# Japan and US sign truce in microchip war; victor in doubt

After a year of angry skirmishes in law courts and conference rooms, the trade war between the US and Japan over semiconductor chips reached a diplomatic and possibly a commercial truce on 31 July. The agreement came minutes before the midnight deadline set by the US Commerce Department. With the threat of tough US retaliatory actions looming, Japan agreed to more than double its purchases of American-made semiconductors from current annual sales of $800 million and to stop dumping silicon chips in the US and other countries at prices that both the companies and the Reagan Administration consider below fair market value.

US rancor over silicon chips has been fiercer than in most world trade disputes. Together, Japan and the US produce more than 90% of the world's semiconductors. At issue in the dispute are the economic futures of both countries. Because they are the nerve center of modern electronics, "semiconductors are the building blocks of high technology," said Commerce Secretary Malcolm Baldrige at a White House news briefing the day after the unprecedented five-year bilateral agreement was signed. Thus Japan averted antidumping duties of 120% that the US intended to levy on most Japanese memory chips.

**Market shares.** The Commerce Department says that since 1975 Japan's chip makers have increased their share of world markets from 20% to about 45% this year. Some observers reckon that if recent trends persist Japan will command 60% of the international market by 1990. Five of the top ten producers in the world are Japanese, led by Nippon Electric Co. In 1974 Japan held 5% of the market for metal–oxide–semiconductor dynamic random-access memories; it now controls 75% of the world market for such chips. Japan dominates world trade in static RAMs and, increasingly, in erasable, programmable read-only memory chips. Even in the sale of application-specific integrated circuits, the most rapidly growing part of the semiconductor industry, Japanese firms already hold some 30% of the world market, whereas they held 10% in 1980. Early this year Fujitsu, NEC and Toshiba began offering free design services for application-specific chips and now command 50% of the US market.

Other indicators of Japanese preeminence exist. Japanese companies are the largest producers of bipolar gate arrays, though IBM's internal technology is superior. Japanese firms intend to totally control megabit DRAM output and sales, with the exception of IBM's production for its own use. US producers admit Japan is no longer interested in simply duplicating American technology, and plans to spend more on R&D this year than the entire US industry. In this field Japanese researchers are walking tall. Half of all papers delivered at this year's International Solid State Circuits Conference were by Japanese nationals.

**Price factors.** Since 1984 US chip sales have been in the doldrums at home and abroad. A year ago, United Technologies Corp closed its Mostek subsidiary, once the world's third largest chip maker, and Texas Instruments, Motorola and Intel scaled back their operations. By contrast, Japanese firms continued making chips at the same pace, all the while investing in new production facilities and cutting prices in world markets.

After studying the situation, the Semiconductor Industry Association, headquartered in San Jose, California, claimed that, as a matter of government policy, Japanese companies virtually ceased using US chips in their products and inundated the world with cheaper chips. US companies, working mainly through SIA, accused the Japanese of two trade violations: limiting the sale of American-made chips in Japan and promoting the sale of Japanese chips in the US at prices that undercut competition. SIA represents both the "merchant" producers, who sell chips to any firm that places the devices in computers, telecommunications systems and electronics apparatus, and the "captive" manufacturers, such as IBM and AT&T Technologies, which produce semiconductors for internal use. SIA convinced the Reagan Administration to take action on the grounds that the US must have a healthy chip industry if it wants a healthy electronics industry and that the nation's military security rests more than ever on the quality of electronic components.

Intel has a separate action against NEC, alleging piracy of a "photographic copy" of one of its powerful microprocessors. The Intel suit will test P.L. 98-620, the Semiconductor Chip Protection Act of 1984, which expands old copyright laws to cover the design and layout of chips as well as the photographic masks used to etch the circuitry (PHYSICS TODAY, March 1985, page 66). Japan officially welcomed the US law and enacted one of its own.

**Political agenda.** The chip war was on the agenda of President Reagan's meeting with Japan's Prime Minister Yasuhiro Nakasone in Washington last April. One outcome of that summit was the peace treaty, which appears to be one sided. The agreement calls for both governments to monitor the prices at which Japanese firms sell chips not only in the US but throughout the world. Commerce will provide what it calculates are fair market values of chips by Japanese producers. If the Japanese sell below those figures, the burden will shift to those companies to show they are not dumping. Should any violations occur, Commerce can break the agreement and immediately impose penalties, probably by increasing duties. For its part, the Japanese government has pledged to take an active part in increasing purchases of American chips at home. The agreement sets no numerical goals, quotas or timetables. The measure of Japanese cooperation, a Commerce Department official said, will be "the bank balances of American chip manufacturers."

The agreement will not be easy to administer. Deciding on fair prices is certain to cause bickering over such matters as marginal costs of production, differences in labor and overhead costs, amortization of buildings and

0031-9228 / 86 / 1000 69- 04 / $01.00 

equipment and other overhead costs. In the end, though, US access to Japanese markets will depend not only on the Japanese government but on American producers.

**Dire analysis.** In two papers prepared for his PhD thesis, the most recent issued on 29 August, Charles H. Ferguson of MIT's Center for Technology, Policy and Industrial Development, discusses the decline of US microelectronics. He argues that the US industry is "substantially inferior to Japan's in most product and process technologies" and has failed to restructure itself along the lines of the vertically integrated Japanese industry to meet the new global competition. Instead, he writes, US microelectronics remains "highly vulnerable, fragmented and poorly suited to intense competition." Protectionist measures will not help, Ferguson warns, unless these are accompanied by a strategy similar to Japan's, which includes government support, industrial coordination and corporate restructuring. Ferguson's brave new world operates on Darwinian laws: Only the strongest, most stable and dynamic firms, with the best research, would survive. His candidates include IBM, Digital Equipment, General Electric, Hewlett–Packard, Xerox, Motorola, Intel and Boeing.

Ferguson's assessment was recently confirmed and complemented in a more technical analysis by a panel of the National Research Council's National Materials Advisory Board. In one of its state-of-the-art reviews, entitled *Advanced Processing of Electronic Materials in the US and Japan*, the group, headed by Walter Bauer of Sandia Livermore Labs, concludes that the "vigorous" commitment by at least ten major Japanese firms gives them a leading edge in technologies critical to microelectronic advances. Japan is out front in seven technologies the report calls "the key to future electronic and optical device development." These are microwave plasma processing, lithographic sources, laser-assisted processing, electron and ion microbeams, compound-semiconductor processing, optoelectronic integrated circuits and three-dimensional stacked structures. The report says the US still holds the edge in three technologies: ion implantation, thin-film epitaxy and film deposition, and rf reactive-ion etching. But, the report adds, "the Japanese have mounted strong programs in all three areas and the balance could easily shift in the next few years." Indeed, the report goes on, within the past year, the US has lost control of optical lithography to the Japanese.

While "overall competitiveness of the US in electronics has worsened dramatically relative to Japan in the past five years," the Bauer panel asserts, the situation can still be reversed. At least six US universities, which are not named by the panel, possess strong academic and research programs directly pertinent to the industry's needs, and a similar number of consortia, such as the Microelectronics and Computer Technology Corp, Semiconductor Research Corp and the National Science Foundation's new engineering research centers are important to wresting the technological lead from Japan.

The Bauer panel also urges government laboratories to provide "substantial support" to the US microelectronics industry, but rightly observes that "this would require a change of emphasis from current policy." Without such efforts in response to the technological challenge, warns the panel, the current trend toward Japan's dominance of the electronics revolution is likely to continue.

—Irwin Goodwin

# Bardon's reputation in NSF physics precedes him to NATO

Patrons of physics don't always have the reputations they deserve and many are not necessarily best placed to bestow funds on those most deserving. Not so in the case of Marcel Bardon, who has been awarding research grants in physics to academics for nearly 15 years at the National Science Foundation. He earned "enormous respect," says Princeton University's Val Fitch, a Nobel laureate who was chairman of NSF's Physics Advisory Committee in the early 1980s, "for his acute judgment and his willingness to take risks."

Aptly put, but Bardon himself prefers to credit the hundreds of physicists who serve NSF as peer reviewers and science advisers for the decisions the agency makes about research projects and facilities. Bardon claims he has little power over awards to individual scientists who submit new proposals or seek to renew ongoing research and even less over the baronial fiefdoms that develop around such research centers as the Cornell Electron Storage Ring and the Michigan State University superconducting heavy-ion cyclotrons. Yet, as one of a relatively small number of scientists in government with authority to bestow money on research, he is capable of influencing the physics research agenda at many universities.

**Bardon bashing.** It is precisely because of this that Bardon is known as "Mr. Physics" to some academic physicists. The appellation isn't always applied with affection. There are some who bash Bardon for wielding too much power over university physics. In the late 1970s he was criticized for advocating a special institute for the study of theoretical physics over objections from many universities and theorists who argued against concentrating NSF money and key thinkers in one place. More recently, he was reproached for advising NSF to sponsor such unusually large projects as supercomputer centers and authorizing the killing of the University of Wisconsin's chronically feeble Aladdin synchrotron light source. Five supercomputing centers were organized at a cost of about $200 million to be spread over five years, despite complaints these would be at the expense of individual researchers. In the other case, Bardon watched skeptically as Wisconsin's Synchrotron Radiation Center was saved by the ingenuity of its operators, who brought the machine up to more than 150 milliamps at 800 MeV—a sixfold increase in stored electron-beam currents in one year's time—with virtually no financial help from NSF.

Many agree with Fitch that "Marcel accepts the responsibility of his job very seriously." William A. Fowler of Caltech, another Nobelist who sat on NSF's Physics Advisory Committee a few years ago, says, "Marcel has a good ear for what is going on and a good nose for making sure we aren't getting tired old wine in new bottles."

Fitch and Fowler count themselves among the physicists saddened by Bardon's departure from NSF at the end of August to take up the post of deputy assistant secretary-general for scientific and environmental affairs at the North Atlantic Treaty Organization in Brussels. As such he is responsible for managing 46 nonmilitary cooperative research agreements among the 16 NATO countries, running workshops, conferences and summer studies, handling more than 1000 fellowships and administering an annual budget of $25 million, supplemented by almost half again as much money from member countries.

"As it's described to me," said Bardon in a recent interview, "the job is not very different from the one I held at NSF." There are major differences, of course. "At NATO we are trying to improve relations between countries where there might be some tensions and political problems. Science is particularly useful in dealing with such