

Knowledge, Truth, and Mathematics

Philosophy 405
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Class 2: Pythagoreans

Sign-Up for Seminar Papers/Presentations

Brown's "Mathematical Image"

1. Mathematical results are certain.
2. Mathematics is objective.
3. Proofs are essential.
4. Diagrams are psychologically useful, but prove nothing.
5. Diagrams can even be misleading.
6. Mathematics is wedded to classical logic.
7. Mathematics is independent of sense experience.
8. The history of mathematics is cumulative.
9. Computer proofs are merely long and complicated regular proofs.
10. Some mathematical problems are unsolvable in principle.

Metaphysics of Mathematics

- Realism: numbers exist, objectively
 - Plato, Descartes, Frege, Gödel, Quine
 - Sentence Realists vs. Object Realists
- Idealism: numbers are mental constructs
 - Kant, Brouwer, maybe Locke
- Nominalism: numbers do not exist
 - Denies that there are any types corresponding to number tokens, inscriptions.
 - Berkeley, Field

The Greek Achievement in Mathematics

- Earlier or contemporaneous civilizations, like the Babylonians or the Egyptians, took mathematics to be all applied.
- Circles were pizzas and frisbees (and fields of wheat, say)
- The Pythagoreans recognized that realism about mathematics entails believing in an unseen world.
- They demanded proofs of mathematical theorems, rather than mere practical utility.

Kline's Chaos Claim:

The civilizations that preceded the Greek or were contemporaneous with it regarded nature as chaotic, mysterious, capricious, and terrifying (Kline, 146).

Picasso, *Guernica*



The Kline View

- Against the Kline view, the world, as we perceive it, is orderly and predictable.
 - The odd surprise (a tsunami, a terrorist attack) is always explicable, in hindsight.
- In contrast, if Kline is right, this order may be unnatural.
- Kline's claim is that the Greeks, through a variety of methods, tamed the chaos.
- The Ionians, like Thales, argued that all diversity is the result of different combinations of a few familiar substances, or even a single substance.
- Democritus favored unseen atoms.
- Empedocles posited four elements: earth, air, fire, and water.
- The Pythagoreans: all things are numbers.

The Pythagoreans Cult

1. To abstain from beans.
2. Not to pick up what has fallen.
3. Not to touch a white cock.
4. Not to break bread.
5. Not to step over a crossbar.
6. Not to stir the fire with iron.
7. Not to eat from a whole loaf.
8. Not to pluck a garland.
9. Not to sit on a quart measure.
10. Not to eat the heart.
11. Not to walk on highways.
12. Not to let swallows share one's roof.
13. When the pot is taken off the fire, not to leave the mark of it in the ashes, but to stir them together.
14. Do not look in a mirror beside a light.
15. When you rise from the bedclothes, roll them together and smooth out the impress of the body (Bertrand Russell, *A History of Western Philosophy* 31-2).

Ontogeny, Phylogeny, and Developmental Analogies

- Kline's claim is that in seeing the world as mathematical, the Pythagoreans were able to turn a chaotic world into a tame one.
- The individual begins life by perceiving a chaotic world, and learns to order and organize that world around him/her.
 - Kant: we impose order from our concepts.
- Perhaps, the baby is given a chaotic world.

The Four Piagetian Stages

1. Sensorimotor stage (birth - age 2): The child builds concepts about the external world and how it works, correlating sense experiences with external objects. The child lacks, and learns, object permanence.
2. Pre-operational stage (ages 2 - 7): The child is not able to think abstractly. The child lacks and learns conservation of quantity.
3. Concrete operations (ages 7 - 11): The child starts to reason logically about concrete events. Some limited abstract problem-solving is possible, but only applied to concrete phenomena.
4. Formal operations (ages 11 - 15): The child develops abstract reasoning.

Is the Metaphor Successful?

- Kline: the Greeks provided a rational view of nature.
- The mythology of earlier cultures makes life and death the whims of the gods.
- But, the gods are presumably rational, too.
 - Their reasons are just potentially hidden from our view.
- The Greeks provided scientific reasons, as opposed to mythological reasons.
- They were not giving order to chaos.
- They were providing natural explanations where no explanations were available.

The Futility of Scientific Explanation

- If we want to know why A fell off of a cliff, it is useful to know that B pushed her.
- It begs the question of why B pushed her.
 - We might find out that C pushed B.
 - And that D pushed C.
 - *Et cetera.*
- The ultimate causes get pushed back, but are not disappeared.
- We do get an order to some portion of the universe, which may be Kline's point.
- Scientific explanations tend to replace a visible world with a less-visible world.
 - Electrons
 - Quarks
 - Strings
 - Numbers
- The Pythagorean claim was that the less-visible world is mathematical in nature.
- Is there any sense that we can make of the claim that the world is mathematical?

Galileo's Pythagoreanism

Philosophy is written in this grand book of the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and to read the alphabet in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles and other geometric figures, without which it is humanly impossible to understand a single word of it; without these, one wanders in a dark labyrinth (*The Assayer*, 1623).

Coulomb's Law

$$F = k |q_1 q_2| / r^2$$

Contemporary Pythagorean

arises out of Quine's indispensability argument

- We start thinking of bodies as physical objects, but these have vague boundaries, and puzzling identity conditions over time.
 - ▶ Am I the same person I was when I was younger, or the same person I will be later?
 - ▶ Is the cragged old tree the same as the small sapling?
 - ▶ We can take bodies to be composed of smaller particles.
 - ▶ We can think of the world as composed of four-dimensional aggregates of these atomic elements.
- Problems with atomism
 - ▶ Electrons do not seem to have great identity conditions.
 - ▶ It is arbitrary, at times, to say whether two point events are moments in the career of one electron, or two different ones.
- Field theory of distributions of states over space-time
 - ▶ electromagnetic fields, gravitational fields, etc.
 - ▶ The world as space-time points and their states
 - ▶ The objects are the space-time regions and their properties.
- We can identify space-time regions with Cartesian coordinates

Vanishing Matter

Predicates that formerly attributed states to points or regions will now apply rather to quadruples of numbers, or to sets of quadruples... I seem to have ended up with this as my ontology: pure sets (Quine, "Whither Physical Objects", 501-2).