Commentary

In My Opinion

The Triumph of Research

"Our new provost wants to require research for tenure and promotion. It's okay for me because I do research anyway, although it's unfair to some of the people who have been around for a while and away from research. They're upset by it." So said a new acquaintance, a recent Ph.D. I met at a conference in the spring of 1999, when asked what her department, a branch of a well-known southern state university, was like. I have heard variations of that statement for years. I could have made it myself twenty-five years ago. And like my colleague, I have no doubt that this change represents progress. In fact,

1) the conditions for university-based mathematics research in America are good;

2) there is a broad social consensus that mathematics research benefits people's lives;

3) we do not always recognize (1) and (2), but we should.

In the last half century of American higher education, university transitions like the one above are so commonplace, and the assumptions and commitment behind them are so much a part of conventional wisdom, that the transition seems, if not inevitable, then at least unremarkable. It is neither. Things could have been different, and the American mathematics community and its range of research could have been far less robust.

Start with the assumptions: In addition to the basic belief that a better university results if faculty do research, there is the notion that the model for research is the individual investigator working on projects that he/she selects. The consensus for this model is so strong that alternatives sound like violations of academic freedom: imagine the department head calling you in to tell you that for the next quarter you are being taken off the four-manifolds project to be reassigned and you will be working on the large data sets in the Galois theory strategic initiative instead; you will be part of a team made up of Professors X, Y, and Z, with Professor W in charge; and you are to report your progress monthly. If this sounds too fantastic, remember that it is not unusual, at least in some components of one's teaching assignment, to move from service course to service course by quarter or semester as department needs change, essentially at the discretion of the department's course-scheduling officer, and for multisection courses to be part of a team of instructors that has been assembled in an ad hoc manner. In other words, it is at least conceivable that something other than the existing research arrangement could have been put into place.

And let us not forget the financial commitment the academic institutions are making to sustain this research environment. Assume that in the typical research department 40 percent of a faculty member's effort is supposed to go to research. Now figure forty faculty in the average research mathematics department, and the collective financial commitment for salary alone for the research departments runs to hundreds of millions of dollars every year.

Any fair assessment of the assumptions and commitment to mathematics research in the American system of higher education has to judge it a triumph for mathematics. The mathematics community has not only benefited from the past half century of these developments, it has actively urged and supported them. However, I think it would be difficult to argue that we in any way *caused* them. Despite our Washington work, our public relations efforts, or our engagement with other science and education communities, valuable as these are, universities' decisions to require research seem to be driven by deeper forces. For example, the colleague's institution cited at the beginning of these comments definitely did not decide to require research because of any lobbying by the mathematics community.

I also find it remarkable that the conversions to research have been so resilient: one would expect at least a few instances where smaller departments, enjoying neither strong financial support nor selective student bodies, only recently beginning to require research, would abandon the enterprise. But even after a decade of hounding by the political enemies of tenure, academic freedom, and investigator-selected research, there seems to be no sign of even isolated reversions, much less a trend.

I want to acknowledge that the rosy picture being painted here has some shadows. Some of the impetus to support and emphasize university research in recent years stems from a desire by university administrators to collect the financial benefits of external funding. And while there is some evidence that one of the reasons universities earlier in the century chose to encourage faculty research was to improve the quality of instruction, the exact relation between research creativity and enhanced teaching of mathematics has not been completely sorted out.

The American mathematics community and our Society need to be (and are) attentive to the opportunities to tweak public opinion and academic policy in the best interests of mathematics and mathematicians. We also need to remember that we enjoy the fruits of a (not always explicitly articulated) public consensus on the value of research, on the individual investigator model, for an ever widening range of institutional contexts, a movement which, as my colleague's story reminds me, is still going strong after at least half a century and which, in my opinion, suggests that American mathematics research still has a predictably solid base and secure future.

—Andy Magid
Associate Editor

Letters to the Editor

Change Terminology at the Turn of the Century

Recalling the day when the Swedes all took to the road and switched from driving on the left side to the right, I wonder if the scientific and mathematical communities would be interested in using the turn of the century as an occasion to change certain conventions that should have been different. An example that leaps to mind is the use of "covariant" and "contravariant" in differential geometry, which is backwards as seen from a modern viewpoint. Changing this usage would require the support of the physics community.

Perhaps a joint ad hoc committee could articulate proposed changes to be voted on by the membership of leading societies. For a few years, papers employing the new conventions would carry "warning labels" until the community adjusts to the new usage and the changes are relegated to footnotes in textbooks.

If this idea strikes a resonant chord and it is not too late, I call upon the AMS to be the vehicle to make it happen.

—R. Peter DeLong
Raytheon Systems Co.

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Source of Pictures Like the March Cover

This is a response to the beautiful cover picture of the March 1999 issue of the *Notices*. For those who find such pictures worth looking at, I invite them to visit my gallery of algebraic surfaces at `http://www.mathematik.uni-kl.de/~wwwagag/Galerie.html`. In addition to some more nice pictures, there is background information which I hope is useful for nonexperts.

—Bruce Hunt
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Census, Sampling, and Politics

David S. Moore (Commentary, *Notices*, March 1999) argues that the public interest is damaged by those who make political, legal, or procedural objections to the proposed use of statistical sampling for the U.S. Census. He thinks that the census should be done by nonpartisan experts and should not be subject to political questioning.

If statisticians want to stay out of political and legal controversies, then they should avoid disguising political opinions as scientific ones. Everyone agrees that sampling has scientific merit, but whether it should be applied to apportionment is a political question, and whether it can be applied under current law is a legal question. When statisticians say that sampling is more accurate than the constitutionally mandated "actual enumeration", they are being as foolish as those who argue that polling a carefully selected sample is more accurate than having a regular election. There is a theoretical point of view under which the registered voters who vote are in a biased subset of the set of all eligible voters, but we have election procedures which are subject to political requirements, and people prefer counting ballots over estimating them.

For example, some people think it is unfair that all states get exactly two senators under the U.S. Constitution, regardless of the size of the state. No doubt statisticians could devise a fairer system. But anyone advocating a change has the nearly impossible burden of making the political case that a change is needed and that a new system would be politically successful.

Likewise, there is no consensus that sampling is needed for apportionment or that such sampling can be done in a way that is demonstrably free from partisan bias. Some people think that we should count only those people who are willing to be counted, just as we count votes only from those willing to vote.

Maybe some day statisticians will have such respect that the public will blindly let their formulas determine how votes are weighted. But as long as they claim that scientific accuracy dictates a change in our method of political apportionment, then critics will be justified in saying there is a "thumb on the scale".

—Roger Schlafly
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Support Free Textbooks

I enjoyed reading Leonard Evens's letter, "Textbooks Could Be Free", *Notices*, May 1999. This is a big idea. All of us have to go all out for its realization.

—László Leindler
University of Szeged, Hungary

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The *Notices* invites letters from readers about mathematics and mathematics-related topics. Electronic submissions are best. Acceptable letters are usually limited to something under one printed page, and shorter letters are preferred. Accepted letters undergo light copyediting before publication. See the masthead for electronic and postal addresses for submissions.

Counterpoint

The Immigration Law of 1990 and Its Effects

Damon Scott

The dismal academic job market for mathematicians is now in its ninth consecutive year, judging from articles in the *Notices*. This year's choice quotation on the subject is by John Ewing, executive director of the AMS: "The problems young mathematicians face are deep, serious, and complex" [1].

Things might be looking up: in February 1999, the *Notices* reported a 3.1% unemployment rate for new Ph.D.'s in the profession, down from the double digits of only a few years previously [2, Table 3C]. All the data from that latest AMS Annual Survey appear to indicate a real and very welcome improvement in the job market. But no one knows what is causing the recent upturn or whether it will last, and other statistics, such as the number of applications per vacancy, are still very high and remain demoralizing for many applicants. We should not turn from the question of job markets because of an apparent recent upturn. Even if the malady is cured (which I doubt), the poor job markets of the 1990s still need to be examined in order to prevent a recurrence.

In December of 1997, Cora Sadosky wrote a *Notices* "Forum" in favor of open immigration in the profession. This essay is written as counterpoint.

The laws of supply and demand show that any job market is sure to suffer from high rates of immigration, and the only thing left to ponder is exactly how and in what form the suffering will occur. To bring lasting stability to the American job market and help American mathematicians in their careers, it is necessary to address the immigration issue plainly, forthrightly, and in a civil manner. The sides of the debate may generally be classified as those in favor of high immigration and those in favor of low. As a practical matter, the question on immigration boils down to this: What should be the level of scientific immigration into the United States in future years? And how many workers on temporary visas should we bring in as well?

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Editor's Note. *In 1997 the* Notices *planned a pair of articles taking opposing positions on the issue of immigration as it affects the mathematics profession. The first of those articles was by Cora Sadosky and appeared in the December 1997 issue, pages 1474–1477, but the second of those articles never appeared. An Editor's Note in the May 1998 issue, page 566, implicitly invited an article taking a position different from Sadosky's. The present essay responds to that invitation.*

The Immigration Law of 1990

In 1990 Congress passed a comprehensive immigration law [3] whose effects have been far reaching and profound. There are several useful commentaries on this law, for example [4], [5], [6], and [7]. As it pertains to the scientific and technical community, the law provides that 40,000 permanent visas per year, plus any unused visas from the priority worker category, be allotted to aliens with advanced degrees in professional fields or possessing exceptional abilities in the sciences, arts, or business [4, p. 3-7]. These are permanent visas; the temporary ones on the H-1B visa program currently allow 115,000 to be granted to technical workers annually [8]. Aliens may also be eligible by possessing a bachelor's degree in the field and five years' experience. Furthermore, in the words of [7], "while a petition in this category is normally filed by the employer seeking the services of the alien, the law permits the Attorney General to waive the requirement of a job offer for the alien's services in the sciences, arts, or business when it is deemed to be in the national interest." Also, as the same commentary put it, "It can be anticipated that the preference will not use all the visas assigned to it, assuring that visas will be available on a current basis for natives of most countries."

The term "exceptional ability" is not defined by the statute [4, p. 3-8], and its interpretation is left almost entirely to the discretion of the federal executive. Such an exemption can be legitimately granted to nearly everyone, to nearly no one, or anywhere in between. To determine what to make of this provision and the law as a whole, it may be advisable to look at the raw 40,000-immigrants-per-annum figure that is directly mentioned in the law. The terms of the law set forth truly massive immigration into the American scientific and technical professions.

Immigration and Its Effects

The effects of massive immigration are overwhelming. No number of interview facilities, employment projects, or requests for funding increases can possibly prevail against the tremendous market forces of a global supply of mathematicians being readily employed to meet a demand that is only domestic.

The 1998 Annual Survey [2] reports, via Table 3E, that only 58% of the 487 academic jobs in mathematics going to new Ph.D.'s in this country went to United States citizens. Among tenured and tenure-eligible hires in Ph.D.-granting departments, the figure is 45%, approximately unchanged from 46% in 1992 [9]. And in 1997 a report by the Commission on Professionals in Science and Technology stated that those immigrants on temporary visas alone occupy over half the 25,000 postdoctoral positions in science in the country [10].

The large-scale use of "part-time" laborers at pitiful wages is but a symptom of this problem. Calling these people "part-timers" is a misnomer, since they often work as many hours as "full-time" professors as they try to cobble together a living from their miserable pay. A more appropriate term is "part-wagers", since their salary and benefits are a mere fraction of the otherwise prevailing

standard. Immigration is without doubt a substantial cause, for it is only by having access to a glutted supply at some level that colleges and universities are able to hire at this level with such wages and working conditions.

Sadosky's essay refers, via her reference 10, to a data brief released by the NSF [11]. According to this document, the number of scientists and engineers gaining permanent visas (called S&E's) was steady at about 12,000 annually during the 1980s, climbed dramatically starting in 1990, until it nearly doubled to 23,534 in 1993, and then declined 26% to 17,403 in 1994. Here the data stop, though the data brief was released in June of 1997. A November 1997 *Notices* account (p. 1333) of an NSF news release on the data brief says that "the latest data indicate that what observers thought was a major, long-term rise in skilled immigrants was only a temporary surge." Obviously, the data indicate both a temporary surge—a huge one, in fact—and a long-term rise in annual immigration of S&E's on permanent visas for the years in question.

Unreported in all this is the use of "nonimmigrants" (as federal law distinctly calls them [12]) on temporary visas. These visas last for six years [13]. But however complicated (and currently not quite adequately reported) is the situation, one thing is clear: immigration (and even "nonimmigration") is a very significant part of the overall employment picture and is able singlehandedly to affect the American job market dramatically.

Central Thesis versus Central Thesis

Let us turn now to the central thesis of the Sadosky essay, printed in italics in the original: *It is imperative that the xenophobic "foreigners are getting all the jobs" does not become a rallying cry for inaction on the real causes of the problem.*

First to be noticed is the use of the term "xenophobic" from psychiatry. Not only is the term extreme and inappropriate, it is also inaccurate. Never once have I met a mathematician who feared foreigners or who loathed foreigners, whatever his or her stand on immigration. Of course, no mathematician would ever say that "foreigners are getting all the jobs," if only because mathematicians are habitually scrupulous on the use of the quantifier "all". What is true is that persons of foreign citizenship are getting a large share of the mathematical jobs in this country, and by the laws of supply and demand this does affect the job market significantly and adversely.

The essay posits three other causes of the unemployment problem (paragraph 9): "declining overall Federal funding for basic research, declining states' funding for higher education, and university administrations applying corporate methods to handle the education boom …". Actually, the federal government has expanded expenditures for research, even with inflation taken into account. The annual appropriation from Congress to the NSF has risen from $1,737 million to $2,607 million from FY1988 to FY 1998 respectively [14, 15], an increase of about 50%. Since the Consumer Price Index has increased by about 37% in the same interval, the appropriation has actually increased in constant dollars. Furthermore, total scientific research (including the Institutes for Health, NASA, NSF, and other agencies, and specifically excluding any defense-related research) is packaged together in the United States budget under the title "Research Fund for America" and was $28,915 million in FY1998; there is a proposed 8% increase for the coming fiscal year [15]. As to total state support for higher education, what little information I could find on the subject indicated it was rising [16]. Incidentally, if these appropriations decline, it will be all the more reason, not all the less, for curtailing immigration in the profession. Finally, if anything plays into administrators' corporate methods, it is the high immigration rate, which, as explained above, gluts the job market and makes exploitive hiring practices possible.

Sadosky mentions another cause: declining enrollments in mathematics. Between 1990 and 1995 the enrollment in calculus declined 17% from 647,000 to 539,000 [17]. These figures represent a loss of well over 500 faculty positions, but more than that they show that Americans are simply retreating from the pursuit of mathematics, science, and engineering in general. (Calculus is, of course, the gateway course for all the technical professions.) The response of American government and industry to this news? Hardly a ripple. They know that the rest of the world is twenty times the size of the United States and can easily supply all the mathematics and science it could ever need now or in the future; all that is needed is to institute a policy of massive immigration. Many American students also have figured out how easily the country can do without their services in science and technology and are taking their careers and coursework elsewhere. The problem is well worthy of being addressed, but it will be solved only by restoring the job market, which itself will be accomplished, if at all, by better managing the one variable that can be set by statute, the immigration rate.

Since I see no evidence that government and industry are using less science and mathematics than in the past or employing fewer people to do it, the worsening of the total scientific job market appears to be due almost entirely to the immigration policies instituted in 1990. Despite various assertions to the contrary, high immigration rates do cause bad job markets, as is amply demonstrated by rudimentary considerations of economics, by the dynamics of salary and employment negotiations, and by common sense. *No American job market can possibly be anything other than dismal in the face of massive immigration from the entire rest of the world—and this statement remains true whether the domestic demand is high or low, rising or falling.* And no other industrialized country's job markets would be able to hold up under the strain of massive immigration either.

Special Immigration and Mass Immigration

As do nearly all proponents of open immigration, Sadosky cites some big names who immigrated to this country in times past: Sylvester, Noether, and, of course, Einstein. But the scientific and technical professions in this country have experienced tens of thousands of immigrants on permanent visas and hundreds of thousands of workers on temporary visas in this decade alone. Invocation of the great names of the past might, at best, justify the immi-

gration policies of those former ages, but it does nothing to justify the current immigration policy, which is completely different. If the United States wants the benefit of a few big names to come into this country, then that can be achieved with a rate of scientific immigration that is only a hundredth part—in fact, only a thousandth part—of the current immigration rate.

Conclusion

A news release printed in *SIAM News* in 1994 [18], commenting on the 62% increase in immigrant S&Es (on permanent visas) between the years 1991 and 1992, says that "such an abrupt increase after a decade of gradually rising immigration is the result of a 1990 change in the immigration law increasing quotas for highly skilled workers. It was a response to projections of a scientist shortage by NSF Director Erich Bloch." Even the quotas of the 1980s may have been too high: in 1989, mathematics departments were "being flooded with 500, 600, even 700 applications for a few positions" and "there is abundant anecdotal evidence about people having a surprisingly tough time finding jobs" [19]. After nine years of deteriorating job markets and employment conditions and in the face of growing collections of horror stories on the same [20], the provisions which Congress adopted in 1990 pertaining to scientific and technical immigration can be seen to be tremendous overkill, if not a move in the wrong direction entirely. The time is long overdue for these provisions of the Immigration Act of 1990 to be repealed. The United States simply does not have the capacity to provide a credible job market for everyone in the world, nor even to that fairly large subset of scientists of foreign citizenship who choose to pursue their graduate study in this country.

References

[1] JOHN EWING, Some advice for young mathematicians, *Notices* **45** (December 1998), 1452.

[2] PAUL W. DAVIS, JAMES W. MAXWELL, and KINDA M. REMICK, 1998 annual survey of the mathematical sciences (first report), *Notices* **46** (February 1999), 224–235.

[3] The Immigration Act of 1990, Public Law 101 - 649 (104 Stat 4978). Passed by Congress on October 27, 1990; signed by President Bush on November 29, 1990.

[4] HELEN A. SKLAR with STUART I. FOLINSKY, *The Immigration Act of 1990 Handbook: The Complete Practice Guide to the 1990 Act*, Immigration Law Library, Clark Boardman Co., 1991.

[5] PHILIP HORNIK, ed., 1995-96 edition of [4].

[6] STANLEY MAILMAN, *Immigration Based on Employment. The New Immigration Act of 1990: The Most Sweeping Reform of Our Legal Immigration System since 1952*, New York State Bar Association, 1991, pp. 95–145.

[7] Law firm of Fragomen, Del Rey and Bernsen, Immigration Law Report **9** (October 1990), 115.

[8] Temporary increase in skilled non-immigrant workers, Public Law 105 - 277, section 411. Printed also in *Immigration Law Advisory Issue* **196** (November 1998), 15.

[9] DONALD E. MCCLURE, AMS Task Force on Employment report to the mathematical community, part I: Academic Hiring Survey 1991–92, *Notices* **39** (April 1992), 311.

[10] Commission on Professionals in Science and Technology, *Postdocs and Career Prospects: A Status Report*, Alfred P. Sloan Foundation, Washington, DC, 1997, p. 14.

[11] JOANNE P. STREETER, *Major Declines in Admissions of Immigrant Scientists and Engineers in Fiscal Year 1994*, NSF Science Resources Studies Division Data Brief, Vol. 1997, No. 6, June 18, 1997; `http://www.nsf.gov/sbe/srs/stats.htm`.

[12] Immigration Act of 1990, Public Law 101 - 649, section 205.

[13] See [4], p. (not pages) 8–32.

[14] Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1990*, p. 5–28.

[15] Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1999*, p. 99.

[16] Bureau of Economic Analysis, U.S. Dept. of Commerce, States and Local Government Current Expenditures and Gross Investment, by Function, *World Almanac and Book of Facts*, 1999, p. 115.

[17] SOLOMON A. GARFUNKEL and GAIL S. YOUNG, The sky is falling, *Notices* **45** (February 1998), 256–257.

[18] The immigration of scientists and engineers to the U.S. soars!, Around the Networks, *S.I.A.M. News* **27** (August–September 1994), 2.

[19] Hiring and job seeking in academia, *Notices* **36** (December 1989), 1347, paragraphs 2 and 5.

[20] ALAN HALE, Shattered hopes and dreams: The dim prospects for careers in science, *The Chronicle of Higher Education* **44** (December 1997), B7.