SEVERAL JAPANESE CORPORATIONS ESTABLISH NEW LABS IN UNITED STATES

The last several years have seen the establishment of a number of R&D facilities in the United States by many of the largest Japanese computer and electronics companies. Among those that have set up US research bases are NEC, Canon, Matsushita Electric, Fujitsu and Hitachi.

These companies have had some kind of presence—sales offices, manufacturing plants—in the US for years, and in many cases they now have American workforces numbering in the thousands or even tens of thousands. But US-based research is a relatively new phenomenon for the Japanese. Although the Japanese corporate labs in the US are quite small compared with the massive R&D efforts conducted by the companies back home, given the general state of US research funding these days, they are at least noteworthy. Much of the work at the new US labs falls heavily in the area of product and technology applications that are specific to the US market. But increasingly, work also is moving beyond development and into fundamental research.

NEC, Canon, Matsushita...

The first and still the biggest Japanese research outpost in the US is NEC Research Institute in Princeton, New Jersey. It opened its doors in 1988 to do basic research in the computer and physical sciences (see PHYSICS TODAY, June 1989, page 61). The facility now boasts a technical staff of 38, and there are plans to expand to about 60 researchers in the next two years.

The union of computer science and the physical sciences at the institute has one goal: to provide the science for a new kind of computer having attributes that more closely approximate those of the human brain. "There are problems that are quite easy to pose—like facial recognition and language translation—but that are beyond the ability of present computers by very large factors," says Peter Wolff, one of the institute's senior fellows, who was a professor of physics at MIT before joining NEC. To solve these problems, Wolff says, "We need at the minimum new architectures, new devices, new materials. Then we'll have to begin moving into new ground. "We're asking people to step outside the boundaries of their usual fields."

In one way or another, work going on at the institute fits into this strategy. Many of the papers published or submitted for publication thus far have been in computer science theory, primarily algorithms. Another area being explored is development of optical interconnects for computers, to replace at least part of the massive amount of wiring found in even simple electronic devices. Richard Linke, formerly with AT&T Bell Labs, has been working with Japanese colleagues from NEC, making use of electro-optical switches called V-STEP devices, which NEC pioneered.

Other research includes neural networks, parallel processing and cognitive science. The institute is also strengthening its hand in biophysics and neuroscience. One area of interest concerns the computational strategies of biological nervous systems—that is, the special features of the brain that make it possible for humans and simpler animals to achieve efficient real-time processing of incoming visual and auditory signals. William Bialek, a recent arrival at the institute from the University of California, Berkeley, is studying the fundamental physical limits of such signal processing tasks.

On the West Coast, Canon, a manufacturer of cameras, computers and office equipment, opened a lab in Palo Alto, California, last August to do fundamental work in emerging computer technologies. The Canon Research Center is primarily looking at software and algorithms in such areas as optical recognition, image-data-compression algorithms, and network management and architecture. According to Harry Garland, one of the center's vice presidents, results will of course be shared with the parent company (a manufacturer of cameras, computers and office equipment) but also will be published in scientific journals. The lab now has seven researchers and will eventually expand to 25.

Canon also opened an R&D site last year in Costa Mesa, California, to do development work in computer software. That lab now has 30 full-time researchers. Canon's other overseas laboratory is located in Great Britain, home to several other Japanese-supported labs (see box, page 82).

In December Matsushita announced the formation of a software lab similar to Canon's Palo Alto facility that will be based in Princeton and headed by Richard J. Lipton, a computer science theorist at Princeton University. The new lab's stated mission is to develop improved computer graphics, document processing and system software—all to be applied to new film production techniques. (Matsushita recently acquired MCA, a Hollywood entertainment conglomerate that produces television shows and movies, among other things.)

Matsushita already has a small group of researchers in Palo Alto doing software-oriented research, primarily in databases and operating systems. But that lab is looking at shorter-term projects than the Princeton lab will, says Adam Yokoi, vice president of technology for Matsushita's US subsidiary, Matsushita Electric Corporation of America.

Matsushita also supports a lab in Santa Barbara, California, that does basic work on speech recognition and synthesis, combining the efforts of electrical engineers with linguistic experts. Other Matsushita labs do applied work in high definition television, airplane entertainment systems and digital image processing, among other things. Each lab is "parented"

by one of Matsushita's research or manufacturing labs in Japan, which sets long-term objectives for the US labs.

Last year Hitachi opened two small US labs, one of which is doing semiconductor technology. Fujitsu has product-related research going on at nine of its US facilities. Sharp now has a small lab in Camus, Washington, designing and development chips. Sony has a high-definition television lab in Santa Clara, California.

Longer perspectives?

Despite the general emphasis on applied research and product development, leaders of some of the new labs claim they are offering the kind of long-range perspective that previously existed in the US only at a few select government and industrial labs.

"We've been given a great deal of flexibility," says Canon's Garland. He says that his lab's scientific direction comes as much from the individual researcher's interests and strengths as it does from Canon headquarters.

At the NEC Research Institute, Dawon Kahng, the institute's president, has implemented a consensus style of management in which the five senior fellows have a voice in hiring and capital budgets, in addition to overseeing research. Researchers there meet occasionally with scientists from NEC's major lab in Tsukuba, Japan, and a handful of outside scholars have also paid visits. "We're halfway between industry and academia," Wolff says.

Of course, even when commercial products are not necessarily the immediate goal, there is still the expectation at many of the Japanese labs that a research project will move in a logical progression to a final, marketable application. At Matsushita's labs, when projects approach commercial development, they are transferred to one of the company's manufacturing groups in the US or Japan.

Motives

Why are Japanese corporations establishing research outposts in the US? Certainly one motive is to better monitor the competition; another is to develop products specific to the US market; and yet another is to tap into America's pool of engineers and scientists. The Japanese are smarting from criticism that they have built their success on the basic research of others—namely Americans—while making no significant contributions of their own. The way they see it, building R&D labs in the US and

Japanese Establishing European Beachhead in UK

Despite all the talk about burgeoning Japanese investment in eastern and central Europe, in physics-related industrial research, at least, the reality is quite different: Great Britain—not Germany or Hungary or Poland—is where most of Japan's research funds seem to be flowing.

Last year it was announced that Hitachi would build a laboratory at the University of Cambridge, and that Sharp would set up a comparable lab at Oxford. Sharp's facility, which opened in April 1990, currently has 11 staff researchers but is still recruiting. The lab has three departments: optoelectronics, headed by R. W. Brown; information technology, headed by P. Gibbons; and imaging technology, headed by David Ezra.

Hitachi's Cambridge lab also is up and running with a small staff doing semiconductor physics under the leadership of Gerhard Fasol. Hitachi has set up another lab at Trinity College, Dublin University, which is doing information science, especially neural networks, artificial intelligence and enhanced computer languages. The head is Nobuo Hataoka, a specialist in voice recognition.

Yet another relatively new Japanese laboratory in the UK, the Canon Research Center Europe Ltd, was established in 1989. It does research exclusively on computing (visual programming and natural language interface) and on stereo audio technologies.

In basic research, small programs are being funded at Cambridge and Imperial College by Japan's Research and Development Corporation, which is part of the Science and Technology Agency. Devoted to atomic-scale structures, each program is getting about £2.5 million for equipment and staff, and in exchange each will open its doors to young Japanese researchers.

The group at Imperial College, headed by physicist Dimitri Vvedensky and chemist Bruce Joyce, seeks to design materials on the basis of their microscopic properties. Vvedensky says the Japanese are not necessarily expecting actual devices to come from the effort; rather, they are trying to generate ideas and creativity, as opposed to the conformity they so often are associated with.

Thanks to the Japanese funds, the Imperial group has taken delivery on an MBE device and a Meiko computer (an Infinity Series Computing Surface). It currently is calibrating its instruments, using conventional materials, in preparation for moving on to more unusual materials.

The Cambridge group, headed by Harry Bhadeshia of the department of materials science and metallurgy, is modeling microstructures in metals and alloys deformed by temperature and pressure. It too is purchasing new equipment, such as a high-temperature x-ray device, a high-temperature differential scanning calorimeter and some computers.

Bhadeshia says that members of the Cambridge group already were working together before getting Japanese funding and also were working closely with a comparable team at Japan's National Research Institute for Metals.

Japanese interest in Great Britain as an investment target is not confined by any means to basic and applied research in physics. From automobile assembly to computers, Britain seems to be the favored base location among Japan's business and government leaders, as Europe eliminates internal barriers and establishes external ones in anticipation of 1992.

Particularly because of the increasingly stringent local-content requirements that the European Community has been setting for semiconductor manufacturing, Fujitsu, Hitachi, Mitsubishi and Toshiba have established fabrication facilities in the UK.

When it is asked why Japanese leaders favor Great Britain as their base for European operations, the first reason that usually comes to mind is language: Apparently the Japanese already are used to doing business and reporting research results in English, and they would prefer not to have to master German, French or Italian as well. In physics, the excellence of British research must also be a factor. Maybe Britain's reputation for eccentricity also helps more than it hurts. After all, as Vendensky put it, one of the things the Japanese are trying to do is show that they can be original.

One thing the Japanese certainly are proving: They are willing to take risks. If Britain ends up acting on isolationist impulses, Japanese investors could find themselves stranded on the beach. While a British withdrawal from the EC is highly unlikely—all the more so now that Margaret Thatcher has been ousted as prime minister—it would be ironic indeed if Japanese investors were confined to Britain's relatively tiny market, unable to use it as a bridgehead to the Continent. —WS

providing jobs for US scientists are ways to pay back the US, at least in part.

Ironically, this too has drawn fire. For the Japanese, who are nothing if not status-conscience, have been hiring top researchers from US universities and from industrial labs such as IBM, AT&T Bell Labs and Bellcore. Most of the Japanese-supported labs are by design within easy commutes to leading research institutions. Canon's Palo Alto lab, for example, has cultivated close ties to Stanford, from which both of its two top-ranking Americans were recruited. Kahng and Joseph A. Giordmaine, vice president for the physical sciences at NEC Research Institute, both had long careers at Bell Labs before coming to NEC; the institute's vice president for computer sciences C. William Gear was formerly head of the computer sciences department at the University of Illinois, Urbana-Champaign.

The thought of Americans working for Japan leaves many folks within the US research and business communities uneasy, even when the promise is made that all results will be published. It's been characterized as "econonomic warfare," with some speculating that the quality of research at universities may decline as a result.

Not surprisingly the Japanese see things in a different light. "It's just business," says Matsushita's Yokoi. "We do recruit good people from other companies, and we hire people from good schools. But that's what everybody does." —JEAN KUMAGAI

MINNESOTA LURES TOP THEORISTS FROM LEADING SOVIET INSTITUTES

Four years ago the University of Minnesota announced that it was establishing, with the support of Minneapolis real estate developer William I. Fine, an institute for theoretical physics (PHYSICS TODAY, February 1987, page 99). Two years later, after a difficult search, Larry McLerran, a theoretical physicist at Fermilab, joined the institute as its director. Now the news is that five appointments have been made to the institute's permanent faculty—and that all five professorships will be held by distinguished Soviet scientists.

Describing the background to the five appointments, Marvin L. Marshak—the head of Minnesota's school of physics and astronomy—said that university recruiters discovered four years ago when they first were trying to staff the institute that they were suffering a severe geographical disadvantage. "Theoretical physicists, like Bose particles, tend to cluster," Marshak said, "and this was not a part of the world where they had been clustering much." So when the University of Minnesota started to talk with potential recruits for the institute, Marshak said, it soon was found that candidates fell into two mutually exclusive categories: those who were qualified and those who were willing to settle in Minneapolis.

The crucial breakthrough occurred when the university's recruiters hit upon something entirely unsuspected: There are highly qualified theoretical physicists from the USSR who *like* Minneapolis. They'd say things like, "It isn't too hot here, the way it is in California."

Soviet recruits

All five of the Soviet appointees initially came to Minneapolis as visitors to the theory institute. Marshak says—seriously—that one thing keeping some of them there now is concern about whether their children would be able to readjust to the USSR's more rigorous schools after spending a year or two in US schools. Most of the Soviet appointees have chosen to retain joint appointments with their home institutions in the USSR, reserving the option to eventually return home. All five are concurrently members of the Theoretical Physics Institute and tenured faculty of the Minnesota school of physics and astronomy.

Boris Shklovskii, who has joined the Theoretical Physics Institute as associate director for condensed-matter physics, will continue to be a member of the Ioffe Leningrad Physical Technical Institute. Shklovskii has been given a chair at Minnesota that has yet to be named.

Arkady Vainshtein, a particle theorist, has a joint appointment as a professor of physics at Minnesota and as a staff member of the Institute for Nuclear Physics in Novosibirsk, where he was a full-time employee until recently. Vainshtein will hold the Gloria Becker Lubkin professorship of theoretical physics at Minnesota, named for the editor of PHYSICS TODAY, who played an important role in the conception and planning of the institute.

Mikhail Voloshin, also a particle theorist, has a joint appointment with the Institute for Theoretical and Experimental Physics in Moscow. He serves as associate director for particle physics at the Theoretical Physics Institute.

Mikhail Shifman, the third particle physicist to be recruited by the institute (not counting McLerran, a seminal figure in the development of quark–gluon plasma theory), left Moscow's ITEP to become a professor of physics at the Minnesota institute.

Leonid Glazman, who most recently worked at the Institute for Solid-State Physics and Microelectronics in Chernogolovka, has become an associate professor at Minnesota.

Marshak, wary of making claims about individuals working in fields that are not his own, declined to rank the Soviet recruits. It bears noting, however, that physics generally is considered to be at the top of Soviet science, and that Soviet theoretical physicists are especially highly prized worldwide for their skills at analysis, computation and approximation techniques.

In a survey conducted last year by the Institute of Scientific Information and described in *The Scientist*, a weekly newspaper published in Philadelphia, two of the Minnesota recruits were on a list of 10 Soviet scientists most frequently cited in the world's scientific literature between 1973 and 1988—Shifman ranked third and Vainshtein fourth. It may be risky to base an estimation of an individual's scholarly achievements solely or even primarily on numbers of citations, but the appearance of Shifman and Vainshtein on *The Scientist*'s list does provide at least a clue to their eminence. (Alexander M. Polyakov, who left the Landau Institute two years ago, first for MIT and then for Princeton, ranked sixth on *The Scientist*'s list.)

'Moscow on the Mississippi'

Referring to the startling concentration of Soviet physicists at the University of Minnesota, Marvin Goldberger, the director of the Institute for Advanced Study at Princeton and a member of the Minnesota theory institute's oversight committee, has dubbed Minneapolis "Moscow on the Mississippi"—a joking play on the movie, *Moscow on the Hudson*, in