Let Platonism die

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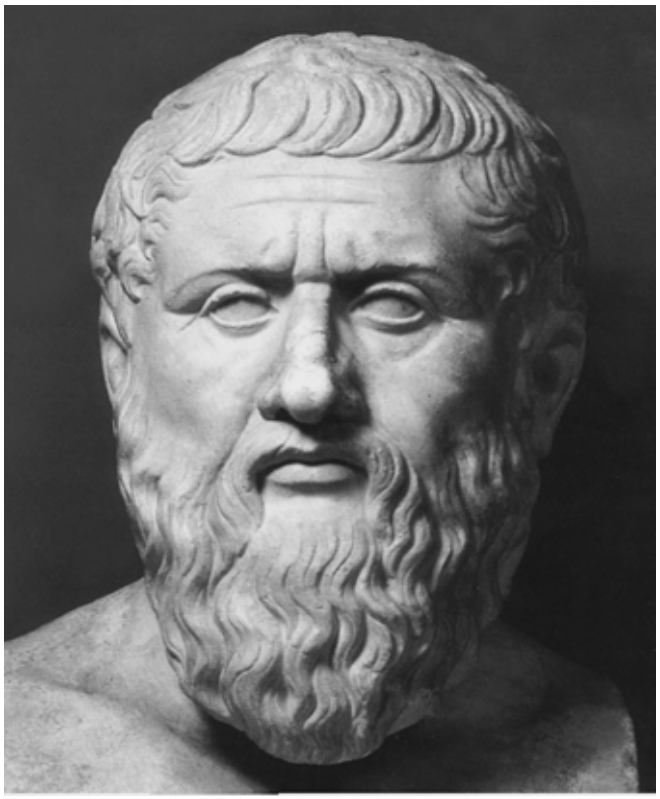

Over the last few years I have noticed that a number of Fields medallists and other famous mathematicians are being asked by interviewers whether they are Platonists. Many are quite unprepared for this question and try to evade it, or give answers which indicate that they have not thought seriously about it.

Mathematical Platonism comes in many flavours, but two particular elements are usually present. One is the assertion that there exists a mathematical realm outside the confines of space and time in which ideal forms of mathematical entities exist. This should be taken literally – the realm is independent of human society and would exist even if human beings had never evolved. Theorems are statements about the properties of these mathematical entities, so their truth does not depend on whether anyone has a proof or even of whether there could be a proof (pace Gödel). If you believe that theorems are objectively true before they have been proved, but that mathematics is a creation of human beings in much the same way as music, law and chess are, then you are not a Platonist. I do not want to discuss this aspect of Platonism, about which much has been written, [1,3].

The other aspect of Platonism is that it involves a definite claim about the way the human brain functions. Platonists believe that our understanding of mathematics involves a type of perception of the Platonic realm, and that our brains therefore have the capacity to reach beyond the confines of the physical world as currently understood, albeit after a long period of intense concentration. If one does not believe this then the existence of the Platonic realm has literally no significance. This type of claim has more in common with mystical religions than with modern science. This is not surprising, because Platonism grew out of the Pythagorean mystery religion, in which mathematics played a key role.

Although he is a Platonist, Roger Penrose is almost unique in accepting that his beliefs imply that the mathematical brain cannot obey the known laws of physics. His proposals for resolving this problem involve microtubules, and are not generally accepted, [5].

The beliefs of most Platonists are based on gut instincts – strong convictions reinforced by years of immersion in their subject. However, scientifically testable claims are not settled by taking a poll of the opinions of people who have never done any experiments to verify them, even if there is a limited entertainment value observing people reacting to unexpected questions. It seems to have escaped the notice of many Platonists that scientific investigations into the mental processes underlying mathematical understanding are now starting to be carried out. Just as the belief of Kant and many others that Euclidean geometry was the inevitable basis of human thought collapsed, intuitively based claims about how our brains allow us to do mathematics are almost certain to be wrong.

Almost everything that we have learned by scientific experiments about the way our brains operate is not only different from what had previously been thought, but pretty bizarre. One example, related to our geometrical abilities, will have to suffice. Investigation of the brain's processing of vision show that the image that impinges on our retinas is analyzed in a variety of different ways, into edges of various orientations, colours, etc. which are sent to the brain separately. It then constructs a three-dimensional 'image' of what the outside world might be like by combining these fragments with other contextual clues, including the memory of the observer. Many types of optical illusion show that this construction can easily fail to match reality. Whether or not an illusion disappears as soon as one realizes that it is one depends on the depth at which it is generated. It is worth mentioning that the investigation of optical illusions is now a subfield of experimental psychology, [4].

The study of our sense of number is in its infancy, but one of the most interesting discoveries is that reasoning about numbers is not a function of general intelligence, [2]. It depends on the successful integration of a number of different modules, or circuits, whose locations in the

brain can be identified by using imaging techniques based on measuring oxygen uptake. Numbers below five are recognized using circuits, common to many other animals, that are different from those brought into play by humans for larger numbers. If these circuits are damaged in a stroke, it is quite possible for the person affected to have perfectly normal reasoning powers in all situations not involving numbers, but to be unable to see the distinction between 5 and 8. Dyscalculia is now a recognised disability, and this type has a purely physiological basis. These studies are proceeding systematically and are beginning to provide a genuine understanding of the basis of our mathematical abilities. They owe nothing to Platonism, whose main function is to contribute a feeling of security in those who are believers. Its other function has been to provide employment for hundreds of philosophers vainly trying to reconcile it with everything we know about the world. It is about time that we recognised that mathematics is not different in type from all our other, equally remarkable, mental skills and ditched the last remnant of this ancient religion.

References

1 Balaguer M.: *Platonism and Anti-Platonism in Mathematics*. Oxford Univ. Press, New York, 1998.

2 Butterworth B.: *The Mathematical Brain*. Macmillan, 1999.

3 Davies E.B.: *Science in the Looking Glass*. Oxford Univ. Press, Oxford, 2003.

4 Hoffman D.D.: *Visual Intelligence*. W W Norton, New York, 1998.

5 Penrose R.: *Shadows of the Mind*. Oxford Univ. Press, Oxford, 1994.

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