The Scientific Geography of Japan

Top universities. The big national universities dominate basic research, with Tokyo, Kyoto, Osaka, Nagoya, Kyushu (in Kitakyushu), Tohoku (in Sendai), Hokkaido (in Sapporo), and Tokyo Institute of Technology taking the lead.

Hawaiian nights. No more Tokyo for the lucky scientists from the National Astronomical Observatory at Mitaka who are building the world's largest optical-infrared telescope on Mauna Kea in Hawaii.

New stars. The multiple antenna array at the Nobeyama Radio Observatory has given Japan the lead in millimeter wavelength astronomy—ideal for probing gas clouds and investigating how stars form.

Breeder believers. The fast-breeder reactor prototype Monju was completed last May and is now being loaded with plutonium fuel. Ignition scheduled for 1992.

Ivory towers. Far from the modern capital in Tokyo, Kyoto University researchers are proud of pursuing a truly academic tradition amid the ancient temples of old Japan. The university has produced most of Japan's Nobel Prize–winners.

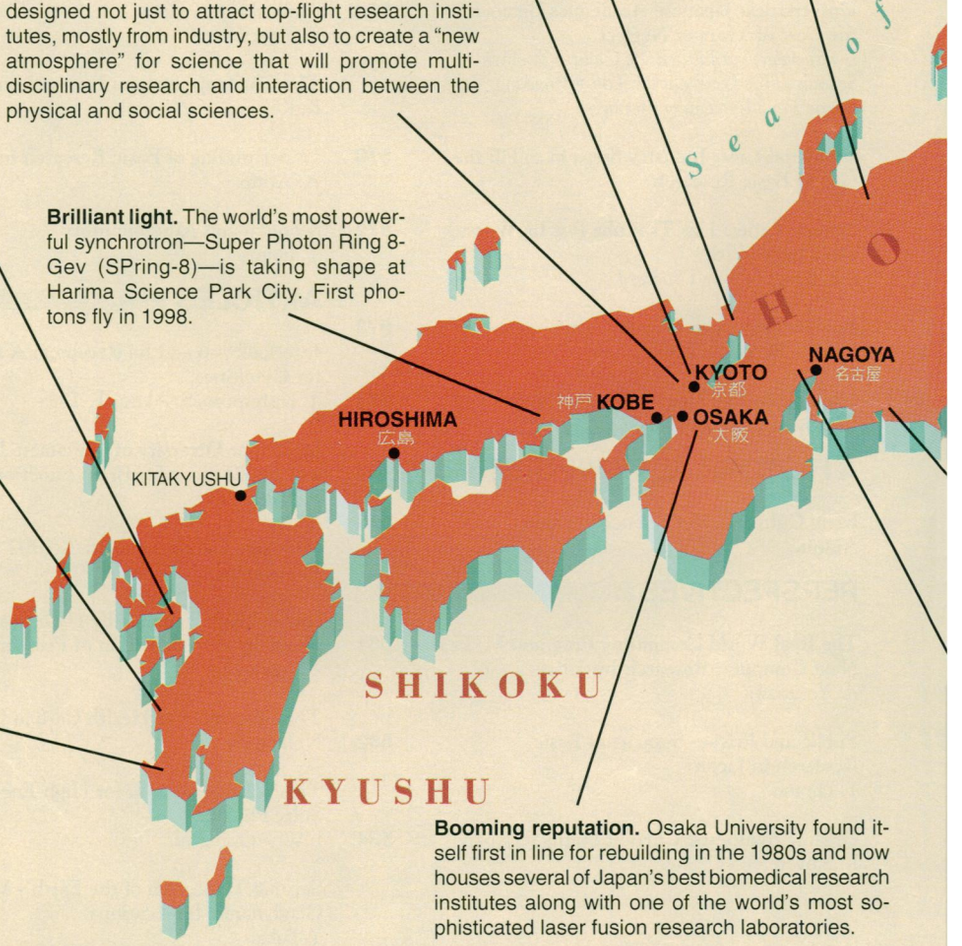
Killer volcano. Massive eruptions at Mt. Unzen made headlines worldwide last year. Among the victims of pyroclastic flows were a young U.S. geophysicist and two French photographers.

Underground lights. In an old mine at Kamioka, the world's largest neutrino detector will pick up neutrinos from the Sun and supernovas—and perhaps finally catch protons in the act of decay.

Culture city. Not another Tsukuba, the Kansai Science and Culture City (abbreviated Keihanna) is designed not just to attract top-flight research institutes, mostly from industry, but also to create a "new atmosphere" for science that will promote multidisciplinary research and interaction between the physical and social sciences.

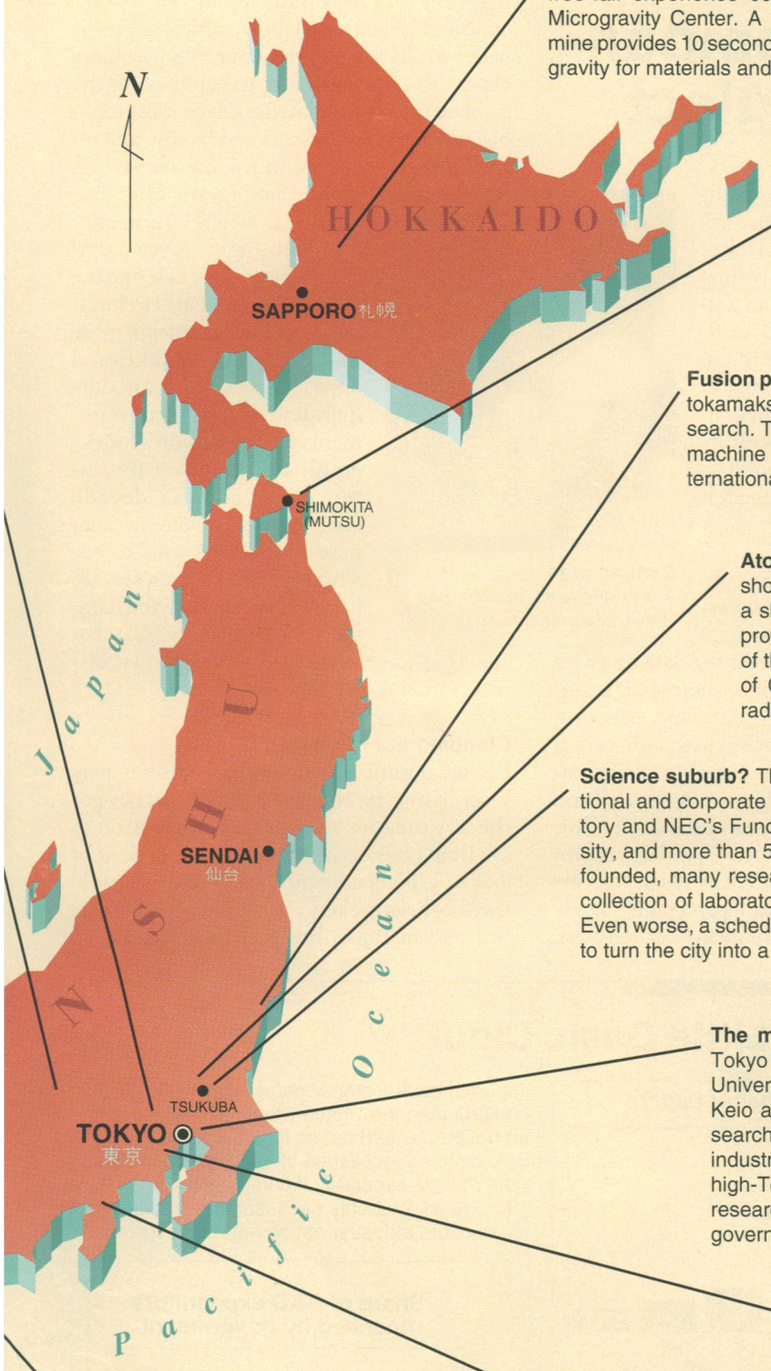
Unending tragedy. Mercury poisoning destroyed hundreds of lives at Minamata in the 1950s and gave Japan an evil reputation for putting industrial development before protection from pollution. That in turn spurred tough legislation and pushed Japanese companies into investments in pollution control that are now reaping profits in an environment-conscious world. But many who claim to suffer from Minamata disease still await compensation.

Brilliant light. The world's most powerful synchrotron—Super Photon Ring 8-Gev (SPring-8)—is taking shape at Harima Science Park City. First photons fly in 1998.



To Mars! The Ministry of Education, Science, and Culture's (MESC) Institute of Space and Astronautical Science specializes in success on a tiny budget and runs its own space launch base here at Kagoshima along with a deep-space tracking station at Usuda in the mountains of central Japan. Headquarters are at Sagamihara near Tokyo. Using home-designed solid-fuel boosters, it has launched 14 scientific satellites since 1971, making Japan the leading power in x-ray astronomy (see page 587) and scoring successes in solar physics and observations of Halley's comet. The thirteenth satellite dropped probes on the Moon—now there are plans for another Moon shot and for an attempt on Mars in 1997. Annual budget is just $200 million!

Booming reputation. Osaka University found itself first in line for rebuilding in the 1980s and now houses several of Japan's best biomedical research institutes along with one of the world's most sophisticated laser fusion research laboratories.



Almost the shuttle. The longest earthbound free-fall experience comes at MITI's Japan Microgravity Center. A 1 km drop into an old mine provides 10 seconds of experimental zero-gravity for materials and biological research.

Greenpeace unwelcome. Japan's nuclear ship *Mutsu* broke down on its first voyage in 1974 and, after being towed from port-to-port and battling off flotillas of protestors, is now berthed at Mutsu City. Close by, at Rokkasho Village, subsidies of around $10,000 per person helped win approval for construction of Japan's first large-scale nuclear reprocessing and plutonium plant.

Fusion power. JT-60, one of the world's big three tokamaks, has given Japan clout in fusion research. There is talk now of a $1 billion follow- up machine to bridge the gap to the four-partner International Thermonuclear Experimental Reactor.

Atom-smashed dreams. The National Institute for High-Energy Physics (KEK) should have operated the world's most powerful electron-positron collider (for a short while) and should have gone on to be the world's first big electron-proton collider. Early feuding and slow funding meant it never quite made any of the really big goals. It may yet build the world's first B factory for the study of CP violation—or it may be reduced to the world's largest synchrotron radiation source.

Science suburb? The Tsukuba Science City is home to almost 190 national and corporate R&D labs (including MITI's Electrotechnical Laboratory and NEC's Fundamental Research Laboratories), a national university, and more than 50,000 scientists. But even now, 20 years after it was founded, many researchers complain that it's little more than a random collection of laboratories lacking a real sense of intellectual community. Even worse, a scheduled extension of the nearby Joban rail line threatens to turn the city into a bedroom suburb of Tokyo by the next century.

The megalopolis. A single unbroken conurbation stretching from Chiba across Tokyo to Yokohama is home to 30 million people. Among the key institutes are Tokyo University, Tokyo Institute of Technology (Tokyo's other main science university), Keio and Waseda (the only two private universities doing significant scientific research), the National Cancer Center, the Foundation for Cancer Research, the industry-led Superconductor Research Laboratory (designed to make Japan first in high-Tc superconductivity), academic institutes for space, polar, nuclear, and ocean research, and, of course, the headquarters of almost everything commercial and governmental.

Frontier style. RIKEN (the Institute of Physical and Chemical Research) offers alternatives to the university system—especially in its Frontier Science Program—in a 680-researcher institute run by the Science and Technology Agency and covering everything from nanotechnology to deep-sea microorganisms.

Far away freedom. In another attempt to break the hegemony of the big universities, the Ministry of Education created "National Inter-University Research Institutes," meant to offer top-class facilities open to all. The Okazaki Institutes for Basic Biology, Molecular, and Physiological Sciences were among the first institutes in this new category and are located far from any of the big universities' territory.

Single helix. The world's largest helical fusion machine, under construction at the National Institute for Fusion Science, builds on basic studies of plasma physics at Kyoto and Nagoya Universities.

No-man's-land. Tired of those tyrannical Tokyo and Kyoto University professors who dominate every institute within their fiefs, MESC placed the National Institute of Genetics out in Mishima. Was it a coincidence that Motoo Kimura dreamed up the neutral theory of evolution here?

Top Secret.
At an unknown location, a specially built transport vessel is carrying a ton of plutonium to Japan on a nonstop journey from recycling facilities in Europe. Terrorists beware—the *Akatsuki Maru* has a naval escort armed with a couple of 35mm cannons.