Two New Graduate Schools Break the Japanese Mold

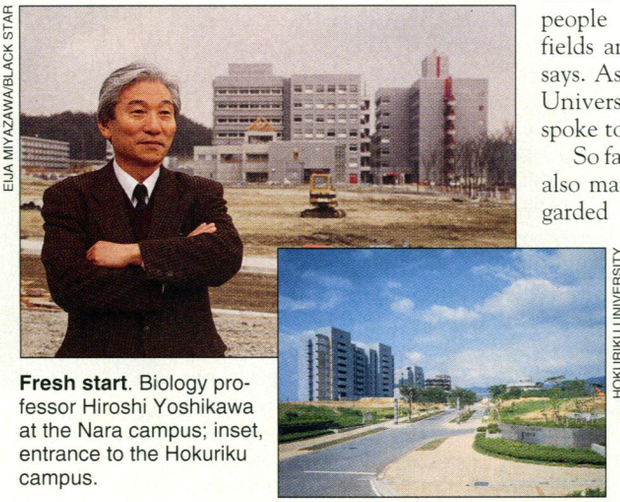
TOKYO—Materials scientist Takuya Honda gave up a professorship at the prestigious Tokyo Institute of Technology 2 years ago to answer what he calls the "challenge of being part of an experiment in education." Honda moved to the Japan Advanced Institute of Science and Technology, Hokuriku, a brand-new graduate school located in remote Ishikawa prefecture on the Japan Sea coast. When Hokuriku opened its doors in April 1992, it was like no other graduate school in Japan: a well-equipped research institute independent of the dozen or so universities that dominate higher education in the country. Its creation is one of the most prominent signs that the Japanese government is getting serious about improving and expanding graduate education.

Graduate schools have long been the most neglected sector of Japan's education system, and there is little incentive for Japanese students to take postgraduate courses. Industry has historically been indifferent to hiring those holding doctorates, believing their additional training does not provide them with the requisite skills to warrant higher salaries. And society sees those in their mid-twenties who are still in school as shirking social responsibilities. Moreover, less than one-third of graduate students receive any type of financial aid, and independent research opportunities are slim. All in all, it's no wonder the ratio of students in Japan who continue their education beyond an undergraduate degree—less than one per 1000 population—is one-third that of France and one-eighth the level in the United States.

But the status of graduate education is gradually changing, thanks to a consensus that Japan needs to train more basic researchers to sustain the country's economic growth. This new emphasis was made clear in 1991, when the University Council, an advisory body to the Ministry of Education, Science, and Culture, issued a series of reports proposing improvements in the quality of graduate education and recommending a doubling of total enrollment by the year 2000. The reports, in effect, endorsed moves already under way at Japan's top universities to strengthen graduate schools.

The launching of Hokuriku and a similar independent graduate school at Nara, about 20 miles east of Osaka, last year indicates that the ministry is interested not just in expanding graduate education but in changing it as well. These moves, however, have caused some grumbling in the traditional universities about the resources going to the upstart schools and the increasing competition for good students.

The two new graduate schools, both specializing in science, are breaking tradition with their curriculum, their approach to graduate education, and even their methods of attracting students. Typically, students pursuing a master's degree earn the bulk of their credits through research work and take few courses outside their own departments. In contrast, Hokuriku and Nara require them to take a broad range of courses. At other universities, students typically work under one professor and follow a single line of research from their final undergraduate year through their doctoral degree; at Hokuriku and Nara, students will be required to pursue at least two separate research themes, with different professors. Both schools operate just two departments, organized around emerging fields rather than traditional subject areas. Each offers graduate study in the information sciences, with Hokuriku adding materials science while Nara focuses on the biological sciences.



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HOKURIKU UNIVERSITY

Fresh start. Biology professor Hiroshi Yoshikawa at the Nara campus; inset, entrance to the Hokuriku campus.

The new schools also draw students from a more diverse background than is typical. The vast majority of Japanese undergraduate students remain at the same institution for their graduate studies. But because the new schools have no undergraduate departments, they must recruit students from throughout Japan. The schools are also encouraging those already in the work force to return for an advanced degree, a practice common in the West but rare in Japan.

Eventually, the two schools each hope to enroll 250 students a year in the master's programs and 74 in the doctoral programs. While those numbers represent only a tiny percentage of overall graduate enrollment in Japan—in 1992, 22,476 students entered master's programs and 3086 entered doctorate programs—the schools' experimental nature gives them a potential influence beyond their size.

Students are, in fact, already voting with their feet, with as many as three applicants for each of the 250 slots at each school. (Actual competition for places in graduate school is unusual in Japan because faculty are able to screen students as undergraduates.) Junji Kabata, a first-year student in materials science at Hokuriku, says he was attracted by the structure of the new departments. "You get into discussions with people with backgrounds in different fields and with different concepts," he says. As an undergraduate at Yamagata University, Kabata says he hardly ever spoke to anybody outside his major.

So far, both Hokuriku and Nara have also managed to lure several highly regarded faculty members like Honda away from Japan's top universities. Hiroshi Yoshikawa, professor of biological sciences at the Nara school, says 273 scientists applied for 17 faculty positions in the biological sciences at Nara, and he says the average age of new faculty—36—represents an attractive mixture of senior faculty who have retired from their former institution, such as Yasuyuki Yamada, whose work on plant physiology while at Kyoto University has been recognized both at home and overseas, and young scientists who are expected to make their mark.

One big draw is the quality of the research equipment. The education ministry helped to get the schools off to a good start by providing enough money to create some of the best-equipped university labs in Japan. Over the past 4 years, for example, Hokuriku has spent $173 million to build and outfit half the 22 major buildings in its master plan.

But the ministry's restrictions on staffing prohibit the universities from taking full advantage of their physical plant. "We have labs full of equipment," says Yoshikawa, "but no research assistants. Also, there is no equivalent to the postdocs common in the United States, and there is no way to hire technicians." Ministry officials are studying the problem, but any solutions will require multiple approvals and then must be implemented at all national universities.

Hokuriku's president, Tominaga Keii, a former professor of chemistry at Tokyo Institute of Technology, says his main aim is to

turn out flexible graduate students who will appeal to industry, which is creating research positions at a much faster rate than are academic and government institutes. Most doctoral programs, he says, turn students into "pinpoint specialists" without the skills to move into new areas, and that is one reason corporations hire so few Ph.D.s and why there is so little cooperation between universities and industrial research labs.

Keii's analysis finds some sympathy in the top echelons of Japan's corporate labs. Akinobu Kasami, head of Toshiba Corps research and development center whose own background is in applied physics and electrical engineering, agrees that changes are needed in graduate education. But he says it is too early to know if the new schools have the right answers. "In the United States, there is a clear difference in the capabilities of those who earn master's and those who earn Ph.D.s," says Kasami. "In Japan that is not the case. "The Hokuriku and Nara approach, he adds, "is an interesting educational experiment, but the results aren't in."

Keii's colleagues in the traditional academic world are less enthusiastic, however. They say research institutes attached to existing universities already have a structure similar to that of the new graduate schools, and that many institutions are pondering curriculum changes similar to what Hokuriku and Nara have adopted. "We don't fully understand the ministry's reasoning" for establishing the new schools, says Toshiaki Ikoma, professor of semiconductor electronics at the University of Tokyo's Institute of Industrial Science.

Scientists are also concerned that the planned doubling of graduate slots among the nation's top universities may trigger a bidding war for a limited number of students. "Without more financial support [for Ph.D. students] it is going to be difficult to increase the number of students," says electrical engineer Makoto Ando of Tokyo Institute of Technology, who has been deeply involved in discussions of curriculum reform at his institution. And Yasushi Hibino, a professor in the school of information science at Hokuriku, worries that the school's distance from major urban centers may hurt enrollment.

In the end, the biggest changes may not be in the academic structure or the curriculum, but in the attitude of the faculty. "We have to make the school attractive if we want to attract students," Hibino says. Says Hokuriku's Honda: "Adjusting to this new educational program is the biggest challenge for those of us from the old schools."

–Dennis Normile

Dennis Normile is a science writer based in Tokyo.

SUPERCONDUCTING SUPER COLLIDER

A New Problem: Too Much Money

The Superconducting Super Collider (SSC) may be dead, but the political wrangling over the project is still very much alive.

The latest episode in the SSC saga aired last week at a hearing of the House science subcommittee, with the Department of Energy (DOE) once again admitting it had erred in calculating the cost of some aspect of the project. But this time, the problem is a surplus—$167 million, to be exact. That's the amount DOE officials say they expect to have left over from the $735 million they have on hand to complete the shutdown. (The figure includes $640 million that Congress has appropriated to terminate the SSC at Waxahachie, Texas, plus $95 million in unspent funds from the project itself.)

Why is the perennially cash-starved SSC suddenly rolling in dough? And why has DOE requested an additional $180 million in 1995 to complete the shutdown? The simple answer is that DOE didn't have a firm estimate until February, months after its 1995 budget request had been submitted, of what the termination would cost. Now even that estimate—$695 million—has been whittled down by $127 million, principally by DOE's decision not to fill in the 14 miles that have already been dug for the planned 54-mile tunnel. Instead, DOE will simply plug up the access shafts for safety purposes and allow nature to turn the rest into an underground reservoir. The surplus is also based on DOE's belief that it has no legal obligation to reimburse Texas for the state's $500 million investment, beyond ceding title to the physical structures the state helped to build.

DOE isn't about to hand $167 million back to Uncle Sam, however. One reason: Texas may go to court to recoup its investment, and any settlement could wipe out the expected surplus. In addition, DOE is holding a competition to use some of the funds for an unspecified "follow-on" project in Texas. A commission set up by Texas Governor Ann Richards, a Democrat, has submitted three ideas—a superconducting magnet laboratory, a regional high-performance computing center, and a cancer and medical isotope facility using the nearly completed linear accelerator (*Science*, 4 March, p. 1211). DOE Secretary Hazel O'Leary has publicly supported Richards' proposal for up to $40 million a year in federal funding for such a follow-on project.

"The will of the House was to shut down the SSC as quickly and cheaply as possible."

–Rep. Sherwood Boehlert

O'Leary may have a tough time convincing Congress to go along with this plan, however. Representative Sherwood Boehlert (R–NY), the SSC's chief congressional foe, believes DOE is violating the spirit of the congressionally mandated "orderly termination" of the project and that its plan for a follow-up project is really an excuse to help Richards' re-election campaign this fall. "The will of the House—stated in no uncertain terms during last year's debate—was to shut down the SSC as quickly and cheaply as possible," Boehlert said at last week's hearing. But DOE, he said, appears to be "more interested in Texas politics than in federal interests."

Many high-energy physicists are also unhappy about plans to fund a new project at the SSC site. Representatives from several of DOE's accelerator laboratories told the agency's High Energy Physics Advisory Panel earlier this month that DOE instead should give more money to Fermilab and the Stanford Linear Accelerator Center to avoid interrupting planned experiments next year.

Martha Krebs, director of DOE's Energy Research program, acknowledged that the department's 1995 request "may have to be revisited" in light of the new cost estimates. But she defended the concept of a follow-on project as a way to satisfy a congressional mandate to "maximize the value of the [government's] investment" in the project. Indeed, Krebs later said DOE intends to provide extra funds to the SSC laboratory to retain a core of scientists who can evaluate the follow-on proposals and begin to work on whichever one, if any, is chosen.

But finding enough able hands may be a problem. SSC director John Peoples, whose permanent job is director of Fermilab, says that current targets require him to reduce the number of SSC scientists to 80 by July, down from nearly 2000 last year, and below the figure of 125 that the Richards' commission sees as the minimum to carry out a follow-on project. Krebs says DOE "is working with Texas right now to discuss how many people might be retained." But DOE will have to work fast: Only 130 scientists are now working at the lab, Peoples says, and they must be given a "significant incentive" to remain there.

–Christopher Anderson