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ABOUT THE COVER: A NEW MATHEMATICAL CELEBRITY

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There are relatively few stories of unrecognized genius at a late age in mathematics. The best-known story is that of Ramanujan, who developed his own way of thinking before his extraordinary gifts were spotted, after childhood, by Hardy. However Ramanujan was only 26 when he arrived in Cambridge.

More usual is Gauss's story, whose genius began to be appreciated in his early teens, and who finished the first draft of his great book *Disquisitiones Arithmeticae* by the time he was 21. These days, great mathematicians are usually spotted young, their potential developed at a top research institution with a top mathematician advising, to eventually emerge in their twenties, establishing fundamental results that change their subject. In number theory, the names Terence Tao and Peter Scholze come to mind, both of whom fit this mold, though it must be stressed that their extraordinary achievements are their own, even if their mentors provided them with guidance and excellent opportunities.

Questions about patterns in the prime numbers are amongst the oldest in mathematics. Even in ancient Alexandria, mathematicians such as Euclid were fascinated by prime numbers of special forms (such as the Mersenne primes). There is some evidence that the ancients may have been interested in prime twins (pairs of primes that differ by 2), prime triplets, and more. Certainly such questions have been passed down to us [8, 11], and have remained as some of the more intractable in mathematics.

In April 2013, Yitang Zhang, a fifty-seven year old lecturer at the University of New Hampshire, submitted a manuscript to the *Annals of Mathematics*, claiming an extraordinary breakthrough on the twin prime question—that there are infinitely many pairs of primes that differ by no more than seventy million. Finally a finite bound, but *by whom*? Zhang had, up to that time, one published paper and a preprint on the arXiv, which contained a mistake, and so was very much an "outsider". Yet his preprint [15] was so well written that it was quickly acknowledged

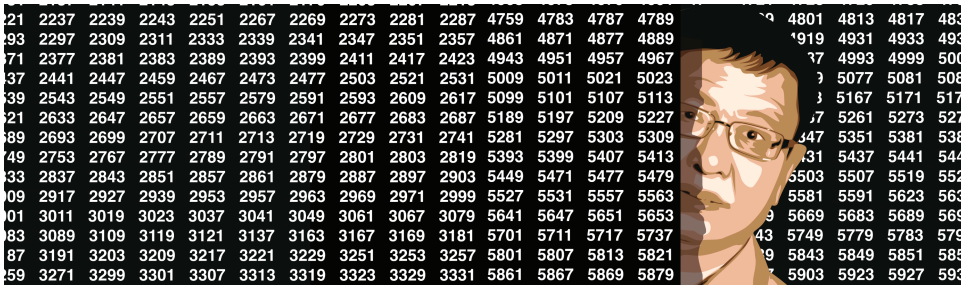

FIGURE 1. Clear copy of the cover. This image of "Yitang Zhang and his primes" by Daniel Hertzberg originally appeared in Nautilus magazine (`nautil.us`) [13]. Used with permission.

as being correct and led to important further developments [10, 12, 14] (and we now know that there are infinitely many pairs of primes that differ by no more than 246).

It is to the credit of the mathematical community that this preprint, with such extraordinary claims by someone far removed from the usual suspects, was quickly accepted as correct (as opposed to the many other claims of great advances on famous open problems, which the experts rapidly dismiss). But there is a good reason for that: Zhang followed the ideas initiated by Goldston, Pintz, and Yıldırım [7] in 2005, brilliantly developing techniques from the important papers of Bombieri, Friedlander, and Iwaniec [1–3, 6], and even Deligne [5], writing his proof as if he had spent his lifetime immersed in these deep and difficult techniques. The mathematics behind these developments is explored in my article at the beginning of this issue of the *Bulletin of the AMS*.

Zhang's story has caught the imagination of many people, not just within mathematics, but also in the wider community. He has been profiled in magazines and newspapers (see, for example, the excellent news release [9] which most newspaper articles have been based on), and there are a variety of "hooks" on which journalists have chosen to hang this story in the more than 100 news articles that have appeared around the world. For example the cover to this issue of the *Bulletin* (see Figure 1) is taken from the header of the article [13], in which the author writes "The lone, unrecognized genius laboring away on a groundbreaking theory over many years is more fiction than fact for most of modern science—but not in mathematics." The beautiful illustration by Daniel Hertzberg does capture this view.

There is even a full-length documentary [4], now being edited by George Csicsery, examining the mathematics as well as the extraordinary life story of Yitang Zhang.

Zhang's amazing breakthrough has received some important recognition—the 2014 Frank Nelson Cole Prize (the world's top prize for number theory), the 2013 Ostrowski Prize, the 2013 Morningside Special Achievement Award in Mathamatics, the 2014 Rolf Schock Prize in Mathematics, and a 2014 MacArthur "Genius Grant", which is usually given to very much younger people in recognition of their great achievements.

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