LEAVING HOME

Continued from Page 55

Futoshi Shibasaki, who turned down an assistant professorship at the University of Tokyo for a postdoc at Harvard Medical School.

The loose structure of U.S. labs also improves the flow of information, he says: "In Japan, you can't get information before a paper is published. Here there's lots of personal communication prior to publication." Similarly, Suzuki finds that her colleagues at Johns Hopkins communicate more freely than those in Japan. "Here the lab is smaller, only about 10 people, while in Japan, the lab has many people—more than 30 where I was—so they break up into groups and overall communication gets poor."

SAM KITTNER

Speak up. Noriko Suzuki says lab interactions work best in English.

Openness may not always be enough, however. In some fields, such as high-energy physics, poor job prospects in the West can make the grass seem greener at home. "Most of my colleagues and classmates don't want to go overseas," says Tsuyoshi Nakaya, a particle physicist working at Fermi National Accelerator Laboratory outside Chicago. "Most of them want to work on the B-meson factory [under construction at the Institute of High-Energy Physics in Tsukuba]." Conversely, even in fields where opportunities in Japan are more limited, many young scientists are reluctant to go abroad because they fear losing out in the competition for jobs back home.

Yet the idea of studying abroad remains an irresistible challenge to Japanese scientists like Nakaya, who are suspicious of security. "My American friends ask me, 'Why are you here?' In Japan, research jobs are very stable," he says. "But if you have to find a new job every few years, you must think of new things all the time. If I got a job for 10 years, I don't think I'd do any new science."

–June Kinoshita

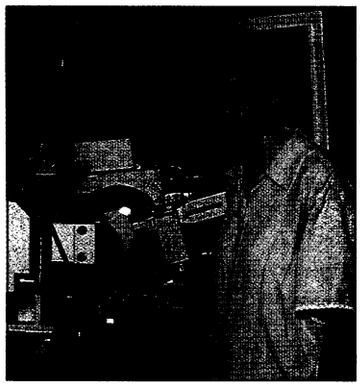
WORKING IN JAPAN

Continued from Page 54

been removed. The language barrier is real. Alisa Erika Koch, a professor at Northwestern University Medical School in Chicago who was a visiting researcher for a year at the University of Tokyo's Institute of Medical Science, recalls being stymied by some cautionary instructions posted on a centrifuge she wanted to use. "It's like being a child again if you can't read," she says.

There is also the question of the professional payoff from a stint abroad. U.S. physicist Douglas Tweet found that his experience working at NEC Corp.'s Fundamental Research Laboratories in Tsukuba "wasn't seen as an asset" by most U.S. companies he contacted as his 3-year postdoc was coming to a close 2 years ago. Fortunately, he was able to satisfy his desire to learn more about Japan by taking an open-ended position at the national Electrotechnical Laboratory in Tsukuba.

Patricia Gercik is managing director of the Japan Program at the Massachusetts Institute of Technology, which places science and engineering students in Japanese laboratories for up to a year. She says that the increasing number of joint ventures between Japanese and American firms is raising the value to U.S. companies of people with both technical and cross-cultural skills. But many companies still "don't get the picture," she says.



EIJI MAYAZAWA/BLACK STAR

Topnotch. Bridget O'Neill says her Tokyo lab is very well equipped.

Despite the inherent difficulties of working in a strange country, Western officials say that recent trends are positive (see graph). Some programs, such as a U.S. "Summer Institute in Japan" scheme which places U.S. graduate students in private and public labs in Japan, are already oversubscribed. One reason for the increased interest, says Weber, is simply a greater awareness of the level of work being done here.

Sheffield's Parbrook agrees. "What really counts is the science you do while you're there," he says. "As information [about the quality of Japanese research] becomes more available," he predicts, "people are going to be more aware of the value of coming here."

–Dennis Normile

PRECOLLEGE EDUCATION

Reformers Fight to Draw More Students Into Science

TOKYO—On a hot and muggy evening this summer, a classroom at Shotoku Gakuen High School began to fill up with people carrying wires, tubes, and chunks of metal. They each took turns demonstrating simple experiments and discussing how to work them into classroom activities. One illustrated the concept of phase change—and demonstrated basic metalworking techniques—by showing a new metal alloy that melts in hot water and can be cast into molds. Another showed a videotape of how a simple homemade accelerometer could measure the change in *g* forces experienced during amusement-park rides. "It's a way of studying while playing," the presenter said.

It was a typical monthly meeting of the Galileo Workshop, an informal group of high school physics teachers formed in 1985 to discuss innovative approaches to teaching their subject. These gatherings are more than a forum for exchanging ideas for novel experiments, however. The participants hope such grassroots efforts will stave off the harmful effects of a drop in the number of hours spent on science in the classroom and shore up declining student interest in science, especially physics. Part of the problem, they say, is that Japan's long-standing emphasis on education has degenerated into a narrow focus on passing tests, particularly the university entrance exams. "Science is covered in the curriculum," says Yutaka Furuta, a physics teacher at the private Tokyo-area Rikkyo High School and a workshop regular. "But there is little chance for students, let alone ordinary citizens, to learn the joy of scientific experiments."

Yoji Takikawa, a physics teacher at International Christian University High School and a driving force behind the Galileo Workshop, worries that these trends will undermine not only the government's plans to boost basic research and increase graduate enrollment, but also the country's economic health. "I have to wonder about Japan's future," he says.

Takikawa may be more pessimistic than most science teachers, but he is hardly alone in his concerns. A few years ago the Physical Society of Japan found "various problems with primary and secondary science education," says Toshio Hyodo, a professor of phys-

ics at the University of Tokyo, who headed up the study. In 1994, the Physical Society joined the Physics Education Society of Japan and the Japan Society of Applied Physics in publicly deploring reduced science class time and the focus on memorizing—as opposed to understanding—scientific principles. Societies in every field of science have issued similar statements.

But reformers like Takikawa face formidable barriers to change. Class time will become more precious as the current practice of holding classes on two Saturdays a month is phased out over the next decade. Meaningful curriculum reform, say government officials, must be preceded by changes in university entrance procedures, which reward students who excel on standardized tests based on rote knowledge rather than creative problem-solving. And it will be difficult to change the emphasis on exam scores until broader social changes allow for different ways of judging people.

As serious as these problems appear, Western education experts say the criticism masks the fact that the Japanese system continues to offer most students a solid foundation. Harold Stevenson, a psychologist at the University of Michigan who has led case studies of Japan's education as part of an ongoing international assessment, says Japan is doing "fabulously" well in giving students basic math and science skills. "They are in the top one or two of every study ever done," he says. Even a reduction in the time spent on science in the primary grades—from 1048 hours in the late 1960s to 735 hours today—leaves Japanese students comfortably ahead of their U.S. counterparts, who in 1993 spent an average of 450 hours a year on science.

A shrinking stage. The most easily quantifiable concern for Japanese educators is the reduction in class time devoted to science since the 1960s as overall school hours have been cut and new subjects added to the curriculum. For grades 1 through 9, the annual time spent on science has dropped by 30%, while in high school a reduction in class time has been accompanied by an easing of requirements. The number of science credits the government requires has dropped from 15 to eight since the 1960s (a class meeting twice a week all year earns two credits), with students now allowed to choose two subjects from among chemistry, biology, geology, and physics.

A shorter school year hasn't led to a thinner curriculum, however. And Takikawa, who is currently a director of the Physics Education Society of Japan, says teachers feel obligated to slavishly follow the lessons laid out in textbooks designated by the Ministry of Education, Science, Sports, and Culture (Monbusho), leaving them to present an impossibly large amount of material in the time available. "Just as students get interested in, say, light, it's time to move on to the next theme," says Takikawa. The pace and inflexibility "make it impossible to foster understanding or a sense of discovery," he adds.

Hiroshi Sakaguchi, an official with Monbusho's elementary and secondary education bureau, denies that the curriculum is too crowded or too rigid. The high school science requirements are outlined in only 15 pages of a slim booklet, he says, and "it would take a voluminous manual" to describe requirements as strictly as critics claim. Teachers are not required to cover everything in the textbooks that Monbusho designates for all public and private schools, he adds.

D. NORMILE

Serious fun. Yoji Takikawa helped organize teacher workshops to improve science curricula.

Even so, teachers say that the pressure to cover everything that might appear on university entrance exams has warped secondary education. "High school students are totally consumed by these examinations," says Tadashi Hiroi, a teacher at Tsukuba University High School and former managing director of the Physics Education Society of Japan. "And it's not just the adolescent students. Their parents, parent associations, and even teachers are also consumed," he adds. There is even a cram school industry enrolling large numbers of students in evening and weekend classes.

It's easy to understand why. Although entrance requirements vary by university, exam scores are the sole criterion for determining who gets into the top national universities. (The importance of the exams is magnified by the tendency of top companies to base hiring decisions on the university attended, with little regard for major or grades.) This focus is seen as the best way to make the selection process objective and impartial.

Students take two rounds of entrance exams for all national and most private universities. The exams cover specific subjects, and students take only those subjects required by the university department they are aiming for. Students, including science majors, can typically choose any two from physics, chemistry, biology, and geology.

Two tracks. Hiroi says that a rising number of students avoid taking the physics exam because they believe it will drag down their overall scores. But it's not just the exam they are ducking. The Physical Society concluded that the percentage of high school students studying physics has dropped from more than 90% in the 1970s to about 20% now. "It isn't that students are bad at physics," says Rikkyo High's Furuta. "They simply don't know physics." The current figures are similar to those in the United States, where just 24% of high school students take physics courses—a figure that actually dipped into the high teens during the 1970s and 1980s.

Even at the prestigious University of Tokyo, which requires all science majors to take college physics, only physics majors are required to take the physics entrance exams. As a result, says Tokyo's Hyodo, only about 70% of the university's life science majors have studied high school physics. To cope with this rising level of ignorance, the university has created a separate track of physics courses for those who haven't studied it in high school.

Yoichiro Murakami, a science historian and former head of the University of Tokyo's Research Center for Advanced Science and Technology, says this rote memorization approach to education boosts the level of average students at the cost of turning education into a one-way flow of information. Murakami now teaches at the International Christian University, whose degree programs in English attract a large number of Japanese who have grown up overseas.

Murakami says the differences between those who have gone through Japan's educational system and those who haven't are striking. "You can tell within the first class which students are 'returnees,' " he says, because they dominate classroom discussions, raise questions, and challenge professors. Murakami says the passive approach to learning in Japanese schools yields students that excel at answering standardized questions but who "do not develop the ability to identify problems and respond to them appropriately."

Takikawa and others at the Galileo Workshop hope to address that deficiency by rekindling in their students a sense of excitement about science. And their vision extends beyond the classroom. Ichimasa Yagi, a Tokyo metropolitan high school physics teacher who developed the amusement-park accelerometer, says the experiments "are not just for school students. We want ordinary people to enjoy science as well."

–Dennis Normile