NSF—A Wake-up Call

NSF 2005

The NSF (National Science Foundation) is a key component of the nation's investment in basic research and in developing scientific talent. The NSF, the National Institutes of Health, and the Department of Energy's Office of Science are the nation's three main sources of basic research investments. For the mathematical sciences, the NSF currently provides 77 percent of federal research investments, and I focus here for simplicity's sake on the NSF's role in the nation's investment in the future. My readings, observations, and travels over the years since leaving the directorship of the NSF's Division of Mathematical Sciences (DMS) have convinced me that we are not even remotely doing enough to live up to our current leadership role in science and technology. We were thrust into this post-WWII leadership role by visionaries advancing the public investment in our future with boldness, and, with the scientific community's sense of common purpose, this advocacy was very successful. The results have been truly magnificent. The investments have massively contributed to our prosperity, health, and security. It is generally accepted by the economic community that more than half of our economic growth is the result of these investments. Basic research is the driver of innovation. Knowledge creation translates into economic growth. Much of this innovation has spurred the current worldwide dynamics in science, engineering, and technology. But this global spread has turned into an economic race in which we are not running at our capacity—in any case, we are not running sufficiently fast to live up to our leadership responsibility.

There is no lack of evidence that U.S. leadership in science and technology is at risk, threatening our scientific capabilities and future economic competitiveness. Even our trade balance for high-tech products is now running a yearly deficit exceeding $30 billion. Yet our superior innovative capabilities are still seen as the basis of our economic strength. Another long-term indicator is the U.S. share of worldwide undergraduate science and technology degrees awarded, which drops year by year (in the year 2000, about 500,000 such degrees in North America, versus 850,000 in Europe, including Russia, and 1,200,000 in Asian universities). We are not investing enough in basic research, and we are not investing enough in people. The poor state of mathematics and science education in our schools is strongly related. This puts our nation in jeopardy.

The country needs to resolve to act more purposefully and more boldly on its science and technology agenda. A structural impediment is the fact that expenditures and investments in the federal household are lumped together into the same cash budget, with outlays exceeding income by a vast amount. No business could operate on a pure yearly cash basis, neglecting investments which affect business year after year, let alone generation after generation. There is no way to balance the federal budget by squeezing investments in our scientific future.

Our investments in basic research, as well as mathematics and science education, need to increase at a high rate. This is not news to Congress and the president, as exemplified in Public Law 107-368 (December 2002), aka the "NSF doubling bill", authorizing a doubling of NSF appropriations over the five-year period from 2003 to 2007. But the appropriation process systematically crowds out investments in our future by paying attention to more immediate needs. The NSF budget request for FY 2006 is close to $3 billion below this authorized target.

What about the mathematical sciences? Funding research in the mathematical sciences has fared relatively well at the NSF over the last few years, but not so at other federal agencies supporting science. But even the NSF's support of the mathematical sciences as a priority area is faltering in the budget request for FY 2006. It contains language about the mathematical sciences being a priority area, but not a single additional dollar is requested for the DMS above the FY 2005 level. This is a good intervention opportunity for the mathematical sciences community to raise its voice. Ask the NSF leadership and your congressional representatives to support an increase in funding for the DMS, currently budgeted at $200 million (the exact figure is $200.38 million). Ask your provost, chancellor, or president for help with this specific request. If your letter is addressed to Congress, ask first and foremost for a FY 2006 budget for the NSF of $6.1 billion. What about the longer term? While the mathematical sciences are generally understood to be critical for progress in science and technology, funding for the mathematical sciences will keep pace with expanding needs only if the trend in federal funding of basic research takes a dramatic turn for the better.

What is needed? The federal research budget is the most important investment in continued American scientific and economic leadership. A threefold investment in the NSF's portfolio is a target to aim at. The current success rate for NSF proposals is drifting toward a low 20 percent, and an incredible amount of first-class research is left unfunded. Many mathematics and science education innovations are not tested in pilot programs for future widespread implementation in our faltering public schools. This ultimately means an underinvestment in the development of our scientific work force at the very time when a soon-to-retire scientific work force is going to have to be replaced. At the same time, it is a fantastic opportunity to involve the increasingly diverse population in this national effort and requires a massive national effort in mathematics and science education.

—Philippe Tondeur
Professor Emeritus of Mathematics
University of Illinois, Urbana-Champaign
Director, Division of Mathematical Sciences
National Science Foundation, 1999–2002

A Connected Department

The interesting article by Jerrold Grossman ("Patterns of research in mathematics") prompted me to discover that I work in a connected department (http://www.mth.uea.ac.uk/~h720/connected.pdf). What makes this a little surprising is that we cover research areas from model theory to oceanography, and we remain connected without the Erdős vertex.

—Tom Ward
University of East Anglia
T.Ward@uea.ac.uk
(Received January 31, 2005)

Consequences of Excluding Religious Comments in Obituaries

In reference to the letter of P. Nevai, *Notices* AMS, February 2005, if you want to exclude politics, then please also exclude this type of letter. If a writer of obituaries cannot say "God gave her an easy death," then you had better exclude any sympathy or fellow feeling and resign yourself to the ice age of Nevai's kind of childish, ill-tempered political correctness. That would be a pity.

—Henry McKean
Courant Institute of Mathematical Sciences, New York University
mckean@cims.nyu.edu
(Received February 7, 2005)

Review of The Golden Ratio

It is unfortunate that the editors of the *Notices* chose to allocate four full pages to a biased and self-serving "review" of a book intended for a lay audience. Rather than presenting an overview of Mario Livio's 304-page book *The Golden Ratio* (*Notices*, March 2005), together with thoughtful commentary, George Markowsky seemed more intent on promoting his own 1992 College Mathematics Journal article "Misconceptions about the Golden Ratio". Much of the review focuses on repeated claims that Livio did not sufficiently acknowledge that article: [Livio] "closely parallels my paper but does not cite the paper either in the text or in the notes to the text", "does not reference my paper", "does not quote my conclusion", "follows my paper closely without giving any attribution", "no citations are given to my work", etc. Markowsky finally admits, in the penultimate paragraph, that "Livio is aware of my paper and quotes it in various places, [but] it is not even mentioned in the notes for" Chapter 3. Apparently, one of Markowsky's main complaints is that his CMJ paper was simply not cited often enough—of course, his review compensated for that with more than a dozen references to his own paper.

The fault is not with Dr. Markowsky, who is certainly entitled to his opinion. Rather, the blame for publishing such an unfair review lies squarely with the editors. They should have questioned the objectivity of such an obviously malicious review that accuses the book's author of doing "a disservice to mathematics" and of "sloppy scholarship", and says that the author "seems interested in spawning some new myths", makes "dubious claims", cites a "ridiculous formula", and "repeats a lot of nonsense". *The Golden Ratio* won Livio the 2003 Italian "Peano Prize" (http://www.dm.unito.it/mathesis/ppeano2003.html), and the 2004 "International Pythagoras Prize" (http://143.225.237.3/News/Premio%20internazionale%20Pitagora.htm) for the best book on mathematics (the same year Andrew Wiles won the IPP for mathematical achievement), and the *Notices*' readers should know that Livio's book has been extremely successful in bringing some of the beauty of mathematics to the masses. Even the 2003 paperback edition carried praise of "wonderful" by Roger Penrose, "eloquent" by *Newsweek*, and "Mysterious, beautiful...a truly splendid text" by the *Los Angeles Times*. Markowsky's biased analysis is certainly not up to the standards expected by readers of the *Notices*. The editors should publish an apology to Livio, and to AMS members, for presenting such an unbalanced review.

—Theodore P. Hill
Georgia Institute of Technology
hill@math.gatech.edu
(Received March 18, 2005)

Reply to Hill

It is a serious disservice to mathematics to continue to peddle discredited stories about the golden ratio. Certainly, we can find material to interest lay audiences in mathematics that is based on fact. If authors wish to use fiction to interest people in mathematics, e.g., Flatland, they should label it as such. Interestingly enough, Hill does not directly address the points raised in my review, but directs a lot of sound and fury at the *Notices* for publishing such a review. The references to my paper provide the reader an opportunity to investigate the claims made in the review. If there are many references, it is because there were many errors that needed to be addressed. Readers should check the references provided and review the points and decide for themselves whether the review is biased. All mathematics books, even ones intended for lay audiences, should be accurate and conform to accepted standards of scholarship. It is time for the mathematics community to retire the golden ratio mumbo-jumbo from mathematical writing.

—George Markowsky
University of Maine
markov@maine.edu
(Received April 1, 2005)

Foreign-Born Presidents

In the Allyn Jackson interview with James Arthur (*Notices*, March 2005), the fifty-eighth president of the AMS mentioned two other Canadians who also served as president: Cathleen Morawetz and Irving Kaplansky. I might point out that Simon Newcomb, the fourth president of the Society, was born in Nova Scotia. Arthur is correct in his belief that he is the first AMS president to live outside the U.S. at the time of his election. His conviction applies not only to the other three Canadians but to presidents born in Russia (F. Browder, S. Lefschetz, and O. Zariski), England (E. W. Brown and F. Morley), Hungary (J. von Neumann and P. Lax), Germany (M. Artin and R. Brauer), Latvia (L. Bers), Poland (N. Jacobson), and Sweden (E. Hille). This list illustrates the fact that the AMS has been an international enterprise for most of its existence.

—David E. Zitarelli
Temple University
zit@temple.edu
(Received March 27, 2005)

Weil's Letter to His Sister

Although the *Notices* does not normally reprint material that has been published elsewhere in English, I was glad to see that an exception was made for Martin Krieger's translation of André Weil's March 1940 letter to his sister, Simone (*Notices*, March 2005). Three matters

about this letter strike me as deserving comment.

The first is that although the body of the letter is mathematical and may not seem to be of great interest to people far removed from algebra, the postscript, occupying page 341, is of immediate general interest. It makes at least four points. The first point is that Weil's letter is a reply to a specific question from his sister: How does a mathematician develop a research program? One must remember that the sister was a famous philosopher and that her interest in this question was likely professional as well as personal. Thus Weil's answer has to be regarded as a really serious attempt to answer the question well. A second point is an acknowledgement by Weil that E. Artin and H. Hasse understood well the analogy discussed at length in the letter. A third point is his view of the purpose of the writing by Bourbaki: that its intention was to "mass the troops," so as to keep them from "paying insufficient attention to each other and so waste their time." In other words, Bourbaki was presenting a body of mathematics that it regarded as the base for the most important and potentially most fruitful directions for future research; there was no claim that Bourbaki books were to be used as textbooks or were to be taken as models of good exposition. A fourth point is a statement that funding agencies in governments around the world would be wise to note: "[I]t is not possible to have someone who can master enough of both mathematics and physics at the same time to control their development alternatively or simultaneously; all attempts at 'planning' become grotesque and it is necessary to leave it to chance and to the specialists."

Krieger does not mention in his short *Notices* article but does say in his book *Doing Mathematics* that in 1960 Weil published a shorter but more pointed version of the discussion of the analogy that was central to the March 1940 letter. The 1960 paper, entitled "De la métaphysique aux mathématiques", appeared in a now defunct journal, *Sciences*, and it can be found in Volume II of Weil's *Collected Papers*. It was this paper that explicitly referred to the hunt for a Rosetta Stone.

To my mind an even clearer discussion of the analogy and the hunt for a Rosetta Stone appears in a preprint, "André Weil", I received from Armand Borel on October 23, 2000. Almost half of this preprint is devoted to interpreting Weil's "De la métaphysique". I have misplaced the correspondence that indicates where Borel's paper was to be published, but the place is not in anything currently listed in MathSciNet with him as author. So that anyone can view it, I have placed the preprint on my Web page at `http://www.math.sunysb.edu/~aknapp/BorelOnWeil.pdf`.

—Anthony W. Knapp
SUNY at Stony Brook
`aknapp@math.sunysb.edu`
(Received April 14, 2005)

High-Stakes Testing

If you wish to be really depressed about the state of American school mathematics education, then Frank Quinn's "Opinion" piece in the April *Notices* should be just the thing for you. He describes "high-stakes K–12 tests" as an "abomination" and gives some of the reasons for hating them. (Missing from these, however, is that their encouragement of direct instruction and discouragement of teacher initiative is sure to exacerbate even further the problem of recruiting highly competent teachers to teach elementary and high school mathematics.)

The depressing thing about Quinn's editorial is that he also calls such high-stakes tests "necessary" and says that such things as falling high school skills and embarrassing international rankings will not "change without high-stakes tests to provide discipline and accountability." Well, no one, I suppose, is against "discipline" or "accountability", but the discipline supplied by these tests is of just the wrong, least-common-denominator kind. And to expect useful accountability from high-stakes tests is to discard all the experience of pre-21st century schooling, when teachers provided accountability where it is really needed—directly to the parents of pupils.

Probably Quinn calls such tests necessary because they are mandated by the No Child Left Behind (NCLB) Act of 2002. Sadly, it will be a considerable number of years before it becomes clear that NCLB is the most destructive education act ever passed by the U.S. Congress. If research mathematicians accept that NCLB is here to stay rather than fighting tooth and nail to repeal it, they will, once again, have shown that they understand little about precollege mathematics.

—Anthony Ralston
SUNY at Buffalo
(Received April 15, 2005)

Reply to Ralston

In my article I tried to present both sides of the argument forcefully enough to suggest that neither is completely wrong and that both sides still have roles to play as we go forward. Personally I dislike test-driven education: I wasn't taught that way, wouldn't want to learn that way, and don't want to teach that way. On the other hand, the status quo really is unacceptable, and the anti-test community has been unable to find a realistic way to fix it. My personal ideal, for instance, would include a tax increase for higher teacher salaries, but pigs will fly before this happens. In any case, this battle is over, and tests have been chosen as the way to address the problem.

I believe Ralston is correct that the NCLB Act will be a disaster if implemented using current tests. It seems remotely possible that better tests might actually work. Ironically, it seems that improving the tests will be up to the people who would rather not have tests at all: advocates tend to think "a test is a test" and are not sensitive to the damage potential of bad tests. So I earnestly entreat those inclined to "fight tooth and nail" against tests to consider instead fighting tooth and nail in a battle not yet lost: against *bad* tests. This is harder of course—grey rather than black-and-white, subtle, and hard work. Those unwilling to help might at least be tolerant of people who agree philosophically but feel obligated to do *something* to try to mitigate the disaster.

Finally, this is a task that needs research mathematicians. "Good" and "bad" tests differ in content, not format. Implementing this requires sophisticated understanding of mathematical structure and how it builds over the curriculum, and the nature and roles of abstract and symbolic thinking. The same systemic failure that brought us testing also suggests that the professional educational community is not up to this task.

—Frank Quinn
Virginia Tech
`quinn@calvin.math.vt.edu`
(Received April 19, 2005)