Universities Throw Open Doors to Outside Scrutiny

TOKYO—Japanese research institutions are not accustomed to rigorous outside scrutiny of their science. In a society where world-renowned scientists get paid no more than their mediocre colleagues, and where only a small fraction of basic research money is distributed on the basis of merit, there's little incentive for researchers or their institutions to make sure that their work stands up to external review. Academics, moreover, have long been wary of outsiders, says Minoru Oda, former head of the Institute of Physical and Chemical Research (RIKEN)—an attitude, he says, that stems from the 1930s and 1940s, when jealously guarding their autonomy "was the only way for professors to survive the militarist era."

But that attitude is changing as Japan becomes more comfortable with its place in global science and as Japanese researchers increase their interaction with colleagues in other countries where such reviews are common. Scientists and university administrators are also turning to external peer review—including both domestic and international colleagues—in an effort to convince government bureaucrats that Japan's academic research is up to world standards and therefore deserves more money.

The physics department at the University of Tokyo led the way. Early last year, it invited an international committee to undertake a wholesale critique of its education and research activities. Before the year was out, individual departments and institutes at Tohoku University, Kyoto University, and RIKEN had also convened panels of outside experts to review their programs. Indeed, the trend has taken hold so fast that when *Science* asked an official at the Ministry of Education, Science, and Culture (Monbusho) which institutions are considering external reviews of one kind or another, he responded flatly: "They're all considering it." Adds Akito Arima, head of RIKEN and former president of the University of Tokyo, "It's simply the age."

But reviews alone will not transform a scientific system that has long been criticized for being too insular. Skeptics note, for example, that Monbusho has so far shown little inclination to depart from the system of lifetime tenure even for entry-level faculty, and is still doling out most of its funds for basic research as block grants, distributed based on seniority rather than merit. Until those basic characteristics of Japan's academic research system change, says one University of Tokyo professor, external review will remain "a sort of meaningless ceremony."

Tokyo sets the pace. The idea of external review isn't completely alien to Japanese science. The synchrotron program at the National Laboratory for High-Energy Physics (KEK) has had regular external reviews, and RIKEN and the national institutes for basic biology, physiology, and molecular science in Okazaki have long conducted international reviews of research directions and themes. But detailed outside reviews of overall operations are the exception, and the national universities have rarely conducted even internal evaluations, much less external ones.

The first step toward academic self-examination was taken in 1991 when Monbusho, at the urging of an advisory council

THE FACE OF PEER REVIEW IN JAPAN

Institution	Department/Program
International External Review*	
University of Tokyo	Botany, Physics, Mathematics, and Center for Elementary Particle Physics
Tohoku University	Entire engineering faculty
Kyoto University	Entire science faculty
Institute of Physical and Chemical Research (RIKEN)	All departments
Institute for Molecular Science, Okasaki	All departments
Institute of Space and Astronautical Science, Sagamihara	All departments
Institute for the Study of the Earth's Interior, Misasa	All departments
Domestic External Review**	
Tohoku University	Entire science faculty
Osaka University	Basic engineering—all depts.
University of Tsukuba	Physics, Materials Science, Neurology
Self-Evaluation* (all departments)**	
Hiroshima University	Okayama University
Hokkaido University	Osaka University
Kobe University	Tohoku University
Kyoto University	University of Tokyo
Kyushu University	University of Tsukuba
Nagoya University	

* At least one non-Japanese member on the panel
** At least one member from outside the institution

Report card. All top national universities now self-evaluate, but only a few elite departments have braved external reviews.

MOST HIGHLY CITED GROUPS (1992–94)

Research Team	Institution	Subject
Physical Sciences		
K. S. Hirata *et al.*	Kamiokande Group	Solar neutrinos
K. Hono, T. Sakurai *et al.*	Tohoku University	Nanocrystal materials
S. Iijima	NEC Fund Res. Labs	Carbon nanotubes
K. Kondo *et al.*	Hokkaido and Kanazawa Univs.	Marine alkaloid chemistry
H. Okuyama *et al.*	Sony Central Res. Lab	Blue laser diodes
Y. Tanaka, H. Inoue	Institute for Space and Astronomical Sciences	X-ray astronomy satellite
Life Sciences		
M. Mishina *et al.*	Niigata University	NMDA receptors
S. Nagata *et al.*	Osaka Bioscience Inst.	Fas antigen
S. Nakanishi	Kyoto University	Glutamate receptors
Y. Nishizuka	Kobe University	Protein kinase C
H. Okamoto, M. Mayumi	Jichi Medical School	Hepatitis C
T. Takeshita,	Tohoku University	IL-2 receptor

SOURCE: INSTITUTE FOR SCIENTIFIC INFORMATION

A dazzling dozen. These 12 Japanese research teams have published papers within the past 3 years that have been cited considerably more often than other work in their field. The actual number of citations varies by discipline.

of leading academic figures, encouraged universities to conduct internal reviews of their teaching and research programs. In response, virtually all of the country's 98 national universities have implemented some form of review.

Arima, who was a member of the advisory council, says the council viewed these self-evaluations as the prelude to more comprehensive—and preferably external—reviews. And Arima decided that his own institution—Japan's most prestigious university—should be leading the way. "If it had been done [first] at another institution, it would not have had the same effect," he says.

As an inducement, Arima made money available to bring in internationally recognized reviewers. And being a physicist, he urged the physics department to take the lead. Shun-ichi Kobayashi, dean of the faculty of science at the university, says physicists were encouraged to go ahead after being shown that they ranked favorably in a recent review of citation index data, an important criteria for Arima. ("He likes checking citation indexes because he has a lot of citations," Kobayashi remarks.)

Thus, in January 1993, a stellar cast including Sidney Brenner of the University of Cambridge and Nobel laureate Leo Esaki, president of the University of Tsukuba, gathered for 3 days to inspect facilities, hear about department policies and funding, visit each research group, and write a report. "It was probably the first such comprehensive review at any Japanese university or research institute," Arima says with pride.

Measuring the impact. Since then, announcements of scheduled external reviews have become a staple of academic life. Most reviews have followed a pattern in which the panel's overall observations and recommendations are made public, while comments on individuals and specific programs are kept confidential.

Many of the recommendations focus on issues—the need for better facilities and increased budgets—that require action by Monbusho. While in some cases this merely adds more voices to the large chorus demanding greater government support, it can pay rich dividends. Yusei Maruyama, a professor in the department of molecular assemblies at the Institute for Molecular Science in Okazaki, says that a recommendation to form a group focusing on theoretical studies of molecular assemblies appears to have helped convince the education ministry to fund two new faculty positions next year in that area—a rare concession from the ministry. Similarly, a glowing international review of the Center for the Study of the Earth's Interior, nominally part of Okayama University and located in Tottori Prefecture, helped persuade Monbusho to give that institute several new positions.

PROFILE

Chemist Goes Her Own Way

Mikiko Sodeoka hasn't had the advantages that often pave the way for scientific success in Japan. She did not go to a prestigious university, and she didn't even take a major in basic science. But that hasn't stopped Sodeoka, currently an assistant professor at the University of Tokyo, from developing into what Harvard University bio-organic chemist Gregory Verdine calls "a world-class synthetic organic chemist." Nor has it kept her from branching into molecular and cell biology, where she applies her skills in chemical synthesis to study how molecules interact with DNA and proteins. "Few labs anywhere have such breadth," enthuses Verdine. "She's the most interdisciplinary young scientist in Japan."

Sodeoka's journey into science has been a foray into uncharted territory rather than a traipse down a well-trod career path. Born in the coal town of Omuta on the southern island of Kyushu, Sodeoka says she gained "an appreciation of nature" from her father, who worked for the local chemical industry. Still, when Sodeoka entered Chiba University, near Tokyo, she majored in pharmaceutical rather than basic science. "I was interested in medicine and life science, but I thought it was so difficult to become an academic researcher," she explains. Like her fellow pharmacy majors, more than half of them women, she "also thought it was good to get a license" so she could get a job as a pharmacist.

EIJI MIYAZAWA/BLACK STAR

Courageous chemist. Mikiko Sodeoka of the University of Tokyo has confidence to take on new fields.

In her fourth year, however, Sodeoka joined a research group in organic chemistry and liked it so much she decided to stay for a graduate degree. She had the good fortune to work with assistant professor Masako Nakagawa (who recently became one of only three female full professors of chemistry on the pharmaceutical faculties of Japan's national universities). "She showed me that women can do good research," Sodeoka recalls. "I felt it would be difficult, but not impossible and worth a try."

After earning her master's degree, Sodeoka joined Sagami Chemical Research Institute, a semiacademic industry lab, where she worked for Masakatsu Shibasaki while finishing her doctoral research. When Shibasaki became a professor at the University of Hokkaido, he asked her to join his new lab.

Sodeoka earned her Ph.D. at Hokkaido and headed for the United States as a postdoc in the Harvard lab of chemistry Nobelist Elias J. Corey. "She impressed me as very intelligent, with a high ability to cut through complications and come up with good insights," Corey recalls. "And she was very, very gracious." She moved on to Verdine's lab, where she immersed herself in molecular biology, and within a year, Sodeoka had engineered a bacterium to overproduce an important transcription factor involved in regulating the immune response. The achievement allowed her to study the protein's interaction with DNA. Reveling in freewheeling, "big-picture" discussions with her labmates, she also demonstrated "impressive" skills as a beer drinker, Verdine recalls, "an ability that is much appreciated at Gordon conferences."

Today, at the age of 35, Sodeoka is back in Japan as an assistant professor in the lab of her old mentor Shibasaki, now a full professor at the University of Tokyo. While the lab focuses on catalytic asymmetric synthesis of organic compounds, he generously allows Sodeoka to spend part of her time on biology, synthesizing fragments of the enzyme protein kinase C in an effort to understand how the enzyme interacts with phorbol ester to trigger its activity.

Like most Japanese scientists her age, Sodeoka has yet to run her own lab, so "we don't know how she'll do with her own group," Shibasaki cautions. But Verdine says he has great faith in her ability. "It takes someone with a lot of courage" to do her brand of original, interdisciplinary work, he says. "She goes where the action is, even if it's out on a limb."

–J.K.

But an equally critical issue is whether the institutes themselves are willing or able to change. RIKEN proved itself capable of doing so recently, after the international reviewers suggested that the institute's policy of only considering scientists who are 32 years of age or younger for permanent positions was too restrictive. "High promise of future creativity and productivity is rarely established by a scientist before the age of mid-thirties," the review report said. As a result, RIKEN has raised the age to 35.

An even greater problem is the lack of any "mechanism for feedback," says Robert Geller, an associate professor of earth and planetary physics at the University of Tokyo. While the report lauded the physics department as a whole, it found some work was of questionable merit. "But this did not lead to allocating more money, positions, and lab or office space to the people doing good work," says Geller, "or taking it away from the less competent." The external review is a "good first stage," he adds, "but it's not enough."

Perhaps the most serious obstacle, however, is Monbusho's rigidity with respect to hirings and the distribution of core research budgets. Salaries and core research budgets are fixed by rank and are virtually identical throughout the country, so there is no mechanism for linking budgets to performance. Nonetheless, Mitsuo Ito, director general of the Institute for Molecular Science, says the system is moving toward rewarding more productive researchers, thanks to the effects of inflation.

"It is impossible to conduct research with that [core grant] money alone," he says. As a result, programs based on performance, such as Monbusho's rapidly growing research grant program, are playing an increasingly important role, even if Monbusho's budget of $825 million this year was less than 10% of the $10.5 billion spent by the ministry on science and technology.

Then there's the question of what to do about lagging institutions. With virtually all government employees, including faculty members, holding lifetime jobs from the day they are hired, universities have little flexibility to bring about needed change when departments become obsolete or don't perform. And institutions lower down in the scientific pecking order may have little incentive to conduct a rigorous review if they suspect it will be critical.

In spite of these drawbacks, Kozi Nakai, head of experimental planning and program coordination at KEK in Tsukuba, believes opposition to outside reviews is fading but that controversy remains over how and what to evaluate. He is heading a Monbusho working group that hopes to issue a manual outlining how universities might solicit outside input and defining a role for data such as the number of papers and citations received.

Reviews can also help smaller institutions and universities identify particular strengths, says Arima. Indeed, he says, the ability to define a strong specialty may become a necessity if, as expected, the reviews play a part in funneling resources to the more active institutions and groups. "In Japan we often say that everyone should proceed together," he says. "But if we want to promote [science] on an international level, there is no other way than to be strict."

–Dennis Normile

PROFILE

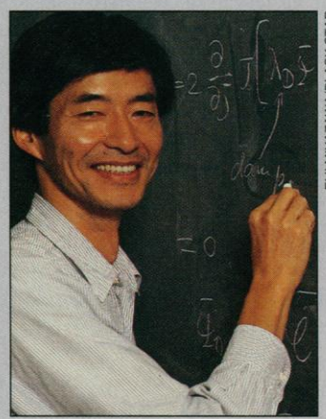
A Straight Line to Success

Experimental particle physics is largely shaped by researchers with forceful egos and and a taste for politics. But theorist Kaoru Yokoya, age 47, doesn't fit the mold. This laconic man who plays a key role in Japan's particle physics community "is 100% scientist," says Kazuo Abe, his colleague at Japan's National Laboratory for High-Energy Physics (KEK).

Known for his mathematical rigor and his keen insights into difficult problems, Yokoya has successfully tackled the phenomenon of "disruption," an effect associated with the bending of particle trajectories under the influence of the oncoming beam, and of the energy loss due to beamstrahlung radiation. The work puts him at the center of one of the hottest projects in physics: designing the JLC (for Japan, or Joint, Linear Collider).

Yokoya's early career was marked by dreams thwarted. A schoolboy desire to become an astronomer fell prey to a prevailing view that the field was merely applied physics and, therefore, not worthy of someone who wanted to tackle fundamental problems. After college, his interest in particle theory was squashed by the reality of the workplace: "I wasn't able to get a job," he recalls ruefully. So in 1978 he took a job at KEK in accelerator theory—studying the physics of particle accelerators rather than of the particles themselves—and wrote a doctoral thesis on the dynamics of polarized electron beams in storage rings. That work, and additional studies of the interaction between colliding beams of electrons and positrons, led to his receiving the Nishina prize, Japan's most prestigious laurel in physics.

Yokoya has also written volumes of critical computer code for modeling collider dynamics. The titles of these programs—SODOM, ABEL, and CAIN—bespeak a sober personality streaked with a dark sense of humor. The difficulty of his science, combined with his rigor and economy of style, poses a constant challenge to co-workers. "When he speaks, I listen carefully," says one U.S. collaborator, "because if he can say a thing in three words, he won't say it in four."



EIJI MIYAZAWA/BLACK STAR

No disruptions. Kaoru Yokoya of KEK is finishing design work on a future linear collider.

His lack of salesmanship hasn't made him the most popular figure among doctoral students at the University of Tokyo, where he has held a joint appointment since 1990. "It is hard to find students in this field," he says. "It is considered to be not pure science but a kind of industrial thing."

One look at Yokoya's style belies that image of the field. Unlike most of his experimentalist colleagues on the JLC project—but typical of theorists—Yokoya has an aversion to hardware. Involved for a time with Japan's "b-factory" now under construction, he left when the design was finalized. "People were talking about things like the size of the magnet to the precision of a millimeter," he laughs. "This doesn't interest me. It's beyond my ability!"

Now that the design work on the linear collider is almost done—next month he will visit the Stanford Linear Accelerator Center to finalize the common parameters of JLC's and SLAC's linear collider designs—Yokoya is wondering what to do next. He ponders such exotica as muon colliders and plasma accelerators that soar beyond current linear colliders in terms of cost, collision energies, and complexity. Big thoughts, perhaps, but he points out that the dreams of a theorist, unlike the machines they engender, cost next to nothing.

–Antonio Regalado

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