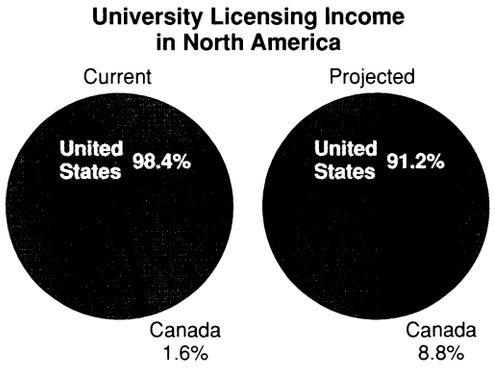
courses that direct contact with the professor is limited and student assessments have little meaning. "In practice, it will be very difficult applying that system without a global reorganization of our academic system," he says. **–CHIARA PALMERINI**

Chiara Palmerini is a writer in Milan.

CANADA

Schools Urged to Boost Technology Transfer

OTTAWA—Canada is losing valuable technology to other countries because of its policies on exploiting the fruits of university research, according to a new report by a high-level government panel. The answer, says the panel, is to give universities rather than individuals the right to commercialize publicly funded discoveries, as well as the money to do the job right. But some academics fear that such a policy, described in a draft report obtained by *Science*, would turn universities into toolboxes for industry and undermine basic science.



Bigger slice. Canadian officials want greater commercial return on academic R&D investment.

The report, "Public Investments in University Research: Reaping the Benefits," is the first product of the prime minister's Advisory Council on Science and Technology, created in 1997. Written by a nine-member subpanel of industry and university officials, it notes that only half of Canada's universities retain ownership of intellectual property (IP) generated by public funds or share it with the researchers; the others turn over full rights to the researchers. The result, says the panel, is that academe has become a "technology supply house for other countries," with faculty members "handsomely rewarded through consulting fees in return for assigning away IP rights" to companies from other countries, notably the United States.

Canadian universities collected a paltry $10 million last year from the marketing of university-based inventions, compared to $700 million in the United States, even though the government spends about one-tenth as much on academic R&D as its southern neighbor. Advisory Council member and expert panel chair Pierre Fortier says the only remedy is to "get some assurances from universities" that commercialization is part of their mission. "We cannot carry on with the laissez-faire approach which has prevailed until now," says Fortier, special adviser to Montreal-based Innovitech Inc. The panel's final report will be submitted 11 May to the full council, which will forward it to the Cabinet in early June. Observers predict it will receive a warm reception from a government eager to promote high-tech industry.

The draft report says that researchers should be obligated to make full disclosure of all IP created from federally funded research. The university, with few exceptions, should own the rights to its commercialization, while the creator should get a "share" in the form of equity or license income. The report proposes legislation similar to the U.S. Bayh-Dole Act of 1980, which gave universities the right to obtain title to inventions developed with federal funds and to grant exclusive licenses to patents based on those discoveries. Such a law would serve to harmonize what is now a hodgepodge of policies and practices.

As an alternative to legislation, the report also proposes that the granting councils adopt a new IP code and prohibit awards to universities that don't follow its guidelines for promoting commercial activity. Fortier says that consultations with 150 academic administrators have recently led the panel to conclude that's a preferable approach. "It's easier to administer," he says. "Legislation could take 2 to 3 years." The panel also recommends that Ottawa spend $30 million a year to hire and train commercialization staff in universities, noting that only 62% of the country's universities have any form of office to foster technology transfer.

While agreeing that universities need to become more attuned to the market, some academics question whether new spending on commercialization is the best solution to the problem of reaping more from Canada's investment in academic research. "Before you can imagine getting a lot of money from industrial applications, you must first invest more in basic research," argues Yves Gingras, professor of the history of science and sociology at the University of Quebec in Montreal.

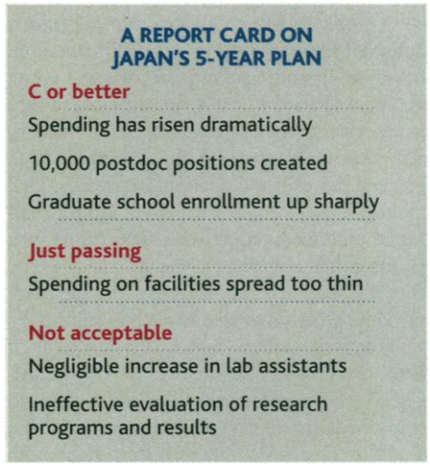
Others, like Canadian Association of University Teachers executive director Jim Turk, worry that the recommended measures will transform universities from institutions of "open scholarship" to ones in which "commercial benefit" serves as the primary rationale for research. Turk takes issue with virtually every aspect of the report and is particularly incensed by its casting of faculty who assign IP abroad as somehow "treasonous" at a time when the government is allowing Canadian high-tech firms to be bought up by foreign interests. He also faults the panel's emphasis on commercialization rather than on the need to create new knowledge that might have applications, a view he sees as a "bizarre, Orwellian redefinition of innovation." **–WAYNE KONDRO**

Wayne Kondro writes from Ottawa.

JAPAN

Mixed Grades for 5-Year Science Plan

TOKYO—A 1995 law that led to Japan's first-ever 5-year plan for science and technology has helped boost spending and the number of scientists being trained, but it has been less successful in ensuring that the increased funding is well spent. That's the preliminary verdict of a committee of the country's top science policy-makers, in an interim report released last week. "There has been a fairly big effect ... on bringing up the overall level of research activity," says Mitsugu Ishizuka, a former official of the Science and Technology Agency (STA) and a member of the committee that drafted the report. "But there are aspects [of the plan] that haven't progressed as hoped."



SOURCES (LEFT TO RIGHT): PRIME MINISTER'S ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY; COUNCIL FOR SCIENCE AND TECHNOLOGY REPORT

The review is likely to be influential, given its source: the Committee on Policy Matters of the Council for Science and Technology, which is chaired by the prime minister and serves as the nation's highest science advisory body. The panel examined such quantitative measures as the level of funding and the number of lab assistants and interviewed national laboratory heads, researchers, and business leaders.

Some of the major numerical goals in the basic plan are being met, the committee concluded. Research spending has risen dramatically and is within striking distance of a projected 17 trillion yen ($142 billion) over 5 years (*Science*, 22 January, p. 478). "We may be close enough to say we've hit the target," says Nobuhiro Muroya, deputy director of STA's Planning and Evaluation Division, which helped with the report. The government has already achieved the target of 10,000 postdoctoral positions. In addition, the number of students studying for advanced degrees has increased from 39,660 to 51,360. University professors have also been given greater freedom to work with companies.

The council gave barely passing grades to other efforts, however. Despite several emergency spending measures to stimulate Japan's stagnant economy, which included money for academic renovations and new equipment, "a lot still needs to be done," says Ishizuka, one of two full-time members of the Council for Science and Technology. "There is still a lot of old equipment [in use]." And attempts to shrink government payrolls have stifled any increase in the number of research assistants, which Muroya says remains quite low.

A big disappointment to many scientists is the committee's finding that procedures established to evaluate programs and institutes have had little impact on research activity. The report notes that although most organizations have gone through the motions, their efforts "are not sufficiently reflected in the allocation of resources or management of facilities." Tomoko Ohta, a population geneticist at the National Institute of Genetics in Mishima and a member of the committee, believes the problem lies in making the evaluations sufficiently rigorous. "[Japanese] are just not accustomed to making critical comments of others," she says.

In a move unrelated to the committee's review, the Ministry of Education, Science, Sports, and Culture (Monbusho) hopes to standardize evaluation procedures and apply them to universities and national labs under its authority. A subcommittee of the Council for Science and Technology is also working on recommendations for other ministries. But no one expects a quick fix. Evaluation efforts "won't work if we don't change our culture," says Muroya, a process that must be carried out incrementally.

The committee hopes to submit a final report in about a year. In the meantime, the council plans to address some issues raised in the review, including the need for a clearer statement of science and technology priorities. One of its first opportunities will come this summer in recommendations to the Ministry of Finance for the fiscal year 2000 budget. **–DENNIS NORMILE**

SCIENTIFIC COMMUNITY

High-Level Groups Study Barriers Women Face

Mildred Dresselhaus isn't proud of the fact that she took a total of 4 days' maternity leave from her faculty position at the Massachusetts Institute of Technology (MIT) in the course of giving birth to four children. But as a young electrical engineer in the late 1960s in a bastion of masculinity, she didn't think she had much choice. "In my youth, it was necessary to play the game that way. We didn't have any options," recalls Dresselhaus, who went on to become an MIT institute professor and a member of the National Academy of Sciences (NAS).

A generation later, Elaine Mendoza, an aerospace engineer, had a lot more options when she decided to start a family. As the president and CEO of Conceptual Mindworks Inc., of San Antonio, Texas, which she founded in 1990, Mendoza has simultaneously raised two young daughters and turned a software business into one of the fastest growing Hispanic-owned companies in the United States. Her husband, an electrical engineer, is even one of her 51 employees.

> **"These distortions have persisted despite three decades of good-faith efforts."**
>
> **—Marye Anne Fox**

The contrast between the two women's experiences reflects the strides made by women in science and engineering in the last 30 years. But much more needs to be done for the country to take full advantage of its pool of scientific talent, most observers agree. This month the topic moved into the first rank of science policy circles. On 14 April a congressionally mandated commission met for the first time, with Mendoza as chair, to examine the barriers facing women, minorities, and the disabled in science. Last weekend Dresselhaus participated in a first-ever NAS symposium on improving scientific career opportunities for women. The commission is the latest in a series of federal efforts to document the problem, while the symposium, organized by the academy's Committee on Women in Science and Engineering (CWSE), builds upon persistent concerns about the minute presence of women—currently 5.9%—in the overall NAS membership.

A major issue for both groups is a decline in the participation of women in science as they make their way through school and into the academic work force. "As you move along the educational and labor continuum, the gender gap becomes more and more pronounced," says Marye Anne Fox, chancellor of North Carolina State University, Raleigh, and moderator of the NAS symposium. "And these distortions have persisted despite 3 decades of good-faith efforts." The trend is especially troubling in younger fields like computer science, says William Wulf, president of the National Academy of Engineering. Women make up half the enrollment in high school computer science classes, he noted, but receive only 28% of the bachelor's degrees in the field. Their share of Ph.D.s drops to 16%, he added, and they hold only 6% of full professorships.

This gender gap reflects the continuing difficulties of women scientists in academia, say many observers. And even those who "make it" face systemic discrimination in such areas as salaries, lab space, and service on key committees, according to a new report on the status of tenured women faculty at MIT (*Science*, 26 March, p. 1992).

It's an open question whether industry is more receptive. IBM's Lillian Wu, a member of the President's Council of Advisers for Science and Technology and co-chair of CWSE, says she's seen a rapid improvement in the past 5 years and that today "there's a tremendous appreciation for what women can bring to technology." But Kathryn Johnson, co-chair of the congressional panel and a geoscientist who runs her own consulting firm in South Dakota, says that she and many other women have become entrepreneurs in part to escape the "glass ceiling" and "chilly environment" at many big companies.

The NAS symposium featured a spirited discussion about such gender-related issues as whether science, in the words of Harvard physicist and CWSE co-chair Howard Georgi, "unconsciously discriminates" against women by selecting for such traits as "assertiveness" and "single-mindedness" that favor men. The way women respond to inequalities was also debated. Asked why the MIT women waited as long as they did to seek redress, Dresselhaus replied, "Women aren't as aggressive in asking for equality in salaries and amenities. There were several instances where I was shortchanged and I didn't complain. So part of the problem is us—not them [men]."

Both committees hope to compile and disseminate a list of current best practices and suggest concrete ways for organizations to increase opportunities for women. But entrenched attitudes are often hard to change. "It's more acceptable for a woman scientist to have a family today," Dresselhaus admits. "But it's not any easier." **–JEFFREY MERVIS**