Theodorus of Cyrene Encyclopedia Article

Theodorus of Cyrene

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Theodorus of Cyrene

465-398 B.C.

Greek North African Mathematician

Known as much for his pupils as for his other work, Theodorus of Cyrene worked on questions involving the square roots of 3 and 5. This led him to discoveries concerning irrational numbers, or numbers that continue indefinitely without any repeating pattern.

Theodorus was born in Cyrene, now part of Libya, which at that time was a Greek colony. Though he was in Cyrene when he died 67 years later, he must have spent part of his life in Athens, where he studied under Protagoras (c. 485-c. 410 B.C.) and interacted with Socrates (c. 470-390 B.C.). He later taught both Theaetetus of Athens (c. 417-c. 369 B.C.) and Plato (427-347 B.C.), the principal source of information regarding his work.

Plato later wrote that Theodorus showed his students that "the side of a square of three square units and of five square units" was "not commensurable in length with the unit length"—in other words, the square roots of 3 and 5 are irrational numbers. Today it is possible to view the first 1 million digits of both (1.732... and 2.236... respectively) at http://antwrp.gsfc.nasa.gov/htmltest/rj n_dig.html, a website containing calculations by NASA mathematicians Robert Nemiroff and Jerry Bonnell for the square roots of these numbers, as well as 2, 3, 6, 7, 8, and 10.

As for Theodorus, little else is known about him aside from Plato's brief reference to his teachings regarding the irrational roots of 3 and 5. It is possible to infer from the Plato passage, located in his *Theaetetus,* that the irrational nature of √2 had already been established. Some claim that Pythagoras (c. 580-c. 500 B.C.) showed that √2 was irrational, and certainly Theodorus must have used the Pythagorean theorem to construct lines of length √3 or √5 .

Most interesting, perhaps, is the role Theodorus played in the generalization of the idea of irrational numbers. This is indicated by this sentence in Plato: "The idea occurred to the two of us [Theaetetus and Socrates], seeing that these square roots appeared to be unlimited in multitude, to try to arrive at one collective term by which we could designate all these roots...." Using a method of reduction known at the time, he apparently proved that the roots of non-square numbers from 3 to 17 were irrational, and from this probably arrived at a general theorem that the square roots of all nonsquare numbers are irrational.