in the figure of Pythagoras himself. If he introduced the famous Pythagorean way of life, if he founded the first Pythagorean *ἐταιρεία*, if he also pursued mathematical and scientific activities (for which there is no early evidence), perhaps these are the keys to who is a Pythagorean. But how about medicine and athletics, Professor Zhmud's other two pillars of Pythagorean identity? Did Pythagoras engage in these activities as well? Are we comfortable with the idea that since Milon was an athlete, Pythagoras was too? Further since so little is reliably attested to Pythagoras, if we define his activities taking his followers' pursuits as guides to Pythagoras's own and then say that engaging in those activities makes one a Pythagorean, we have an intolerable circularity.

Finally, regarding Pythagoras' contributions to mathematics: as Professor Zhmud says (256), in the century and a half passed between Thales (the founder of Greek geometry) and Hippocrates (the author of the first *Elements* of geometry) a lot of progress was made in mathematics. Professor Zhmud gives evidence that the association of Pythagoras with the famous theorem is attested as far back as the late fourth century (257), although elsewhere he is less than certain that this is the theorem to which source is referring (267). We need to bear in mind that even this date is a century and a half after Pythagoras's death. Again, it is a better pedigree than Iamblichus, but in my mind it still leaves a good deal of uncertainty.

Professor Zhmud credits Pythagoras with the following achievements:

- Proving the Pythagorean theorem, probably by the use of the arithmetical theory of proportions (256, 271)
- Discovering the ratios of the harmonic intervals (258-9)
- Discovering the arithmetic, geometric and harmonic means (271)
- Adding arithmetic and harmonics to astronomy and geometry (subjects already pursued in Ionia) to form the quadrivium (271)
- Inventing number theory including the five basic theorems about even and odd numbers, which he proved on the basis of definitions of unit, number, and even and odd numbers that we find in Aristoxenus and Euclid (272-73)
- The use of indirect proof (273)

Here Professor Zhmud carries to extremes his

practice of ascribing to Pythagoras the pursuits of his followers. Not only is Pythagoras not said by any early source to have engaged in mathematical pursuits, the only early Pythagorean we know of who did so was Hippasus (275). Professor Zhmud says that the Pythagoreans achieved too much in mathematics in the fifth century for Hippasus alone to have done it (275), and he points out that the discoveries he attributes to Pythagoras are not complex and “correspond fully with the stage *mathēmata* had reached before Hippasus” (268). Still, it seems to me to be optimistic in the extreme to attribute all of them to Pythagoras. It is safer to limit ourselves to the thought that Pythagoras encouraged others to be active in these areas rather than supposing that he engaged in them himself -- a line of interpretation floated by Professor Zhmud himself (141).

Here is another story that seems to me equally plausible. Pythagoras discovered the numerical ratios of the concordant musical intervals or alternatively, he saw the potential of a discovery was made by someone else (I think of Lasus of Hermione as a possibility); there is no good evidence that the discovery was due to Pythagoras. He was struck by the thought that numbers could account for something apparently as different from numbers as music, and in a breathtaking generalization paralleled only by other Presocratic thinkers, declared (without more evidence) that number was fundamental to reality. Some of his followers (Hippasus among them) took up the project of exploring numbers. Among other things they identified and defined species of numbers (including even and odd) and discovered (and proved, more likely by pebble diagrams than by indirect proofs based on definitions) elementary results such as that the sum of two odd numbers is an even number. They also identified properties of ratios of numbers such as those concerned with the three means mentioned above. In this way we have an account of the origin of the Pythagorean tradition of mathematics -- and one that accounts for the silence of our sources on Pythagoras's contribution to it.

These brief discussions of Pythagorean identity and Pythagorean mathematics are not intended to disprove Professor Zhmud's carefully worked out conclusions, but rather to illustrate the kind of work that needs to be done in order to to maintain contrary views. I want to conclude by saying that my already considerable admiration for Professor Zhmud has been raised to new heights. I regard his book as a landmark whose arguments and theses cannot be disregarded by anyone who wants to form an accurate picture of Pythagoras and the Pythagorean tradition. I say with confidence that it will remain a standard reference for the foreseeable future.

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