THE CHRONICLE OF HIGHER EDUCATION

The Math Mandarins

By Andrew Hacker • March 20, 2016

Given their impact, they are a relatively small group, by my count no more than 200. Most of them are senior professors of mathematics at top-tier universities best known for graduate programs and advanced research. Many hold office in scholarly societies and serve on public commissions, where they pronounce on the state of the discipline. So in addition to being erudite, they exert influence.

I call them the mandarins, since they have much in common with ancient China's caste, not least for their aura of complacency and privilege. The mathematician Lynn Arthur Steen, of St. Olaf College, called them "the mathematics power elite," playing on C. Wright Mills's trope for America's corporate overseers. Paul Halmos saw them as a "self-perpetuating priesthood." They seek to dictate how a crucial realm of knowledge will be defined, taught, and studied at every level.

But doesn't it make sense to defer to masters of a discipline? Every advanced society has professionals who know more about some things than the rest of us.

My concern is that mandarins aren't content to stick to their scholarship. Rather, they take it as given that their intellects entitle them to dominate much of our educational system and set priorities for the greater society. While their apparent targets are students, their larger goal is to configure the coming generation of adults.

This explains their emphasis on requiring advanced mathematics for everyone. W. Stephen Wilson, of Johns Hopkins, urges "laying the foundation for college readiness in mathematics early, by grade six or seven." On first reading, this may seem reasonable. But does it really make sense for all four million of our seventh graders to master a stringent math sequence, ideally up through calculus by 12th grade or as close to that as possible? Even if they all take math through high-school graduation, aren't there more useful types of math — statistics, for instance — for them to focus on?

The mandarins, in their domineering manner, have sought to grow a garden of intricate mathematical minds to carry the field into the future. In this, they've failed utterly, with a singular lack of success in attracting young people to their discipline. The number of math majors, from 1970 to 2013, has declined from 27,135 to 17,408. But the real drop is much greater because the number of bachelor's degrees awarded over all has more than doubled, from 839,730 to 1,840,164. Math majors in 2013 accounted for precisely 1 percent of all bachelor's awards, less than a third of the discipline's share in 1970. It's hard to find another academic field that has plummeted this far. And the drop in graduate degrees has also been steep, master's degrees falling from 5,145 in 1970 to 1,809 in 2013 and doctorates from 1,052 to 730.

Every mathematician I've met speaks with devotion to her or his calling. But conveying that devotion is harder.

"Mathematicians love mathematics and want other people to love it too," says Peter March, formerly of Ohio State University and now at Rutgers. "But our problem is to get a hook into students who aren't already 'into' mathematics."

Says Ohio State's Sia Wong: "In our teaching, we offer logical arguments, beautifully laid out, and then are disturbed that our students don't appreciate our work."

Why haven't mathematicians had more success? It's not as if they don't have ample opportunity. In tandem with composition, mathematics is a subject that virtually all high-school students and most undergraduates are required to take. No other field — not history or philosophy or chemistry — has such marquee visibility.

Maybe math professors have trouble conveying their love of the subject to students because they so rarely encounter them. Since so many students are assigned to introductory or remedial classes, the subject enjoys outsize enrollments even though it attracts few majors. Departments get generous budgets for handling all those conscripted sections. Moreover, the outlays are low because the teaching is done mostly by underpaid adjuncts and graduate assistants. As a result, much of the cash flow can be diverted to maintaining senior faculty members and giving them lighter classroom loads.

Using contingent faculty members frees regular professors from tasks many of them find distasteful, if not demeaning. Stephen Montgomery-Smith, of the University of Missouri at Columbia, says that instructing freshmen and sophomores would be a waste of his talents. "It's nice having adjuncts to teach classes we don't want to touch," he explains. "If I were doing college algebra, I would get bored out of my mind." A mandarin definition of academic

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freedom, then, is exemption from assignments they find dreary.

In 2013 the American Mathematical Society released a lengthy report on undergraduate instruction, with several tables showing who was teaching the introductory courses. Among the doctoral universities they sampled, like Cornell and UCLA, only 10 percent of such sections were taught by tenured faculty members or tenure-eligible junior professors. The remaining 90 percent were given over to lecturers on short appointments, part-time adjuncts, or graduate assistants. As a result, even freshmen considering math as a major were unlikely to meet a member of the full-time faculty.

The survey also included liberal-arts colleges, like Linfield in Oregon and Gettysburg in Pennsylvania. But I was surprised to learn that only 42 percent of their introductory sections were taught by regular faculty members. I say "only" because those colleges claim a commitment to teaching undergraduates. Yet even they hire lecturers or part-time staff members for more than half their sections.

Professors are expected to conduct research. That's why they have lighter teaching loads, are awarded sabbaticals, and present papers at conferences. Even smaller colleges, which purport to give priority to teaching, increasingly look for publications when hiring and promoting professors. But all too much of scholarship today centers on writing for one's colleagues on narrowly focused topics, often accompanied by unfathomable theories. Mathematicians at SUNY Potsdam examined whether doing research buttressed teaching. "In mathematics," they found, "the two activities tend to adversely affect one another. The information with which a mathematics research project deals is usually inaccessible to undergraduates." A Williams College website described the research interest of one of its professors as "The Statistical Distribution of Zeros of Random Paraorthogonal Polynomials in the Unit Circle."

Of course, specialization pervades every academic discipline. Even so, a professor in urban ethnography can convey what she's doing to a colleague in medieval history or comparative literature. Mathematicians, increasingly, can't even explain their work to one another. Stanford's Keith Devlin, in his lectures and writing, makes mathematics come alive as few of his colleagues can. Still, he says, mathematics "has reached a stage of such abstraction that many of its frontier problems cannot be understood even by the experts." He is echoed by Ian Stewart, of the University of Warwick, who says, "I have never even dared to try to explain noncommutative geometry or the cohomology of sheaves, even though both are at least as important as, say, chaos theory or fractals."

Even if more mandarins did teach undergrads, they'd view it as a chore. That probably wouldn't help recruit more students to the field.

Early in 2012, a Council of Advisers on Science and Technology submitted a report to President Obama titled "Engage to Excel." Its main aim was to induce more young people to study science, technology, engineering, and mathematics, given increasing concern about the nation's purported shortfalls in those areas. The advisers noted that there's no paucity of young people who show an early interest in these fields. The real problem, they said, was that "fewer than 40 percent of students who enter college intending to major in a STEM field complete a STEM degree." The U.S. Department of Education found that 41 percent who begin in engineering programs either drop out or switch to another field. A striking 59 percent of those who start in computer science don't finish in the field.

Buried in the report was what might seem an innocuous proposal. The mathematics instruction required for science, technology, and engineering "could be improved by having faculty from outside mathematics develop and teach mathematics courses." Thus professors of engineering or computer science, along with faculties at community colleges, could conceive and teach the mathematics needed in their varied fields. It's not as if they don't know their algebra. What Obama's advisers realized is that the "T" component of STEM can extend to operating magnetic imaging and installing entertainment centers, which are usually two-year programs. Insofar as students need quantitative training, they should get it from instructors familiar with each field's needs.

But those advisers failed to reckon with the math mandarins. Quite quickly, one journal reported, "a rumble of consternation erupted among mathematicians." Tara Holm, a Cornell professor who headed the American Mathematical Society's committee on education, called the proposal "outrageous." Her view, shared by most of her mandarin colleagues, was that only faculty members in accredited departments of mathematics should be permitted to teach the subject, even in vocational programs. It's akin to surgeons who seek to keep nurse practitioners from stitching a minor gash.

The mandarins' perspective is that anyone lacking their imprimatur is incapable of teaching mathematics, from elementary grades up, as they conceive of and pursue it. America's educational troubles are vast, but the mandarins' egos are greater still.