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4-1989

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Myrlene Marsa

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Recommended Citation
Marsa, Myrlene, "Pythagoras: Mathematician and Philosopher" (1989). *Senior Research Projects*. 132.
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# PYTHAGORAS: MATHEMATICIAN AND PHILOSOPHER

By: Myrlene Marsa

Senior Project

Honors Committee

April 27, 1989

The name Pythagoras should bring back fond memories to anyone who has taken even an elementary geometry course. His most famous theorem deals with the relationship between the legs of a right triangle and its hypotenuse. Other theories regarding numbers and mathematics, while not necessarily his own originally, have been passed on to us in their current form as a result of his ability to collect and organize these truths. While Pythagoras made large contributions to the field of mathematics and number theory, he prevented himself from discovering more about numbers because of his mystical approach to numbers and mathematics.

Pythagoras was born in Samos around the year 569 B.C. Greek myth maintains that his father was Apollo while his mother was a mortal. He spent his early years on the island of Samos and later spent some time in captivity in Babylon. Later in his life he went to Egypt where he studied with the priests of the ancient religions for a number of years. Both of these cultures were significantly advanced scientifically, however their religious beliefs were quite mystic. Not a lot is known about Pythagoras' life and what we do know is sketchy; however he did contribute most of his life to the study of mathematics and philosophy. He is known as the founder of numerology because of a kind of number mysticism which he developed. "Pythagoras is also credited with having discovered the importance of numbers in music and having laid the fundaments of the theory of that art." (Runes 979) Probably because of his close contact with the older societies and religions of Babylon and Egypt,

Pythagoras joined mathematics and mystic philosophy very tightly together. As a result, his theory of mathematics and numbers is very intimately connected with his philosophy of the universe.

Pythagoras and his followers developed a theory of numbers that was very mystical. "A major dogma of the Pythagorean brotherhood was the belief that all of math and science could be based on the natural numbers." (Kramer 19) Pythagoras attached great meaning to all of the natural numbers. For instance, one was not a number at all but rather the source of all numbers, since to get from one number to the next, one is added.

In the Pythagorean faith all of the numbers had a special significance. "One represented reason, two stood for woman, three for man, five represented marriage, since it is formed by the union of two and three. Four stood for justice, since it is the product of equals." (Kramer 20) Since two is woman, all even numbers were regarded as feminine and all odd numbers as masculine. Ten is considered the perfect number since 1 + 2 + 3 + 4 = 10 and the first four numbers together represent the totality of the reason and justice of man and woman. The Pythagoreans not only attached significance to specific numbers but also to certain mathematical concepts. They believed that the infinite was evil. According to them the one was the source of the finite, while the two was the creator of the infinite therefore they believed that even numbers were the cause of evil and the cosmic opposites of odd numbers. As a result of this belief Pythagoras never speculated about more than three dimensions. His universe was a careful balance between

opposites. Negative numbers also did not exist since negation was considered evil. They also believed that numbers had a separate life and existence of their own--independent of men's mind. While natural numbers were the basis of his number theory, there was room for rational numbers also. To Pythagoras and his followers, rational numbers were simply ratios of one natural number to another. This did not contradict any of their feelings about numbers.

"His religious veneration of number and logic led him to the statement that all things are numbers . . . ." (Reichenbach 33) Even the gods were numbers. For this reason mathematics was extremely important, for when one considered the numbers and their relationships, he was really considering the gods which was the whole responsibility of man. Mathematics became a religion to Pythagoras and his followers. His philosophical ideas can be summarized as follows: 1) the immortality of the psyche; 2) transmigration of souls; 3) periodic return or the idea that nothing is absolutely new; 4) all life is related. In all of these ideas, Pythagoras involved numbers. For instance, in relation to the transmigration of souls, Pythagoras believed that the cycle from the beginning of one life to the next is 216 years. This number has significance in that it is the cube of six and six is considered to be a circular number since all of its powers end in six. (Gorman 29) Pythagoras' symbolism of arithmetical numbers was also employed to explain the origins of the cosmos.

> "According to some writers Pythagoras was supposed to believe that physical objects were composed of geometrical points which possessed magnitude, i.e. these points were like tiny billiard balls which, when conglomerated into masses, produced solid objects." (Gorman 136)

Numbers were thus able to create points in space and then through combinations of individual points, lines, planes, and finally three-dimensional bodies could be produced.

This theory of how numbers relate to the universe and its construction has some problems, as Pythagoras found out. When Pythagoras was attempting to prove his theorem regarding a right triangle he discovered something that was very disturbing. In considering a right triangle whose sides are both equal to one, he discovered that according to his theorem, which is in fact correct, the square of the hypotenuse was two and therefore the hypotenuse was equal to the square root of two. Now he attempted to represent the square root of two as a ratio of two natural numbers. If this could have been done than the square root of two would be a rational number and thus would not cause any problems. However, by using his methods of proof, he discovered that there was no common fraction that would give the value of the square root of two. Thus the length of the hypotenuse could not be expressed with any number that was in Pythagoras' universe. "Natural numbers and their ratios rule the universe, Pythagoras believed. Hence what he had proved was a challenge to his faith. The numbers which he worshiped were ineffectual in a simple situation!" (Kramer 28) "The discovery of . . . the irrational was a blow to the belief that here is a

proportion or harmony in all things . . . ." (McInerny 42) A direct result of this discovery was also the disintegration of the theory on how the world was put together. Obviously, if the world was constructed as a result of distinct points coming together in various forms, then every shape must be created this way, but because of the existence of irrational numbers, this theory was destroyed. Hence the universe must be constructed by some other means. This problem of irrational numbers was never resolved by Pythagoras or his followers.

Pythagoras made many contributions to the mathematical world. Perhaps the most profound was the discovery of irrational numbers. The step from rational to irrational numbers is considered by mathematicians to be a huge conceptual leap. The irony is that while Pythagoras was able to make this step, he never made the relatively small step from irrational numbers to real numbers which are simply the union of positive and negative rational and irrational numbers. This is because of his mysticism in dealing with numbers. To make the bridge between irrational and real numbers, all that is required is to add negative numbers; but because his philosophy allowed for no negation he missed this opportunity to complete the set of numbers and thus prevented himself from making an even greater contribution to mathematics.

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