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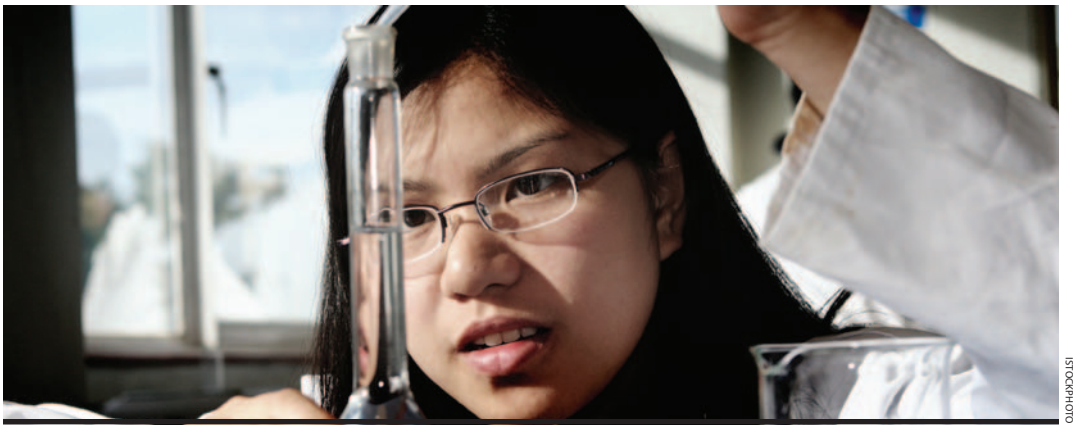

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Maintaining U.S. Scientific Leadership

English and Immigrants Are the Immediate Needs

By Richard O. Lempert

IT HAS BEEN SO LONG since the United States had to look up to any country in science that we Americans have come to regard science leadership as a birth right. When children in other countries score better on science tests than American youngsters or our production of Ph.D.'s and engineers or share of patent applications declines relative to other countries, we act as if the United States is slipping rather than other countries advancing, and we see a crisis emerging.

Perhaps the field we have truly fallen behind in is history. We forget that in the early 20th century German was the lingua franca of science. Germany was where young scientists went to study, and where top scientists presented, and often had done, their cutting edge work.

Far from being natural or inevitable, the United States' science leadership is an offshoot of this country's preeminence in the system of world governments that emerged after the defeat of Germany in World War II. This system was built on the rewards to science innovation in a vibrant capitalist economy, and on WWII- and Cold War-impelled needs to develop our science and engineering capacity. It uniquely benefited from immigration, especially from Europe in the Nazi era and immediate post-war period. And it could not have happened without the wealth and vision that allowed the United States to not only generously subsidize basic science but also to establish an educational system that was broad-based at the bottom and unparalleled in availability and quality at the top.

If these advantages were not enough, the competition for science leadership was weak thanks to the devastation that Europe suffered in two world wars and the slow rebuilding of European economies in the post-war era. The upshot: U.S. science

leadership is not natural and inevitable, but the loss of that leadership may be.

Countries much larger than the United States, most notably India and China, are experiencing economic growth that outstrips ours, and as they grow in wealth they are rapidly improving their educational systems and basic science infrastructures. Moreover, as globalization leads companies born in the United States to move research and production capacity abroad, market demand for trained scientists and engineers is increasing elsewhere while it is being dampened here.

Even if the United States retains a per capita education and investment advantage over India and China, population differences alone mean that the number of trained scientists and engineers in these countries will soon dwarf the number in America, with differences in the quantity and quality of science innovation likely to follow. Added to the Asian challenge is a Europe that can no longer be seen as a set of discrete countries when it comes to science. Rather, cross-border research teams are being encouraged, and European Union-wide funding mechanisms are being established.

In short, several decades from now we may find that we are not the world's number one country when it comes to science, however measured, but perhaps no. 4 behind China, India, and the EU. We may also find that being in fourth place is not altogether bad. When children in China are vaccinated against polio, they are not worse off because the vaccine was invented in the United States. When an Indian inventor draws on two decades of U.S. government-funded research to achieve a technological breakthrough, her accomplishment will not be lessened because it would not have happened had research in the United States not paved the way.

As the world no. 1 in science, U.S. science investments have had substantial spillover effects, improving the quality of life in other countries and enabling scientific, technological, and medical accomplishments that have benefited people abroad. As other countries improve their science, the progress of American science and the lives of our people will increasingly benefit from educational and infrastructure investments made elsewhere and from research supported by currencies other than the dollar.

Acknowledging the inevitable and seeing a bright side does not, however, mean we should regard what is happening as an unalloyed blessing and passively allow American science to slip. There are substantial costs should U.S. science capacity sink absolutely, and real costs even if slippage is only relative. Scientific advances create intellectual property, and wealth creation through intellectual property has become an increasingly important part of the U.S. and world economies. What's more, the world remains a dangerous place, and it may become more so should countries like China develop expansionist ambitions. Science for security must remain a high national priority, and although we may not be able to keep other nations from catching up, we do not want to be surprised by their achievements or surpassed.

In devising policies to maximize the strength of U.S. science, our nation has two unique resources it must not squander. The first is English. Thanks to the preeminence of U.S. science for more than half a century, English is second only to mathematics as the universal language of science. Scientists around the world speak and write English. This gives American scientists a leg up in communicating with scientists across national boundaries and makes many of the most important writings of foreign scientists easily and immediately accessible to Americans.

Additionally, American students are not dissuaded from pursuing science careers nor do they have their science studies delayed because of the need to master a foreign language. Short of eliminating federal science funding, nothing, I venture to guess, would harm American science as much as a need to read Chinese to keep up with the latest science developments.

One goal of our national science policy should be to maintain English as the global language of science. This might entail subsidies or other incentives to promote the publication of English-language

online science journals, aid to enable the acquisition of English-language science materials (including print journals) by universities and libraries abroad, and programs to train foreign scientists in English, either in their own countries, online, or by bringing them to the United States or Britain for science internships or language instruction.

The high subscription price of leading English-language science journals is a particular threat because it means that for financial rather than science reasons market forces are likely to promote a proliferation of lower priced foreign-based journals in languages other than English. These journals, started for reasons of cost, may become science journals of record in their home countries, meaning that cutting-edge overseas research may become less easily or immediately available here. The short-run solution may be U.S. subscription subsidies for foreign scholars and institutions, but the only viable long-term solution is to bring costs down, most likely by electronic distribution that through competition reins in the profit-oriented publishers who now mediate between the creation and distribution of science knowledge.

The United States' second great advantage is our system of higher education. We are still the preeminent nation when it comes to science training, and we benefit from this in many ways. Foreigners who come to study here learn English, and they build relationships with U.S. scientists that endure after they return home, if they return home. Study here can also lead to an appreciation for the United States and its values, including especially the values of democracy and free inquiry. Perhaps most beneficial of all are the foreign-born scientists who stay to take jobs here or who return periodically to work collaboratively with U.S. scientists. They add to our science workforce and scientific productivity and go a long way to make up for inadequacies in the production of U.S. born scientists.

Ironically, the threat to U.S. science dominance is in part due to our willingness to educate the world. Some of the foreign scientists trained here have returned home to become leading researchers or educators in countries such as India and China, while others have returned to Western Europe and reinvigorated their graduate science education. Thus, our leadership in science education, although not as vulnerable as our overall science leadership, is also ripe for challenge.

Rather than rise to the challenge, however, we have aided the challengers. Short-term political and security concerns have trumped longer-term interests in science strength along with longer-term wealth and security. Responding viscerally to the attacks of 9/11, we made entering this country more difficult for foreigners whatever the reason. One result was that students who had planned on doing their advanced science studies in the United States went instead to Europe, Australia, Japan, or Canada. Or they pursued advanced degrees in their home countries.

More recently, the Iraq war and attitudes toward immigration have made the United States less attractive to educated foreigners. Difficulties in entering the United States have also affected the location of and attendance at scientific conferences as well as the ability of universities and companies to employ foreign researchers. Although the U.S. government has become sensitive to the harms that some of its post 9/11 policies caused and has tried to ameliorate problems, it could be doing much more—including proactively encouraging more foreign students to study science here and making it easier for them to work here when their studies are concluded.

The downside of replenishing our science workforce with the foreign born is that it diminishes pressure on industry and government to stimulate domestic science training. Yet few dispute that improving domestic education must remain a high priority, especially as opportunities for science workers abroad grow sufficiently attractive as to not only lure foreign-born U.S. science workers back to their home countries, but also to entice native-born American scientists to work abroad.

Essays, and indeed books, can and have been written on what stimulating domestic science training will take, and I shall not attempt to canvass the

suggestions that people more knowledgeable than I have made. But I will reiterate one point. We cannot afford to leave undeveloped the talents of minorities and the poor by failing to provide the nutrition, health care, preschool training, and later education that will allow these youth to realize their potential. It is no longer just personal accomplishments we are talking about; it is the national well being.

A virtue of science progress is that it cannot help but create free riders. New discoveries and inventions fuel other new discoveries and inventions and raise everyone's quality of life. Even if intellectual property laws allow innovators to secure fortunes for themselves, exclusive rights last only for period of time, and rarely can all profits be captured. We, along with other nations, are made better off by new vaccines discovered in Britain, cell phone technologies born in Finland, robotics breakthroughs from Japan, and the development of disease-resistant plant varieties in the United States.

Americans love to rank things, whether it is football teams, law schools, or most livable cities, and we love to identify with or be "Number One." For many it is a matter of national pride that the United States is acknowledged as the world's leader in science. Hence it is a matter of great national concern when it appears other nations are catching up or that we may be slipping. But the two ways of reducing disparities in the rankings are quite different.

If other nations are doing better in supporting science and producing more scientific breakthroughs, then we are likely to benefit from their successes. But if our lead is slipping because we are losing capacity and failing to invest in the physical and human capital that produces outstanding science, then there is substantial cause for concern; not only the United States but the world will be worse off as a result. In short, we should focus more on how we are doing and spend less time worrying about whether other nations are catching up to us in science.

If our youth are well-educated in science, if our science workforce has the highly trained staff it needs, if we facilitate the international exchange of scientific knowledge, and if our educational establishments and industry remain fountains of innovation, then we need not worry whether other nations are doing as well or better than we are. We will be strong. But if our lead is lost because we squander our advantages and fail to educate our youth, then slippage in the ranks of nations doing science may indeed signify crisis. sp

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