

## What is the greatest mathematical creation of all time?



Richard Muller, Prof. Physics UC Berkeley, author "Physics for Future Presidents"

Updated May 21 · Upvoted by [Mathieu Dutour Sikiric](#), PhD in math, about 50 published papers and [W Richard Stark](#), Professor of Mathematics, University of South Florida, since 1977.

The fact that the square-root of two cannot be expressed as the ratio of two integers. This was done by the Pythagoreans. What made it spectacular is that it was the first "truth" that never could have been discovered experimentally. The truth of this theorem lies only within the human mind. And yet the proof is so simple it can be understood by a high school student.

Here is a quote from my book [Now: The Physics of Time](#):

—beginning of excerpt from [Now](#)-----

The Pythagoreans, about 600 BC discovered that the square root of 2 could not be written as a ratio of integers. As a result, they called them *irrational*. Not rational. Crazy.

This may sound like an arcane mathematical matter, but think about it. How could you ever be sure that statement is true? After all, the square-root of 2 is not a particularly weird number; it is the length of the hypotenuse of a right triangle whose arms each have length 1. Physical measurement could not possibly conclude that the number is irrational. You could never try all possible integer combinations. Suppose I told you that the square root of two was equal to 1,607,521 divided by 1,136,689. It isn't, but that fraction is very close. Try it; do the division on your calculator and then square it. Or use a spreadsheet....

One even more astonishing fact about the irrationality of the square-root of 2, something that shows how extraordinary this fact truly is—is that it was discovered only once in the history of civilization. All other statements of this fact around the world can trace the origin of their knowledge to the work of the Greek mathematicians.

—end of excerpt----

Here's a quick proof: We will assume that  $\sqrt{2}$  can be written as the ratio of two integers,  $p/q$ , where either  $p$  or  $q$  is an odd number. (If they are both even, then cancel the common factor of 2 and repeat until at least one is odd.) And then reach a contradiction. That will demonstrate that the original assumption was false.

$$\sqrt{2} = p/q$$

$$p = q\sqrt{2}$$

**Square both sides:**

$$p^2 = 2q^2$$

Since  $p^2$  is a multiple of 2, that means that  $p^2$  is even. But then  $p$  is even, since the square of an odd number is always odd. (If you don't know that, then it is easy to prove. Any odd number can be written as an even number plus 1. Square that, and you'll see you get an odd number.)

Since  $p$  is even, write it as  $2m$ . Now plug into the equation:

$$p^2 = 2q^2$$

$$(2m)^2 = 2q^2$$

$$4m^2 = 2q^2$$

$$2m^2 = q^2$$

That means that  $q^2$  is even, and therefore so is  $q$ .

That is a contradiction. We had said that at least one of  $p$  and  $q$  must be odd, but we've shown both are even. Therefore our assumption that we can write  $\sqrt{2} = p/q$  is false.

If this intrigues you, here's another excerpt from my book [Now](#).

—excerpt from [Now](#) -----

According to legend, the Pythagoreans were so upset by the discovery that the square-root of 2 is irrational that they threw Hippasus, the man who discovered it, overboard from a boat. (The modern metaphor is “throw him under a bus.”) Hippasus’s proof may have been similar to the one I give [above], but there are nice alternative proofs, one based on geometry.

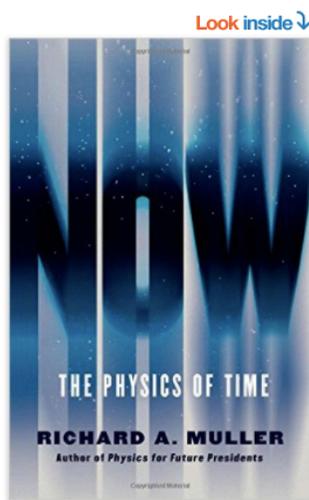
According to another version of the legend, the Pythagoreans considered the discovery of the nature of the square-root of 2 to be so profound that it became the foundation of their religion. In that story, they threw Hippasus overboard to punish him for having revealed this great secret to outsiders. But it is certainly true that the Pythagoreans had uncovered in this theorem the deep truth that there is knowledge that exists outside of physical reality, a truth so astonishing that they revealed it only to those sworn into the Pythagorean faith. Hippasus had discovered that nonphysical truth, truth that defies physical verification, does indeed exist.

## Now: The Physics of Time 1st Edition

by Richard A. Muller (Author)

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