LOOKING AHEAD

Bright Dreams Despite a Legacy of Hits and Misses

It's easy to come away from Japan with two closely related impressions: that its technologists will continue to dazzle the West with ever more sophisticated products, and that its basic researchers will continue to plod along, held back by sagging finances and a culture that rarely seems to reward brilliance and originality. Scratch a little deeper, however, and it's not too difficult to stand these notions on their heads.

Even a short tour of Japan's research bureaucracy reveals that the technology wizards who drive the Japanese economy are far from perfect. Although no one likes to talk about it, Japan has blundered badly in the past and, judging by some of the long-shot projects that industry and government are now backing, could easily blunder again. At the same time, Japan's laboratories—in academia and in industry—contain a host of scientists with big dreams and smart ideas, enough of which are already on the drawing board for Japan to emerge as a powerful full member of the world's basic research community by the end of the decade.

Nobody's perfect. Although cast as the invincible architect of high-tech Japan Inc., the Ministry of International Trade and Industry (MITI) has made some spectacular errors. Most infamous is MITI's attempt in the 1960s to force its car manufacturers to amalgamate because ministry bureaucrats thought Japan couldn't otherwise take on Detroit. Later, MITI thought to do away with drivers altogether, backing research in the 1970s on a "driverless car" (a pamphlet advertising the project featured a video camera mounted in the driver's seat of a black sedan). Next in line were a series of overambitious artificial intelligence projects, culminating in the sadly overhyped Fifth Generation computer project. Sold as an attempt to develop computers that could think like humans, the project ended earlier this year having advanced only some arcane aspects of logic programming.

The giant Science and Technology Agency (STA) also has plenty to be embarrassed about. Item One: the nuclear-powered ship *Mutsu*, which broke down immediately upon first setting sail in 1974. (The ship's crew was forced to plug a reactor leak with boiled rice and old socks.) Item Two could well be the agency's H-II rocket program. Back in 1964, STA decided to build its own launch vehicles instead of buying them from the United States. Unfortunately, the engine of its big launcher, the H-II, keeps catching fire. The date of the rocket's first launch has slipped from 1992 to 1993 to 1994....

Trendy science. Even Japanese managers of "small science" aren't immune to the lure of big and impractical ideas. Perhaps their biggest weakness is a tendency to jump onto research bandwagons—sometimes well after they've lost momentum in the West. Cold fusion may be the ultimate folly of this kind (MITI is just beginning to fund work in the field). High temperature superconductor research may be another. MITI and industry poured money into a brand new $40 million a year Superconductor Research Laboratory in 1988, so far with little to show for it.

The list goes on: neural network computing, fuzzy logic, and x-ray lithography are all areas that have attracted huge amounts of hype and huge amounts of money—but will they provide a return on the investment? Similarly, electronics companies are pouring large sums into neurobiological research, ostensibly to build computers that more closely resemble the human brain—a task whose magnitude seems to have been totally underestimated.

Big dreams. Fortunately for Japan, this spotty history hasn't discouraged researchers from dreaming big dreams. And while some may share the fate of the driverless car, others appear much more likely to fuel Japan's rise as a major research power.

For instance, MITI is currently ramping up two 10-year basic R&D projects: the Real World Computing Project, an attempt to build computers that can process sounds, images and patterns (see page 581), and an initiative in nanotechnology and atomic manipulation. So far, both projects have avoided the trap of great expectations set for previous MITI efforts. And with budgets of $500 million and $200 million respectively, neither program should be underestimated.

Japan is also pushing ahead with several more conventional, but potentially very productive, scientific projects. Astronomers can look forward to operating the Subaru 8-meter telescope on Mauna Kea in 1999, which will be the world's largest infrared telescope. Deep in a mineshaft in western Japan, the Super-Kamiokande neutrino detector—again designed to be the world's largest—should begin measuring neutrino flux and proton decays in 1996. And Japan's fusion community is breaking new ground with plans for the Large Helical Device, an experimental fusion reactor designed to produce more stable plasma confinement than the now-fashionable tokamak.

Ambitious plans, of course, are still in abundance. High energy physicists hope that Japan can build a huge international linear collider—now considered the logical follow-on to the U.S. Superconducting Super Collider—sometime in the next decade. The Institute of Space and Astronautical Science is planning to send a 40-kilogram probe to Mars by 1997. And there are even plans for the *Mutsu* to make a comeback—without its reactors—as the world's largest ocean drilling ship. So long as Japanese science retains its unique flavor of wide-eyed idealism, such projects will never go out of style.

–Alun Anderson and David P. Hamilton

Critical Technology League Tables

Emerging Technologies	STA's survey: Current status	STA's survey: Trend	U.S. DOC's survey: Current status	U.S. DOC's survey: Trend
Life Sciences				
Biotechnology	🇺🇸	↑	🇺🇸	↑
Medical devices and diagnostics	🇺🇸	↑	🇺🇸	↑
Materials				
Advanced materials	=	↑	🇯🇵	↑
Superconductors	=	↑	=	↑
Information Systems, Electronics				
Advanced semiconductor devices	🇯🇵	↔	🇯🇵	↑
Digital imaging technology		↑	🇯🇵	↑
High-density data storage	🇯🇵	↔	🇯🇵	↑
High-performance computing	🇺🇸	↑	🇺🇸	↑
Opto-electronics	=	↑	🇯🇵	↑
Manufacturing Systems				
Artificial intelligence	🇺🇸	↑	🇺🇸	↔
Flexible computer-integrated manufacturing	🇯🇵	↔	🇺🇸	↔
Sensor technology	=	↑	🇺🇸	↑

Who's ahead? Surveys of relative strengths in key technologies by Japan's Science and Technology Agency (STA) and the U.S. Department of Commerce (DOC) show some interesting differences [🇺🇸: U.S. ahead; 🇯🇵: Japan ahead; =: both at same level; ↑: Japan progressing faster; ↔: both progressing at same rate].