The Frenzy About High-Tech Talent

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BOOKS AND REPORTS DISCUSSED IN THIS ARTICLE

Falling Behind?: Boom, Bust, and the Global Race for Scientific Talent
by Michael S. Teitelbaum
Princeton University Press, 267 pp., $29.95

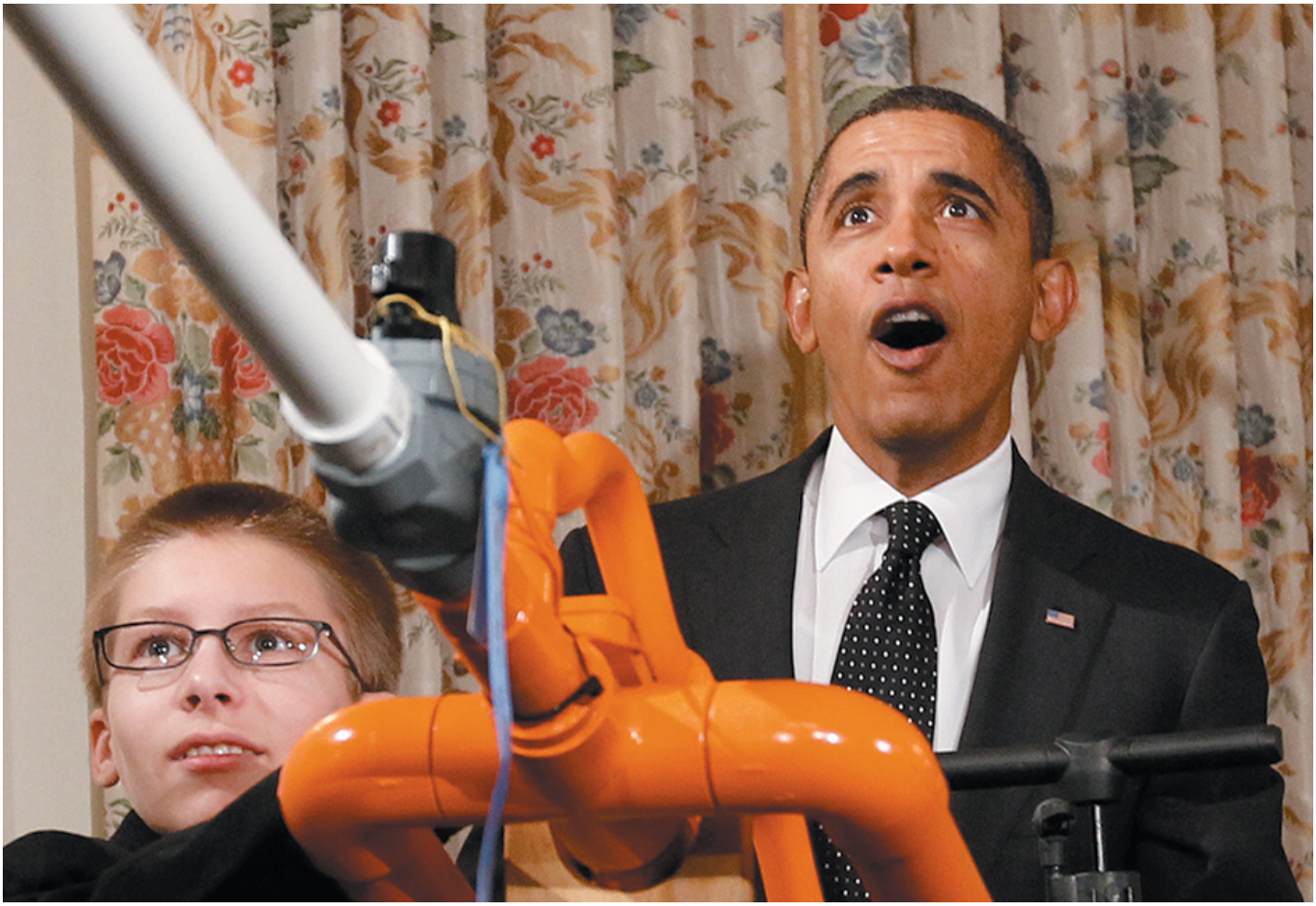
Occupational Outlook Handbook: 2014–2015
by the US Bureau of Labor Statistics
JIST, 1,002 pp., $25.95, $19.95 (paper)

A National Talent Strategy
a report by the Microsoft Corporation
32 pp., available at news.microsoft.com

How to Secure Your H-1B Visa: A Practical Guide for International Professionals and Their US Employers
by James A. Bach and Robert G. Werner
Apress, 165 pp., $24.99 (paper)

The Smartest Kids in the World and How They Got That Way
by Amanda Ripley
Simon and Schuster, 306 pp., $15.99 (paper)

Introduction to Technocracy
by Howard Scott and others
John Day, 61 pp. (1933)



Kevin Lamarque/Reuters

President Obama with teenage inventor Joe Hudy of Arizona during a demonstration of Hudy's Extreme Marshmallow Cannon at the White House Science Fair, February 2012

1.

Pronouncements like the following have become common currency: "The United States is *falling behind* in a global 'race for talent' that will determine the country's future prosperity, power, and security." In *Falling Behind?*, Michael Teitelbaum argues that alarms like this one, which he quotes, are not only overblown but are often sounded by people who do not disclose their motives. Teitelbaum vehemently denies that we are lagging in science, technology, engineering, and mathematics, now commonly abbreviated as STEM. Still, he writes that there are facts to be faced:

- In less than 15 years, China has moved from 14th place to second place in published research articles.
- General Electric has now located the majority of its R&D personnel outside the United States.
- Only four of the top ten companies receiving United States patents last year were United States companies.
- The United States ranks 27th among developed nations in the proportion of college students receiving undergraduate degrees in science or engineering.

A recurring complaint is that not enough of our young people and adults have the kinds of competence the coming century will require, largely because not nearly enough are choosing careers that require the skills of STEM. A decade ago, the Business Roundtable was urging that we "double the number of science, technology, engineering, and mathematics graduates with bachelor's degrees by 2015." We're now at that year, but the number of degrees awarded in those fields has barely budged. More recently, a panel appointed by President Obama asked for another ten-year effort, this time to add "one million additional college graduates with degrees in science, technology, engineering, and mathematics."[1] Where the missile race was measured by numbers of warheads, now we hear of a race to award more

diplomas.

Contrary to such alarmist demands, *Falling Behind?* makes a convincing case that even now the US has all the high-tech brains and bodies it needs, or at least that the economy can absorb. Teitelbaum points out that "US higher education routinely awards more degrees in science and engineering than can be employed in science and engineering occupations." Recent reports reinforce his claim. A 2014 study by the National Science Board found that of 19.5 million holders of degrees in science, technology, engineering, and mathematics, only 5.4 million were working in those fields, and a good question is what they do instead. The Center for Economic Policy and Research, tracing graduates from 2010 through 2014, discovered that 28 percent of engineers and 38 percent of computer scientists were either unemployed or holding jobs that did not need their training.[2]

Teitelbaum stresses a fact of the labor market: contrary to the warnings from a variety of panels and roundtables, public and private employers who might hire STEM workers have not been creating enough positions for all the people currently being trained to fill them. Take physics, a quintessential STEM science. The Bureau of Labor Statistics (BLS), in its latest *Occupational Outlook Handbook*, forecasts that by 2022 the economy will have 22,700 nonacademic openings for physicists. Yet during the preceding decade 49,700 people will have graduated with physics degrees. The anomaly is that those urging students toward STEM studies are not pressing employers to ensure that the jobs will be there. And as we shall see, the employers often turn to foreign workers for the jobs they have to fill.

2.

It's true that the US has fewer people studying the subjects involved in STEM than many other countries. The chief reason is that more of our students choose to major in business and liberal arts. But that doesn't signify a paucity of interest. Among the high school seniors who took the ACT and SAT tests last year, fully 23 percent said that they intended to major in mathematics, computer science, engineering, or a physical or natural science. And those contemplating programs related to health made up another 19 percent. But something evidently happens between their freshman and senior years. By graduation, the number of students who start in STEM fields falls by a third and in health by a half. In engineering, of every one hundred who start, only fifty-five make it to a degree. Why the attrition?

For some, the STEM program they planned on may be more demanding than they envisaged. Or they may be put off by how a subject is treated in college. Teitelbaum quotes the president of the Association of American Universities, who cites a less publicized cause: "poor undergraduate teaching in physics, chemistry, biology, math, and engineering, particularly in the freshman and sophomore years." Of course, bad teaching has varied causes. But it may be more apparent in STEM fields, where fixed material has to be covered; the reactions of many students suggests that many professors apparently see no need to make their teaching appealing. While student ratings have drawbacks, those in Table A hint at serious problems in STEM classrooms (see below). In mathematics, few freshmen meet a full-time professor close up. A recent survey by the American Mathematical Society found that 87 percent of all classes are taught by graduate assistants, adjuncts, or instructors on annual contracts.[3]

Table A

STUDENTS RATE THEIR PROFESSORS

at colleges that focus on

STEM subjects		*Liberal Arts*	
Cal Tech	65	Beloit	97
Drexel	67	Colby	95
Georgia Tech	64	Grinnell	95
Illinois Institute	68	Kenyon	97
MIT	69	Pomona	95
Purdue	69	Swarthmore	99
Stevens	65	Vassar	96

Source: Princeton Review

Table B

STEM WORK: WHAT IS IT?

Gynecologic Sonographers
Avionic Equipment Mechanics
Stenocaptioners
Cryptanalysis Keyers
Logisticians
Electronic Drafters
Multimedia Animators
Continuous Mining Operators
Echocardiographers
Neuroscience Nurses
Synoptic Meteorologists
Petroleum Pump System Gaugers
Geodetic Surveyors

Semiconductor Processors
Laboratory Phlebotomists
Environmental Inspectors
Tumor Registrars
Nuclear Monitor Technicians
Prosthodontists
Extruding Specialists
Digital Image Technicians
Electrophysiologists
Maxillofacial Radiologists
Pilates Equipment Designers
Remote Sensing Specialists

Source: Bureau of Labor Statistics

3.

Modern America was basically built by engineers, from canals to cars to computers, and engineering has long been honored as a crucial occupation. Yet the BLS projects that in the decade ending in 2022, the number of engineering jobs will have increased only by 8.6 percent, which falls short of the 10.6 percent rise expected for the workforce as a whole. Most striking are forecasts for the chemical, mechanical, and electrical specialties, long mainstays of the profession. Together, the three are estimated to grow by only 4.3 percent, well under half the expected growth in the workforce.

How can there be less demand for engineers, since predictions for STEM say their skills will be sorely needed? For many years, firms like General Dynamics and Westinghouse were mainstays of the economy. Yet inadvertently, the engineers they employed were devising equipment and processes that would undercut the skills on which they had built their own careers. Paul Beaudry and his colleagues at the University of British Columbia and York University have called this development "deskilling." Its rise has been a harsh surprise, since the common wisdom was that we would have to become more highly trained to confront the complexities of our time. Yet Beaudry's group shows how "high-skilled workers have moved down the occupational ladder and have begun to perform jobs traditionally performed by lower-skilled workers."[4] But this doesn't literally mean that graduate engineers shift to benchwork as technicians. Rather, their jobs are dissolved and they no longer have a place on the payroll.

Who, then, is handling the tasks that were once the province of graduates of Georgia Tech and Purdue? A recent study by the Brookings Institution found that "half of all STEM jobs are available to workers without a four-year college degree."[5] Some have two-year diplomas, others earn certificates; but even more are high school graduates who learned of openings and acquired new skills on the job. In Table B, culled from the BLS, I've listed a few.

Engineering also illustrates how the economy mishandles the talent it has. At current rates, our universities will be awarding about 760,000 engineering degrees in the decade ahead. But that is over five times what the BLS projects for the profession's growth. So most who do find jobs will be replacing engineers who are leaving the field, either voluntarily or partially so. They take a variety of jobs, whether in sales, management, or other fields of work. Businesses find they can recruit the graduates they want at salaries that young people find acceptable. What isn't said is that the pay won't rise much higher, as shown by the salaries of those in mid-career. According to BLS samplings in 2014, median pay ranged from $71,369 for civil engineers to $96,980 for aeronautical engineers. By comparison, the median for practicing nurses is $83,980, and the median for pharmacists is $101,920. (There is a special high of $130,280 for petroleum engineers who get premium pay for working in desert sands or surrounded by arctic ice; they also risk being laid off when petroleum prices fall.)

In engineering—as with computer science—those who start families tend to shift to sales or middle management. But many move to unrelated fields, ranging from real estate to nursing, while others find positions as financial analysts or security consultants. This attrition could be averted by prolonging career spans, as in law and medicine. After all, most engineers—and their software counterparts—still have their expertise in their fifties and sixties. But employers see no need to encourage longer periods of employment, since each year cheaper graduates, both American and foreign, arrive with their résumés.

4.

"A National Talent Strategy," distributed by the Microsoft Corporation, echoes the warning that the United States faces "a substantial and increasing shortage of individuals with the skills needed to fill the jobs the private sector is creating." As before, skills refer not to verbal abilities or even a knack for closing a sale, but those based on STEM training. A 2012 survey of Microsoft's own facilities found "more than 3,400 unfilled research, development and engineering positions." To address this shortfall, Microsoft offers "a two-pronged approach."

The first is domestic, and urges that training begin early. Microsoft would have all high schools support full programs in computer science, which every student could at least sample. These programs are now relatively rare, accounting for not even one percent of Advanced Placement enrollments. To lift the numbers, Microsoft proposes that related disciplines cede some of their time and dominance, and "allow computer science courses to count as either 'core' math or science courses." If American companies are to win the software wars, a cost may be fewer enrollments in basic physics.

The report notes that only 4 percent of American bachelors' degrees are in engineering, compared with China's 31

percent. The booklet doesn't explain why these percentages are cited, but leaves the hint that we should be trying to get nearer to the Chinese figure. One way would be to encourage more young people to attend college, especially from underrepresented groups, and give them extra support if they choose STEM majors. Another is to reduce the high attrition among those who start in STEM majors, although the report doesn't mention doing something about indifferent teaching, which is a possible cause. A third tactic, albeit not openly stated, is to lure undergraduates away from the humanities and other liberal arts as well as the social programs. Left tacit are the costs of such a shift and the wider implications of moving closer to China's curriculum.

The second strand of "A National Talent Strategy" seeks "to draw the world's best minds into our economy." Here Microsoft is unabashedly pro-immigration, holding that it makes sense to import talents that are in short supply here. As before, the best minds are equated with those who master STEM disciplines—in this case, the personnel Microsoft wants. Hence its call for expanding the H-1B visa program, which enable firms to fill "specialty occupations" such as computer science with workers from abroad. Also, it asks that federal rules be amended to allow retaining "high-skilled foreign STEM talent already employed by companies in the United States."

A variety of American industries have long held that their survival depends on being permitted to bring in foreign workers. Most familiar has been much of agriculture, which claims that resident citizens will not take the pay that employers can afford. Today the technology sector is making a similar plea, with the obvious difference that it needs more cerebral skills. Under H-1B, candidates must be sponsored by specified employers, with elaborate paperwork on both sides, including avowals that the domestic workforce has been thoroughly combed for qualified candidates. Apparently, the time spent on such applications is worth it.

As of the end of 2012, fully 262,569 H-1B visa-holders were working in the United States. By far the most were from India (168,367), with China a distant second (19,850). Indians are most wanted because they come knowing English and can start on assignments the day after they arrive. Topping the list are "computer-related occupations," such as coding, followed by engineering. Microsoft leads the employers' list, with Intel, IBM, and Oracle close behind. But a host of enterprises now have software systems in need of servicing. The H-1B roster also includes Goldman Sachs, JP Morgan Chase, and the Rite-Aid pharmacy chain.

A central question, of course, is why Americans weren't available or applying for these 262,569 jobs. During the 2001–2011 decade, the most recent for which we have figures, our colleges turned out some 2.5 million graduates in computer science and engineering, which seems a fair-sized pool. On its face, it should contain enough people with the qualifications that Microsoft and Oracle and Rite-Aid expect. One explanation is that these and other firms in fact prefer people from abroad. Indeed, many are already in universities here, where they receive half the graduate degrees in computer science and engineering. Of students from India awarded Ph.D.s, 85 percent were still in the US five years after receiving their degrees.

James Bach and Robert Werner's *How to Secure Your H-1B Visa* is written for both employers and the workers they hire. They are told that firms must "promise to pay any H-1B employee a competitive salary," which in theory means what's being offered "to others with similar experience and qualifications." At least, this is what the law says. But then there are figures compiled by Zoe Lofgren, who represents much of Silicon Valley in Congress, showing that H-1B workers average 57 percent of the salaries paid to Americans with comparable credentials.

Norman Matloff, a computer scientist at the University of California's Davis campus, provides some answers. The foreigners granted visas, he found, are typically single or unattached men, usually in their late twenties, who contract for six-year stints, knowing they will work long hours and live in cramped spaces. Being tied to their sponsoring firm, Matloff adds, they "dare not switch to another employer" and are thus "essentially immobile."[6] For their part, Bach and Warner warn, "it may be risky for you to give notice to your current employer." Indeed, the perils include deportation if you can't quickly find another guarantor.

Matloff also found that employers "tailor job requirements so that only the desired foreign applicants qualify" and they "have an arsenal of legal means to reject all US workers who apply." Despite Microsoft's talk of "best minds," the majority of H-1B workers are, in Matloff words, "ordinary people doing ordinary work." On a Government Accountability Office scale, only 17 percent were graded "fully competent" in their specialty. Typically, they produce

the lines of code needed to keep so much of our digitized world functioning. Of course, coding can be challenging and creative. But behind each innovative designer, there's a need for dozens of routine coders whose main job is to get every symbol, letter, and integer precisely right.[7]

Most businesses prefer having an oversupply of workers, in part to keep those on board fearful lest they be replaced. And if less money goes to the rank-and-file, that often means that more money is available for the executive floors. In Matloff's view, the dramatic warnings about scarcities of skills are actually "all about an industry wanting to lower wages." To this extent, he argues, wider income spreads between executives and other employees are integral to corporate visions for the years ahead. But unlike in earlier eras, a STEM proletariat will be digitally literate, thanks to the coding classes Microsoft would make universal (and which are increasingly available from other firms and from high-tech education companies providing classes for recent high school graduates as well as older workers; among them are "boot camps" that charge as much as $12,000 for eight or nine intense weeks). What they'll do as they reach, say, thirty-five years old is not the concern of an economy based on revolving cubicles, marginal salaries, and importing acquiescent labor. In the summer of 2014, Microsoft laid off 18,000 of its employees.

5.

On the most recent international mathematics test called PISA (Program for International Student Assessment), students from the United States ranked thirty-second, even lower than Portugal's or Slovenia's. At the top were Singapore, South Korea, and Japan. (China didn't enter, but has been first or second on other lists.) There is no paucity of theories about why Americans fall so short. If schools and teachers get most of the blame, we also hear about adolescent indolence and parental nonchalance, abetted by electronic distractions.

Amanda Ripley's refreshing book, *The Smartest Kids in the World and How They Got That Way*, takes a positive approach. She spent time in three countries—Finland, Poland, and South Korea—to find out why they routinely do well. As it turns out, Finland (eighth) and Poland (ninth) might be hardest for the US to emulate, since an egalitarian ethos guides their approach to education. In Finland, for example, teaching children in the lower grades attracts highly qualified graduates. Hypercompetitive South Korea is really the centerpiece of her survey.

PISA's national rankings are derived from standardized tests, with preset answers and seventy-five seconds allotted per problem. Of course, you have to know mathematics. But as Ripley makes clear with South Korea, equally important is mastering the test formats and becoming familiar with the kinds of calculations demanded. She shows how cramming academies aimed at preparing for tests, which run to 10:00 PM every night and enroll 70 percent of all students, end up being more important than the regular schools. In a daytime class she visited, a third of the pupils were asleep. (Girls strap tiny pillows to their wrists for quick naps at their desks.)

While the night sessions aim to get students places in Korean universities, their tests are akin to those on which international rankings are based, so the prowess gained at the cramming academies counts in world rankings. In Ripley's account, Korean children are willing to endure the system, lest they dishonor their parents. "Competition had become an end unto itself," Ripley remarks, "not the learning it was supposed to motivate." Phrases like "joyless learning" and "hamster wheel" recur; so do "cheating scandals" and "leaked test questions." A study in the *Korean Journal of Pediatrics* found eleventh- and twelfth-graders averaging between five and five-and-a-half hours of sleep per night. Where Korea is concerned, her title—*The Smartest Kids in the World*—has to be sardonic. It raises the question of whether the US would want to lead the world in seventy-five-second tests, with the cost in sleep and, above all, the toll on other kinds of learning.[8] How much does the quality of our society depend on young people acquiring understanding of history, literature, and the basic sciences, as well as the ability to write clear sentences?

6.

In 1933, in the depth of the Great Depression, an engineer named Howard Scott produced a small book he called *Introduction to Technocracy*. This new principle, he predicted, would replace politics and economics as "the instrument for effecting social change." Technocracy, he added, "makes one basic postulate: that the phenomena involved in the functional operation of a social mechanism are metrical." On the premise that everything of significance can be

measured, decisions will be relegated to those "disciplined in engineering thought processes." Even then, Scott saw society ready for a technocratic order. "To modern civilized men," he wrote, "explanations offered in the name of science are accepted under the new order of common sense." None of this was meant as ironic, and for a while, Howard Scott had a wide hearing. His vision of technocracy is having a new day.

The fervor over STEM goes beyond promoting a quartet of academic subjects. Rather, it's about the kind of nation and people we are to be. Already in play are efforts to instill the metrics—and morality—of technology within ourselves as individuals and into the texture of society. Artists and poets may have to score high on tests of trinomial distributions if they want bachelors' degrees. In viewing science, technology, engineering, and mathematics as strategic weapons, we are constricting honored callings and narrowing national priorities, while the alleged needs for STEM workers are open to serious question, including whether the demand for them may be exaggerated and manipulated.

Letters
The Stem Frenzy September 3, 2015

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1 See "Engage to Excel," a report by the President's Council of Advisors on Science and Technology, February 2012. ↩

2 National Science Board, "Science and Engineering Indicators 2014"; Janelle Jones and John Schmitt, "A College Degree Is No Guarantee," Center for Economic Policy and Research, May 2014. ↩

3 Conference Board of the Mathematical Sciences, *AMS Survey of Undergraduate Mathematical Programs* (American Mathematical Society, 2012). ↩

4 Paul Beaudry et al., *The Great Reversal in the Demand for Skilled and Cognitive Tasks* (National Bureau of Economic Research, 2013). ↩

5 Jonathan Rothwell, *The Hidden* STEM *Economy* (Brookings Institution, 2013). ↩

6 Norman Matloff, "Immigration and the Tech Industry," *Migration Letters* (May 2013). ↩

7 Earlier this year, Disney laid off several hundred American technical workers, to be replaced by H-1B arrivals from India. Key to the shift, as Disney phrased it, would be "knowledge transfer." Thus those slated for dismissal were told that if they wished a severance check, they had to teach what they did to the newcomers. See Patrick Thibodeau, "Fury Rises at Disney Over Use of Foreign Workers," *ComputerWorld*, April 29, 2015. ↩

8 See Seonkyeong Rhie et al., "Sleep Patterns and School Performance of Korean Adolescents," *Korean Journal of Pediatrics* (January 2011). On China, see Diane Ravitch, "The Myth of Chinese Super Schools," *The New York Review*, November 20, 2014. ↩