the receptor's channel, a change that should enhance the strength of the synapse. Huganir says his lab has unpublished data that other AMPA subunits are phosphorylated as well. "It is clear that the AMPA receptors are getting highly regulated" at several levels, he says, adding that he suspects phosphorylation may turn out to help with the transport of the receptors to the synapse as well.

Other recent work suggests that LTP may create striking postsynaptic changes in the form of whole new synapses. Two teams, one led by Malinow and Karel Svoboda of Cold Spring Harbor, and the other by Tobias Bonhoeffer of the Max Planck Institute of Neurobiology in Munich, Germany, recently reported that within 20 minutes after the start of LTP, tiny new structures appear in the postsynaptic neuron that may become new dendritic spines (*Science*, 19 March, p. 1923, and *Nature*, 6 May, p. 66). The work is preliminary and the fate of the structures isn't certain, but Bonhoeffer believes they will turn out to be new spines. "Eventually those newborn spines will each have a synapse," and the movement of AMPA receptors triggered by LTP may eventually fill those new synapses as well.

Although it remains to be seen how all these pieces will fit together, the case for migrating AMPA receptors playing an active role in modulating synapses is "very compelling," says Stanford's Tsien. But he and others say that doesn't mean that all of LTP will be accounted for by changes in the postsynaptic neuron. LTP occurs within a minute, and the receptor movements have not been confirmed to occur that quickly. That means, says Tsien, that there are likely to be "other mechanisms taking place to fill in what is happening" during the first moments of the process.

Unpublished work from his group suggests that one of these is increased glutamate release occurring within the first minute after LTP has been triggered. This result also bolsters the view that there will be presynaptic and postsynaptic contributions to the synapse-strengthening process. "I think what the field is telling us is it is both" pre- and postsynaptic, says Richard Scheller, who studies synapses at Stanford's medical school. But wherever the balance of pre- and postsynaptic mechanisms turns out to be, the idea that AMPA receptors modulate synapse strength is likely here to stay. **–MARCIA BARINAGA**

HUMAN RESOURCES

Efforts to Boost Diversity Face Persistent Problems

More groups are going to bat for underrepresented minorities in science and engineering. But can they do better than past efforts to make a difference?

Time is a precious commodity for Diann Brei, an assistant professor of mechanical engineering at the University of Michigan, Ann Arbor. With her biological clock ticking, the 35-year-old Brei and her husband decided last year to have a second child even though she knew it might cost her a chance at tenure when she comes up for review in 18 months. "The informal rule is that one child before tenure puts you at risk," says Brei. "I've heard I'm the only woman in the engineering school to have had two children before tenure." Last month the Alfred P. Sloan Foundation came to the rescue, awarding her its first pretenure faculty fellowship. The money will allow Brei to attend meetings, retain a graduate student whose industrial funding had ended, and resume a full research schedule as quickly as possible.

Mariana Loya isn't thinking about children or tenure just yet. Instead, the 20-year-old materials engineering major divides her time among classes at the University of Washington, an undergraduate research project on biomaterials, and tutoring inner-city kids. Loya, whose father is Latino and Native American and whose mother is Asian, also talks up the importance of science and math at scores of public appearances as Miss Washington, the state's representative in last fall's Miss America pageant. Such outreach brought her to the attention of the National Academy of Engineering (NAE), which showcased her at its 2-day summit last month on women in engineering. Officials hope that Loya's glamorous image will help attract other minority women into what NAE president William Wulf calls a "pale, male profession."

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Role model. Engineering student Mariana Loya, the current Miss Washington, has been presented as the new face of engineering. Yet even she says she may not pursue an engineering career.

The Sloan program and the NAE summit represent two fresh efforts to tackle the chronic underrepresentation of women and non-Asian minorities in the scientific work force. They are joined by a new federal Commission on the Advancement of Women and Minorities in Science, Engineering and Technology. On 24 June, at the National Science Foundation (NSF), the commission will hold the first of two public hearings to collect information for a report to Congress. NAE's follow-up to its summit, which drew 200 leaders from academia, industry, and government, is a new Committee on Diversity in the Engineering Work Force that will hold a workshop next month to discuss how diversity can boost a company's bottom line.

These activities are meant to continue chipping away at a problem that, experts say, begins with negative messages in elementary school, continues through undergraduate and graduate programs that erect barriers—financial, academic, and cultural—to all but the best candidates, and persists into the workplace. And the stakes are getting higher all the time, says one commission member. "If we don't solve this problem soon, we'll reach a crisis point in our ability to compete in a global economy," says George Campbell, president of the National Action Council for Minorities in Engineering (NACME).

A new NSF report on women, minorities, and persons with disabilities, the ninth in a biennial series, describes the uneven progress to date (www.nsf.gov/sbe/srs/nsf99338). In some areas, gains have been substantial. For example, women now receive 12% of the doctoral degrees awarded in engineering—up from a mere 2% in 1978. Even so, Texas A&M University associate dean Karan Watson has calculated that such an output provides only enough women Ph.D.s for each of the 1500 U.S. engineering departments to hire a new female faculty member once every 6 to 12 years.

And the changes in the percentages of underrepresented minorities in most disciplines have been slight, although Asians

have increased their presence significantly in most fields (see chart). Minority women in particular are in short supply as they battle the twin obstacles of gender and race, according to a 1996 analysis by NACME. "In the entire history of the United States," notes Campbell, a physicist, "only 20 African-American women have received doctorates in physics."

No single solution can remedy all the various deficits. Young faculty women like Brei, who already have a Ph.D. and a job, still need a boost, says Sloan's Ted Greenwood, who thought up the pretenure fellowship program after noticing that the increasing number of women with doctoral degrees was not translating into more tenured faculty. The strain of juggling family and work duties seemed like a big part of the problem, he says, and the fellowship, which is open to tenure-track faculty members returning from leave taken for family reasons or for those reentering the work force, "was something that we could do that had a chance to make a real difference."

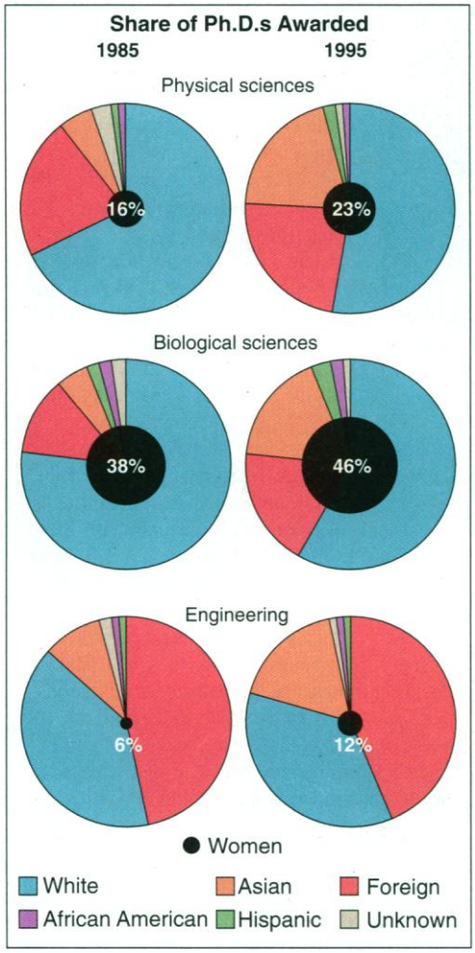
Brei couldn't agree more. "It takes away a big part of the stress of getting back on track," she says about Sloan's $20,000 grant, which is matched by the university. "It's hard to travel when you're pregnant, and this will let me go to a few conferences and show people that I'm not planning to slow down after the baby."

Enticing young people, particularly minorities, to take up science and engineering requires a different tack. Participants at the NAE summit decided that one short-term answer is a public relations campaign. "The image of a scientist or engineer as a geek, or a madman, is not an attractive one for most teenagers," explains computer scientist Carol Kovac, vice president for services, applications, and solutions at IBM's T. J. Watson Research Center in Hawthorne, New York, and a summit participant. "And none of the scientists they know look like Miss Washington. Even more important is the message that science is a way for them to improve the world."

Loya, who became interested in engineering "because I didn't want to be left behind by technology," delivers the same message to groups of all ages. Yet she illustrates a part of the problem: "I want to go to graduate school, but I'm thinking about an MBA because it's easier to move up the corporate ladder," she says. "I love research. But I'm a people-oriented person, and I don't know if engineering is the right match for me."

Indeed, retaining women and minorities who express interest in scientific careers is a big challenge. "Image is important," notes Campbell, "but our studies show [financial aid] is the biggest factor in retention rates." NACME has calculated that it would require $250 million a year in scholarships and other financial support for the nation to produce enough minority engineering graduates each year—20,000 instead of the current 6000—to equal their proportion of the college-age population. Currently, Campbell says, the federal government, nonprofits, and industry spend only a small fraction of that amount to address the problem.

Once those new scientists and engineers graduate, they will need to find a supportive work environment to keep them from fleeing to greener pastures—something not always in evidence. "I was sitting next to the dean of an engineering school with no foreign faculty and no women," says Linda Skidmore, executive director of the new federal commission, describing a breakout session at the NAE summit. "He said he couldn't understand the fuss because he had all the good people he needed." The chair of the new NAE panel, engineer and former utility executive Cornell Reed, hopes to "see if we can make an economic argument for the value of diversity" at a July workshop for some two dozen corporate executives. "Until a few years ago, I was the only one of 23 corporate officers who was African American, and all of us were engineers from the Midwest," says Reed, who retired from Chicago's Commonwealth Edison in 1997. "That makes for some pretty narrow thinking."



A sliver of hope? The share of U.S. doctoral degrees awarded to Hispanics and African Americans has barely budged in the past decade for most fields, although Asians have made notable gains and women have also increased their presence.

But even after opting for greater diversity, some institutions may not know how to achieve it. That's why the new congressional commission plans to compile and disseminate a list of "best practices" and model programs for all sectors—government, academia, and industry. "Each underrepresented group faces different problems, at different points along the way," explains Elaine Mendoza, chair of the commission and head of a Texas software company she founded. "We hope to identify commonalities and offer suggestions in each area."

However, some observers are worried that the commission, conceived as a forum to examine women's issues and appointed by members of Congress and the National Governors Association, may not be sufficiently knowledgeable about, and attuned to, the concerns of other minorities in the scientific workplace. They note with unhappiness that Campbell was the only African American, and the lone man, at the commission's first meeting. (Raul Fernandez, the only other male panel member—and one of two Hispanic business leaders—was absent.) They also worry that the commission may not focus on the areas of greatest need. "Minorities are the biggest problem, by far, in biomedicine," says Ruth Kirschstein, deputy director of the National Institutes of Health, who briefed the panel at its initial meeting in April. "And they will miss the boat if they look mainly at barriers to women."

NAE's Wulf says he's very conscious of the need for sustained, tangible results. He's also frustrated that the corporate engineering community has not been more supportive: NAE was forced to spend $130,000 out of its meager pot of institutional funds to put on the summit, although corporate contributions topped $200,000 for both the meeting and a Web site created last summer.

Wulf believes that NAE, as the profession's most prestigious body, must play a leading role in any campaign to foster diversity. Only then, he reasons, will programs like Sloan's and the words of spokespersons like Loya take root and trigger permanent changes. But altering the views of such a body will be hard work, he admits. "One of the biggest challenges is the NAE membership, whose average member is 70. It may be like the old saying about how to change a university. You do it one grave at a time." —JEFFREY MERVIS

SOURCE: "WOMEN, MINORITIES, AND PERSONS WITH DISABILITIES IN SCIENCE AND ENGINEERING: 1998," NSF