

Mathematics in Greek Philosophy

Dr. Ess - Fall, 1997

Thales:

Mathematical discoveries:

method for measuring the height of a pyramid (at the time when a person's shadow = his height)

"geometry" (Kirk & Raven, 84)

Geometry for the Greeks evidently derived from the Egyptians, who had particular insights {e.g., the square of the hypotenuse of a right-angled triangle = the sum of the squares of the other two sides: but this holds only for specific cases, e.g., 3,4,5}.

Thales generalized these special cases, and in this sense is the father of mathematics as a science, e.g.

angles at the base of an isosceles triangle are equal

the two sides of an isosceles triangle are equal

when two straight lines intersect, opposite angles are equal

the angle on the circumference of a circle subtended by the diameter is always a right angle

the sum of the angles of a triangle = 2 right angles

the sides of triangles with equal angles are always proportional.

Simple applications:

- 1) Using the principle of similar triangles: measuring the distance from shore to ship at sea
- 2) Measure the height of a pyramid by comparing the length of its shadow with that cast by an object of known height.

[Alioto has an interesting quote about the Pythagoreans:

In other words, with Thales, mathematics became deductive and therefore abstract. The Pythagoreans extended this process of abstraction and in turn infused all of nature with mathematical concepts. It seems that they were the first to stress the idea of number and geometry underlying diverse natural phenomena. The result, adapted and enshrined in Plato's later philosophy along with an ethical, transcendental corollary, was the important recognition that numbers are abstractions, mental concepts, suggested by material things but independent of them. For the early Pythagoreans, however, the physical world was actually constructed from numbers. (36).

This, I believe, was a major step for philosophy because of the use of abstraction to relate to reality .--Robert]

Anaximander:

COSMOLOGY:

The earth is as drum; it is stable because of its equilibrium --it is in a stable place, equidistant from other bodies. [According to Aristotle: because it is centered and central (K&R, 134)].

There are fire-wheels circling the earth -- constituting the stars, moon, and sun, as these are visible through "breathing holes." [Reference to Homer? K&R, 10)

GIVES TO THE STRUCTURE OF THE WORLD A MATHEMATICAL BASIS. This develops an assumption in Homer and Hesiod (but not, for example, in the *Enuma Elish* and *Gilgamesh*) that the world is orderly (a *kosmos*) and determinable. His notion of proportionate distances may have influenced Pythagoras [K&R, 136]

Pythagoras: establishes the equation/identity of things with numbers.

More specifically, it is probable that Pythagoras discovered that the chief musical intervals are expressible in simple numerical ratios of the first four integers, i.e.:

Octave -- 2:1

Fifth -- 3:2

Fourth -- 4/3

This discovery, coupled with the discovery/invention of a mathematical order to the universe itself, leads to the venerable notion of "the harmony of the spheres." As Julian Marias paraphrases it: since the distances of the planets correspond approximately to the musical intervals -- then every/ star emits a note, all the notes together comprise the harmony of the spheres, a celestial music. We do not hear it because it is constant and without variation. While we may be tempted to dismiss such a notion, note that this vision provided a foundation for such "modern" figures as:

- a) Copernicus (who follows the Pythagorean astronomer Ecphantus in affirming the rotation of the earth), and
- b) Kepler (who diligently searched for over 10 years to find the Pythagorean harmonies -- discovering the three laws of planetary motion in the process).

More broadly, as K&R put it:

If the musical scale depends simply upon the imposition of definite proportions on the indefinite continuum of sound between high and low, might not the same principles, Limit and the Unlimited, underlie the whole universe? If numbers alone are sufficient to explain the "consonances," might not everything else be likewise expressible as a number of a proportion?

Moreover, since the first four integers contain the whole secret of the musical scale, their sum, the number 10 or the Decad, might well "seem to embrace," as Aristotle puts it, "the whole nature of number," and so come to be regarded, as it certainly was, with veneration.

As well, the first four integers generate the three maior figures beyond the point (cf. Speusippus, Kirk & Raven, pp. 253ff.).

Also attributed to Pythagoras - the Pythagorean theorem, with its corollary, the incommensurability of the diagonal and the side of a square. Revealing this secret cost one poor student his life, it is said.

[For those who are really with it: the experience and conception of a (musical/aural) harmony (=connection in the face of difference) avoids the conflict implicitly raised by

Anaximander (dualism) and Anaximenes (monism) -- and between

Parmenides (dualism) and Heraclitus (monism)]

Pythagoreans: Greek mathematics began in the Milesian school (cf. Thales, Anaximander), inheriting the knowledge of Egypt and Asia Minor (Babylonia). The Pythagoreans transform it into an autonomous and rigorous science.

In mathematics, the Pythagoreans discovered a type of entity -- numbers and geometric figures -- which is not corporeal, but which seems to have non-arbitrary features of its own (in contrast with the arbitrary, changing whim of fancy, imagination, dream). Marias suggests that this discovery perhaps leads to the further claim that Being is not simply corporeal, material being -- in which case, we would now have a problem. A development of the concept of being is called for[?].

In any case, for the Pythagoreans, Being means the being of mathematical objects:

Numbers and figures are the essence of things;

Entities which exist are imitations of mathematical forms [anticipates Plato's alleged theory of forms]

Pythagorean mathematics is not an operative technique: it is the discovery and construction of new entities, which are changeless, eternal -- in contrast with things which are variable and transitory.

[Aristotle's account of the Pythagoreans (*Metaphysics* A5, 985b23)

Since of these principles *numbers are by nature the first*, and in *numbers* they seemed to see many resemblances to the things that exist and come into being - more than in fire and earth and water (such and such a modification of numbers being justice, another being soul and reason, another being opportunity - and similarly almost all other things being numerically expressible); since again they saw that the attributes and the ratios of the musical scales were expressible in numbers; since, then, all other things seemed in their whole nature to be modelled after numbers, and numbers seemed to be the first things in the whole of nature, they supposed the elements of numbers to be the elements of all things, and the whole heaven to be a musical scale and a number. And all the properties of numbers and scales which they could show to agree with the attributes and parts and the whole arrangement of the heavens, they collected and fitted into their scheme; and if there was a gap anywhere, they readily made additions so as to make their whole theory coherent. E.g. as the number 10 is thought to be perfect and to comprise the whole nature of numbers, they say that the bodies which move through the heavens are ten, but as the visible bodies are only nine, to meet this they invent a tenth the 'counter-earth.' (trans. Ross; emphasis added -- C.E.)]