Where Have all Japan's Scientists Gone?

To the stock market and other high-paying jobs. Can foreign students, women, and older researchers fill the gap?

Tokyo—GO INTO A TYPICAL JAPANESE UNIversity laboratory at lunchtime and you will see a group of doctoral students in white coats wielding chopsticks over their rice and pickles, drinking green tea, and eagerly discussing their work. But get a little closer and you'll be surprised: Almost a third of the students will be speaking Chinese and others will be talking in the accented English of India and the Philippines.

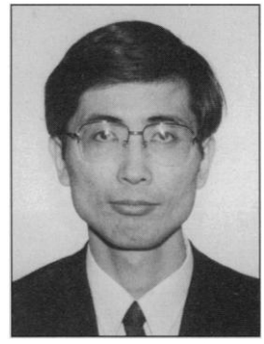
Much as the Japanese like to boast of their "work ethic" and "cultural homogeneity" the truth is that, just like the United States, Japan's research enterprise is now coming down with a bad case of "advanced nations' disease." The symptoms are familiar: The number of applicants for university science and engineering courses is falling and bright graduates are fleeing to securities companies, banks, and anywhere else that boasts a smart office and a fat salary. And, again like the United States, Japan suddenly finds itself relying on Asian students to fill the holes left at the laboratory bench—last year almost 40% of all Japan's doctoral students in engineering came from overseas.

The similarities to the United States don't end there. Both nations are predicting massive shortfalls in the future supply of scientific personnel. Japan's Science and Technology Agency (STA) recently came up with the frightening prediction that by 2005, Japan (with half the population of the United States) will need 980,000 researchers but will be able to provide only 500,000. That forecast, backed by a sheaf of new surveys, is now galvanizing action by Japanese industry and government. Industry, always light on its feet, is already turning to underused sources of scientific personpower, principally women, older researchers, and foreigners (employed either in Japan or at research labs rapidly being built overseas). And government, despite a reputation for being more ponderous, is showing signs it may at long last reform the universities and research system to try to make science—and basic research in particular—a more attractive proposition.

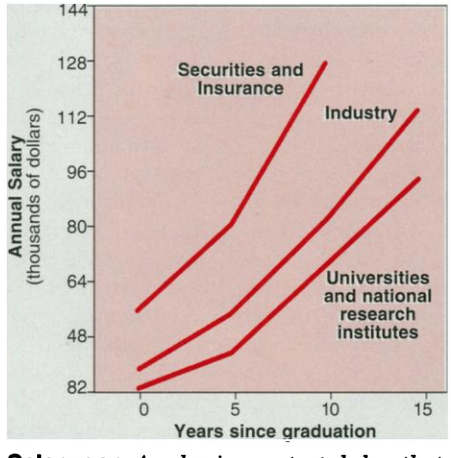
If there is a simple answer to why young Japanese are abandoning science, it's money. "We have found that new graduates in the science and technology world are tending to go to the financial world, merely because they pay a very good salary," says Yukihiro Hirano, research group leader at the National Institute of Science and Technology Policy (NISTEP), which has been analyzing statistics on changing recruitment trends since 1988. And if the problem is that simple, then so is the solution, argues Junichi Nishizawa, world-famous for his work on revolutionary semiconductor devices and now president of Tohoku University. "I am advocating that the salaries of professors at the national universities be doubled," he told *Science*.

Hirano, for one, does not think Nishizawa's demand is unreasonable. Nor do quite a lot of other people, including officials in MITI, which is urging manufacturing companies that, for the sake of the long-term future, now is the time to push researchers' salaries up. As Hirano points out, differences in the salaries of graduates widen very rapidly (see graph). "Even the very prestigious electronics companies cannot pay a good salary in comparison with the banks and securities companies," Hirano says.

"Shooting themselves in the foot" is how Nagami Kishi, an economics and business analyst with his own consulting company, describes the action of the banks and securities companies who are headhunting the best scientists. It makes a mockery of Japan Inc.'s legendary abilty to plan for the long term, he says, when they are "weakening the technical companies that produce the profits."



Trend-watcher. *Yukihiro Hirano, tracking the drift from science.*



Salary gap. *Academic pay starts below that in other sectors and falls further behind.*

The Bank of Japan agrees. In a report published last year, it warned that the trend could spell trouble for the Japanese economy as firms continue to switch their investments into high-technology products, which can only be developed by skilled scientists and engineers. Already, according to the bank's figures, 56% of Japanese technical companies are short of scientific personnel. Back in 1990, another survey of 1500 of Japan's biggest companies found 18% of their research posts unfilled. The survey would have come as no surprise to Hitachi: In 1988, when a third of the graduates joining two big securities companies were scientists, it had tried to recruit 1000 scientists and found only 700. The situation is not much better now, a company spokesman says.

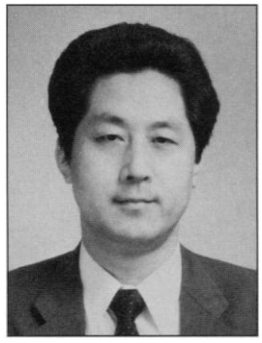
Money may be the immediate cause of today's recruitment problems but Hirano is quick to point out that the rush to grab a fat salary is only a "second order perturbation" of a much more serious underlying trend: Fewer students are applying to major in science and engineering. The number is down overall from 133,000 in 1987 to 114,000 in 1991, despite a rise in the total number of university applicants. Indeed, the situation is so bad that four competing Tokyo-based universities are putting aside their differences for a public campaign to persuade business and humanities majors to switch to science.

Such measures will at best provide a band-aid, however. As the gross national product continues to grow, and the emphasis on high-tech products increases, the demand for engineers will soar—just as a sharp drop in birth rate that began in the 1970s works its way through the population. "We will have a smaller and smaller younger generation," says Hirano. And that, he says, means that a drastic change in Japanese society will be needed to recruit enough bright young people into technical professions.

To hear some executives tell it, a drastic change is already on the way. At a forum held last month by Keidanren, the powerful business association, the heads of many of Japan's biggest companies claimed they were getting ready to reshape their organizations. "Many of the books written over the past 5 or 10 years about Japanese companies are now way out of date," says Kishi.

A major goal is to attract more women into research. Take the TDK corporation, a leading producer of recording tape. The

company has just established a subsidiary, TDK Akita Research Institute, which will eventually be spun off from the parent company as an independent all-female research center, hiring women chemists, physicists, and engineers. Nissan motor company is also proving fast off the blocks: Half of this year's scientific recruits were women, a staggering fraction in Japan.



Sea change. *Nagami Kishi says companies are busy restructuring.*

The STA cannot afford big pay raises but is trying to lure more women into its research institutes by providing new types of fringe benefits. Says Hirano, "We must offer such things as flexi-time and the opportunity to join management based on productivity, not on being a male and having seniority, as in the present system."

Target number two is older people. Sony is taking a similar approach to TDK's all-female research institute with a subsidiary that is hiring only people between 55 and 65. So far, 71 engineers who would normally have retired have been recruited from other companies. According to Kishi, they earn around 5 million yen ($40,000) a year, but "they are very happy to be working...even though they were making much more money before." One key attraction: Sony guarantees that everyone can work to 65 or 70 instead of the usual retirement age of 55.

It's no surprise that companies like Sony, renowned for their innovative capacity, are trying new ways to attract scientific expertise. More unexpected, however, is that—after decades of complaints—major changes now seem on the way in the government-run universities and research institutes.

Last week, in the latest of a series of government reports, the influential Science and Technology Council—which is chaired by the prime minister and sets overall science policy—called for the government to double its investment in R&D as early as possible, raise pay for scientists, increase the numbers of research students, and give more jobs in research institutes to women.

The report comes on top of an announcement last month that the STA has hammered out a new law that it believes will soon end criticism of Japan's research system as closed and inflexible. "It is designed to facilitate full-scale communication among universities, private organizations, and other countries," says Youchi Itoh of STA. One key change would allow foreign companies participating in government-funded research to own patents jointly with the government, which is currently impossible.

In spite of all these changes, however, it's clear that foreign researchers—mostly from Asia—will continue to be Japan's hidden resource. Foreign graduate students are pouring into Japan and the government wants more: The target is to (almost) triple the numbers enrolled in graduate courses to 100,000 by the year 2000. There will then be far more foreigners than Japanese in engineering courses.

The prestigious University of Tokyo has even begun offering graduate civil engineering courses in English to boost applications from top-class foreigners who don't have time to learn Japanese. Hajime Okamura, a senior member of the civil engineering faculty, says that many other universities are now imitating the course. And, he says, about half the foreign students decide to stay and work in Japanese industry.

That's no surprise, given that there are plenty of jobs and good promotion prospects. Geng Yang, an electrical engineer from mainland China, will finish his doctorate at Sophia University this April. "Extremely easy," is how he evaluates the prospects of getting a job in Japan. B. Deveraj, a biophysicist from India, left Tohoku University 2 years ago and already has a responsible post on a large MITI-sponsored research project. "I'm doing fine," Deveraj says. "If I was in the United States or India I could not be in such a position at 31."

For many Japanese companies, there is no time to wait for foreigners to come to them. Instead, they are following the boom in setting up—or buying—overseas research R&D facilities. That is getting the Japanese government a little worried. A recent Ministry of Education report cautions that hiring scientists abroad could be seen as an attempt to corner the worldwide market in research. The result, it says, could be further political problems between Japan and the United States. But if the next century's trade war is over brain power, not microchip power, everyone will know exactly who to blame: the bright young scientists who went into the stock market and by then will be running Japan. ■ **FREDERICK S. MYERS**

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Sequencing Venture Sparks Alarm

The latest tussle in the international genome project went public last week when word got out in the British press that U.S. businessman Frederick Bourke is attempting to hire two of the leading lights of the project—John Sulston of the Medical Research Council (MRC) in Cambridge, England, and Robert Waterston of Washington University in St. Louis—to start a private DNA sequencing company. Sulston and Waterston head what is in many ways the flagship project of the Genome Project: an ambitious effort, funded jointly by the National Institutes of Health (NIH) and the MRC, to sequence the genome of the nematode *Caenorhabditis elegans*.

Officials at the MRC are crying foul, accusing Bourke and Leroy Hood of the University of Washington, his close adviser, of trying to "poach" Sulston and skim the cream off a project that has been funded with public money for 20 years. Nobel laureate Aaron Klug, who directs the MRC's Laboratory for Molecular Biology in Cambridge, likens it to a hostile takeover. Dai Rees, secretary of the MRC in London, denounces it as a "flagrant bid to create an IBM of human genetics."

James Watson, who directs the genome effort at NIH, is said to be equally incensed but could not be reached for comment. He was in England over the weekend meeting with Rees, Klug, and Sulston in an effort to halt the defection. He and others worry not just about the loss of Sulston and Waterston but about the effect if such a major component of the public Genome Project goes private. They raise the specter of Bourke buying up the rewards of the Genome Project and secreting away data that should be in the public domain.

Bourke, who met with Watson for several hours recently, dismisses the complaints as "ridiculous" and casts himself as a "revolutionary" battling a "reactionary response." To him, the real reason for the backlash is that "people's egos are dented. They are concerned about credit." His goal is simple, he says: "I want to move the science forward just as Jim Watson does. Here is a vehicle to make the Genome Project move faster. It is good for everyone."

Several leading genome scientists agree, at least in principle. "It has been understood from the beginning of the [Genome] Project that a lot of the analysis of genomes would be done in private companies," which could do the job both faster and cheaper, says Maynard Olson of Washington University, who serves on the committee that advises Watson.

"This is what we all hoped would happen," agrees Francis Collins, who directs an