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Mathematical Explanation

Mathematics is often claimed to be essential for science. While extensive use is made of mathematics, it is far from clear that it plays the same sort of role in explaining and understanding that the rest of science plays. An interesting recent example concerns the 17 year life-cycle of the cicada. Why that long? Because 17 is a prime number. Of course, more is involved, but it is claimed that primarily is part of the explanation. I shall argue that this is misconceived. Mathematics, in this sense of explanation, explains nothing in the natural world. On the other hand, there is a second sense of explanation—understanding, as in "I want to understand your theory; please explain it to me." What do we understand of, say, physical properties such as the spin of an electron? Can it be explained, in the sense of providing understanding? I would say that we know nothing, except that electron spin is in some sense analogous to a certain matrix, and so on. In this sense of explanation, namely, understanding, mathematics is often essential. The only understanding we have of the spin of an electron (and of much in the world), is by means of mathematical structures that we do understand and that we conjecture to be structurally similar to the natural world. So, mathematics is essential to science, but only in the second sense.