future, Japanese progress "got our attention," he said, but "Cray Research is dedicated to one proposition: to continue to provide the fastest, most powerful machines in the world."

For the Japanese also, formidable problems in computer architecture and component technology remain to be conquered and they have yet to shatter the stereotype that they are talented copycats. There are also some doubts that ingrained Japanese caution in management and reliance on consensus in decision-making is well suited to innovation. And Japanese universities at the moment are regarded as incapable of turning out the cadre of computer scientists and engineers required to fulfill Japanese aspirations.

Nevertheless, is it possible that the United States and Europe could continue to excel in innovative work and the Japanese continue to read the journals and visit the Western labs and use their superb development and production talents to build a dominant role in supercomputers?

One federal scientist in the thick of a supercomputer project concedes, "It's a real concern. We worry about it an awful lot. It's the kind of technology transfer we'd like not to have." He said it is clear that a "better interchange between research and industry" is needed in the United States. "But if we were to do something that would tend to discourage the free exchange between researchers we would destroy the very synergy we sought to create. We have a great technological society but we Americans have got to emphasize not tripping over our own feet."

The dilemma over supercomputer development is not unique. Rather, it puts in acute terms the question of the U.S. rivalry with Japan in high technology and of what the U.S. government should or shouldn't do about it.—JOHN WALSH

Japanese Borrow Plan from U.S.

Japan's plans for its fifth generation computer systems are audacious and daring. But, with little experience in the areas they wish to pursue, how did the Japanese formulate them? With the help of American computer scientists, apparently. Researchers from Massachusetts Institute of Technology (MIT) in particular but also from Stanford and Carnegie-Mellon University seem to have had an overriding influence on the plans.

Michael Dertouzos, head of the Laboratory for Computer Science at MIT says he "panicked" when he first saw the Japanese plans, feeling it was somehow not right for the Japanese to copy MIT ideas so blatantly. Now, he says, he has changed his mind. "More power to them," he says. He only wishes American industry would listen to the university scientists so attentively.

What the Japanese did was to invite eminent American computer scientists to visit and lecture in their country and describe what they thought would be important projects to pursue. Among the MIT researchers invited to visit Japan were Jack Dennis and Gerald Sussman. Dennis suggested that the Japanese build data flow machines, an MIT invention. The data flow machines proposed by the Japanese are, says Dertouzos, "unmistakable" in their MIT origins.

Sussman gave the Japanese his ideas on artificial intelligence. He was invited to visit Japan for 3 days in November 1979. Although he did not know the purpose of his visit before he arrived, it turned out that he was to speak before Japanese scientists planning the fifth generation project. "For 8 or 9 hours a day I was flaming forth," he recalls. "All their distinguished scientists were there. They'd clearly read everything I had ever written and had Japanese translations of my papers in front of them. They were very smart, very well prepared, and they kept their mouths shut."

Sussman's ideas were incorporated almost verbatim in the Japanese proposal. Even one of his slides and the diagrams he drew on the blackboard appeared. Sussman recalls that he looked at the Japanese report on their long-range plans with surprise, seeing his proposals and saying to himself "Gee, that looks like a Sussmanism." In fact, he says, the original Japanese report "is so close to an MIT research proposal that it's frightening."

Edward Feigenbaum of Stanford University says his visit to Japan resulted in the Japanese plans to emphasize knowledge engineering or expert systems. Feigenbaum spent 12 weeks in Japan in 1979 during which time he gave lectures at major universities and industrial laboratories. "In all these places I gave lectures on applied artificial intelligence at Stanford. This is work on expert systems. The result was to make an extremely convincing case to the Japanese that this was a hot area to invest skill and energy," Feigenbaum recalls.

As a result, Kazuhiro Fuchi, who was then head of the information science department at Japan's Electrotechnical Laboratory and who is now director of the Institute for New Generation Computer Technology (ICOT), the central laboratory for Japan's fifth generation project, convinced the Ministry of International Trade and Industry (MITI) that it should include expert systems in its long-range plans. "The credibility was supplied by my lectures," Feigenbaum says. "Some Japanese referred to me as the Father of Knowledge Engineering in Japan."

Feigenbaum explains that using his statements to lend prestige to a project is firmly in the Japanese cultural tradition. "The Japanese have a saying, 'The nail that sticks its head up is the one that gets hit.' If they can say, 'Feigenbaum had success with this idea,' it's my nail that's sticking up."

In Feigenbaum's new book, *The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World*, written with Pamela McCorduck, he tells of asking Fuchi whether Japan could really build expert systems with so little experience. He quotes Fuchi as replying, "Metaphorically speaking, if your countries are like adults, then Japan may be likened to a baby, but in my own mind Japan is actually closer to boyhood. It may seem funny for me to talk about how a boy should behave, but boys must learn from adults and listen to them and respect their opinions."

Asked how he feels about Japan's adoption of his ideas, Feigenbaum says, "I have mixed feelings. I feel very good about my ideas being used but I also worry about the health of our own information processing industry. I would much prefer ideas to go from Stanford to American industry."

—GINA KOLATA