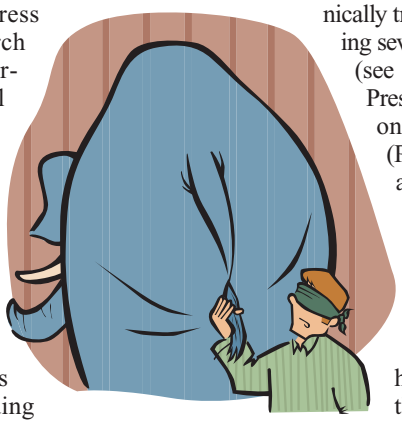
biggest kid on the academic-research funding block, signaled the end of a 5-year doubling. Although science groups were glad to see Congress doling out more research dollars to NIH, they argued that because all fields are interdependent, such a growing imbalance is bad for all of science.



To remedy the situation, advocates settled on a common vehicle—a proposal to double NSF's budget. As pro-science groups joined forces with leading high-tech industrial firms, they broadened their message to include workforce issues as well as funding. "Companies care about federal support for research," says Peyton, "but from a business standpoint the personnel issue is much more pressing. After all, these are the people you'll be hiring in the next 1 to 3 years."

The campaign has been successful—to a point. Late last year, President George W. Bush signed into law a bill that spells out a 5-year doubling path for NSF, but it contains only guidance, not money. And the president's current budget request for NSF calls for only a 3.5% increase in 2004, a far cry from the 15% annual rises that would be needed to double NSF's budget by 2008. To keep the issue alive, vigilant lobbyists are peppering meetings, congressional hearings, and other forums with anguished cries about the state of the scientific workforce.

Indeed, workforce initiatives are popping up like spring flowers in Washington science policy circles. A federally funded coalition of companies, government officials, and professional societies called Building Engineering and Science Talent (BEST) last fall warned of a "quiet crisis" based on the fact that "American colleges and universities are not graduating enough scientific and technical talent to step into research labs, software centers, refineries, defense installations, science policy offices, manufacturing shop floors, and high-tech start-ups." Jackson, the author of the BEST report, issued a similar warning in March under the auspices of the Government-University-Industry Research Roundtable, an unusual hybrid body staffed by the U.S. National Academies. The report, *Envisioning a 21st Century Science and Engineering Workforce for the United States*, describes "a shrinking workforce [and] an unprecedented labor shortage."

Over the next several months, top government advisory groups will offer their analyses. A task force of the National Science Board will shortly deliver a report asserting that the U.S. government has the responsibility to ensure an adequate supply of technically trained workers and suggesting several ways to meet that need (see sidebar, p. 1073). And the President's Council of Advisors on Science and Technology (PCAST) has just established a task force, headed by former Microsoft COO Robert Herbold, to see if sufficient numbers of U.S. students are being trained for scientific careers and if universities have the resources to meet the challenge. The White House Office of Science and Technology Policy has created an interagency group to gather up the numbers.

In the meantime, Teitelbaum doesn't expect the community to stop beating the drums for increased federal support to reverse the alleged dearth of scientists and engineers. "It's a hardy Washington perennial," he says, "even if there's no credible, quantitative evidence to back it up."

In the end, its staying power may derive from the fact that the debate rests not so much upon numbers as upon an abiding faith in the value of a robust scientific enterprise. And that faith translates into the need for scientists to be fruitful and multiply regardless of current market conditions. "Doesn't everybody agree that everybody should be trained as an engineer?" quipped PCAST co-chair Floyd Kvamme at a recent meeting.

Jackson summarized that imperative last month at a 2-day science and technology colloquium sponsored by the American Association for the Advancement of Science (which publishes *Science*). "This country needs more scientists in the pipeline," she said. "And we also need to create the right climate to generate that [demand for] scientists." —JEFFREY MERVIS

Taiwan-China Collaboration

A Bridge Over Troubled Waters

Researchers from Taiwan and the mainland have hit scientific pay dirt with the first—and so far the only—collaboration between two institutions across the Taiwan Strait

TOKYO—A hot campaign issue in Taiwan's presidential election in March 1996 was whether the island should drop its long-held objective of reuniting with the mainland and formally declare its independence. As a warning to what it regards as a renegade province, China staged military exercises along the Taiwan Strait and fired test missiles into nearby waters. It was hardly fortuitous timing for physicists planning the first-ever institutional-level scientific collaboration across the strait. But it didn't deter Chang Chung-Yun, a physicist at the University of Maryland, College Park, then on sabbatical at the Institute of Physics of Taiwan's Academia Sinica.

"I was scared because the missiles were being launched when I flew from Taipei," admits Chang, who was born on the mainland but is now a U.S. citizen. It was his idea to get Taiwanese scientists together with researchers at the Chinese Academy of Sciences' Institute of High Energy Physics (IHEP). That month, the two institutions signed a memorandum of understanding to work together on the Taiwan

Powerful collaboration. Scientists from Taiwan and mainland China are studying neutrino emissions from this nuclear power plant outside Taipei.

CREDITS: (TOP TO BOTTOM) ILLUSTRATION: TIM SMITH, TEXONO

Experiment on Neutrinos (TEXONO).

Seven years later, political relations between Taiwan and the mainland still oscillate between tepid and boiling over. But scientific ties are warming nicely, thanks partly to TEXONO, which just published its first result, on the neutrino magnetic moment, in *Physical Review Letters*.

"The science is modest," admits Henry Tsz-king Wong, who heads the collaboration for Taiwan. "But we've built bridges for future collaborations." Indeed, other groups are preparing to cross those bridges. And researchers hope good science will promote friendlier politics.

Mutual benefits, barriers

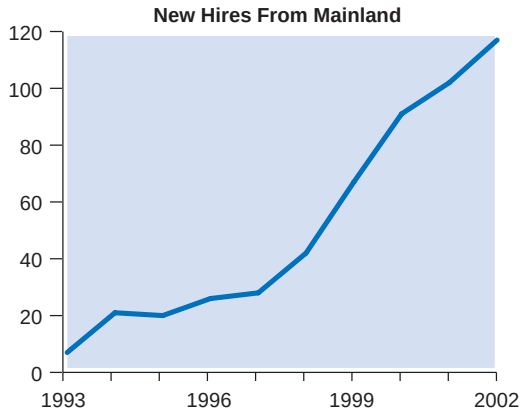
Wong says geographic proximity, a common language and culture, and practical reasons mean "it really makes sense for us to work together." He says Taiwan's smallish scientific community needs the mainland's numerous researchers, whereas Taiwan has a cadre of experienced, mid-career scientists missing in China because of the Cultural Revolution. Maryland's Chang adds that pairing Taiwan's world-leading electronics know-how with the mainland's rapidly advancing industrial capabilities should be "mutually beneficial" in developing experimental devices and instrumentation. The Chinese Academy of Sciences and Academia Sinica even trace their roots to the same institution formed in 1928 on the mainland.

But political barriers have hindered scientific ties. Li Jin, an IHEP physicist who heads the mainland side of the TEXONO collaboration, recalls that during a 1980 stint at Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois, researchers from Taiwan and the mainland "did not even want their pictures taken together."

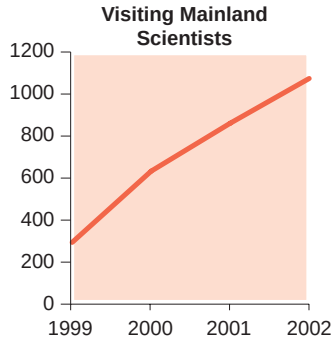
But by the late 1980s, unofficial scientist-to-scientist collaborations were producing joint publications—and discovering pitfalls. A 1998 *Science* paper on sponge fossils coauthored by Li Chia-Wei, a biologist at Taiwan's National Tsing Hua University in Hsinchu, and Chen Jun-Yuan, a paleontologist at the mainland's Nanjing Institute of Geology and Paleontology, triggered denunciations on the floor of the Taiwan legislature and calls for Li's funding to be terminated. His crime? His institutional affiliation included the address "Taiwan, China," instead of the official "Republic of China." "I was put in a very difficult situation," says Li, now director of the National Museum of Natural Science in Taichung, Taiwan.

Lee Shih-Chang, head of the high-energy physics group at Academia Sinica's Institute of Physics, started nurturing ties to IHEP in the early 1990s to strengthen his institute's experimental program. With funding from Taiwan's National Science Council, Lee brought senior mainland experimentalists to Taiwan to help develop experiments for accelerators at Fermilab and at CERN in Europe.

But it was Maryland's Chang who saw the opportunity to take the visiting-scientist cooperation to the next level: formal ties between institutions. He proposed that IHEP and the Institute of Physics form a joint team to develop a detector that would be set near one of Taiwan's nuclear power plants for studying neutrinos. The investment would be modest but large enough to require institutional backing on both sides. A carefully designed experiment could make an important contribution in one of the hottest areas of particle physics. "The project offered both scientific and sentimental benefits," Chang says.



Welcome addition. The number of mainland scientists visiting and taking jobs in Taiwan through programs coordinated by the National Science Council has skyrocketed in recent years.



Taiwan agreed to fund the project in 1996. But the mainland's National Natural Science Foundation balked over how the institutes would be identified. A compromise—identifying Academia Sinica as being in Taiwan, instead of the "Republic of China," and IHEP as being in China, instead of the "People's Republic of China"—led to mainland financial support. Later, several other institutions on both sides of the strait joined the project.

But there were more hurdles. Mainland scientists visiting Taiwan need to get an exit permit from the mainland as well as a visa from Taiwan, a process that takes at least 4 months and is subject to unexpected delays. The Taiwan side provided 90% of the $700,000 to build the detector, yet many of the critical components were produced on the mainland. This meant more approvals to move both funds and high-tech materials across the strait. In several cases, Wong says, the only way to convince "paper handlers" was to visit their offices and demand to be shown the legal basis for denial of a permit.

But perseverance paid off. In June 2001, the team finally started taking data at a detector set up 28 meters from the core of a reactor at the Kuosheng Nuclear Power Station 30 kilometers north of Taipei. Occasionally, an ephemeral neutrino produced by the reactor hits an electron in a 1-kilogram germanium crystal at the heart of the detector and produces an electronic signal. By analyzing those signals, the team produced the best upper limit yet of the neutrino magnetic moment, an indicator of the particle's inherent magnetism.

Petr Vogel, a neutrino physicist at the California Institute of Technology in Pasadena, says the result "is not earth-shattering, but it [is] the best limit on an important quantity." Given the budgetary constraints and the fact that this is the first experimental physics experiment in Taiwan, the TEXONO collaboration "performed admirably," he says.

Although no other collaboration matches the magnitude of TEXONO yet, other joint efforts are on the way. More and more Taiwan institutions are hosting visitors from the mainland, notes Lee, who predicts that more collaborative research will follow. A physics group at Taiwan's National Central University in Jung-Li is building a detector that will be used in experiments at IHEP's electron positron collider in Beijing. And James Shen, director of Academia Sinica's Institute of Molecular Biology, hints at a couple of TEXONO-style collaborations under discussion in the life sciences, although he doesn't want to disclose details prematurely.

For those who aspire to follow in TEXONO's footsteps, Wong advises, "Don't get frustrated, and keep a sense of humor." And although IHEP's Li doesn't see the political tensions between Taiwan and the mainland dissolving anytime soon, he thinks that the bureaucratic obstacles "are getting smaller and smaller." For both men, a chance to do good science is reason enough to reach across the strait. **–DENNIS NORMILE**

SOURCE: NATIONAL SCIENCE COUNCIL, TAIWAN