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🏠 Current Issue

About Notices

From the Secretary

Full Issues

Features

Career

Topical Columns

Reviews

What Is ...

Notices Media Kit

👤 Join the AMS



EARLY CAREER

What Does a Mathematician Do?

William Thurston

The following question appeared on mathoverflow.net, and it was answered by the late William Thurston in October of 2010. We republish it here with the permission of Bill's widow, Julian Muriel Thurston.

Question: I find that mathematics is made by people like Gauss and Euler—while it may be possible to learn their work and understand it, nothing new is created by doing this. One can rewrite their books in modern language and notation or guide others to learn it too, but I never believed this was the significant part of a mathematicians work; which would be the creation of original mathematics. It seems entirely plausible that, with all the tremendously clever people working so hard on mathematics, there is nothing left for someone such as myself (who would be the first to admit they do not have any special talent in the field) to do. Perhaps my value would be to act more like cannon fodder? Since just sending in *enough* men in will surely break through some barrier.

Answer: It's not mathematics that you need to contribute to. It's deeper than that: how might you contribute to humanity, and even deeper, to the well-being of the world, by pursuing mathematics? Such a question is not possible to answer in a purely intellectual way, because the effects of our actions go far beyond our understanding. We are deeply social and deeply instinctual animals, so much that our well-being depends on many things we do that are hard to explain in an intellectual way. That is why you do well to follow your heart and your passion. Bare reason is likely to lead you astray. None of us are smart and wise enough to figure it out intellectually.

The product of mathematics is clarity and understanding. Not theorems, by themselves. Is there, for example any real reason that even such famous results as Fermat's Last Theorem, or the Poincaré conjecture, really matter? Their real importance is not in their specific statements, but their role in challenging our understanding, presenting challenges that led to mathematical developments that increased our understanding.

The world does not suffer from an oversupply of clarity and understanding (to put it mildly). How and whether specific mathematics might lead to improving the world (whatever that means) is usually impossible to tease out, but mathematics collectively is extremely important.

I think of mathematics as having a large component of psychology, because of its strong dependence on human minds. Dehumanized mathematics would be more like computer code, which is very different. Mathematical ideas, even simple ideas, are often hard to transplant from mind to mind. There are many ideas in mathematics that may be hard to get, but they are easy once you get them. Because of this, mathematical understanding does not expand in a monotone direction. Our understanding frequently deteriorates as well. There are several obvious mechanisms of decay. The experts in a subject retire and die, or simply move on to other subjects and forget. Mathematics is commonly explained and recorded in symbolic and concrete forms that are easy to communicate, rather than in conceptual forms that are easy to understand once communicated. Translation in the direction conceptual → concrete and symbolic is much easier than translation in the reverse direction, and symbolic forms often replaces the conceptual forms of understanding. And mathematical conventions and taken-for-granted knowledge change, so older texts may become hard to understand.

In short, mathematics only exists in a living community of mathematicians that spreads understanding and breathe life into ideas both old and new. The real satisfaction from mathematics is in learning from others and sharing with others. All of us have clear understanding of a few things and murky concepts of many more. There is no way to run out of ideas in need of clarification. The question of who is the first person to ever set foot on some square meter of land is really secondary. Revolutionary change does matter, but revolutions are few, and they are not self-sustaining—they depend very heavily on the community of mathematicians.

Source: <https://mathoverflow.net/questions/43690/whats-a-mathematician-to-do/44213#44213>

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