Inmos Enters the 64K RAM Race

Britain's strategy for a place in the microelectronics industry is to start a company in Colorado; but will Britain's Americans beat the Japanese?

On the outskirts of Colorado Springs, in the picturesque foothills of the Rocky Mountains, one of the world's most advanced microelectronics facilities is nearing completion. It is the latest entrant in the hotly contested race to develop and produce the next generation of computer chips, in particular a chip known as the 64K RAM. But what makes this facility different from other microelectronics plants in the United States is that it is being financed by British taxpayers.

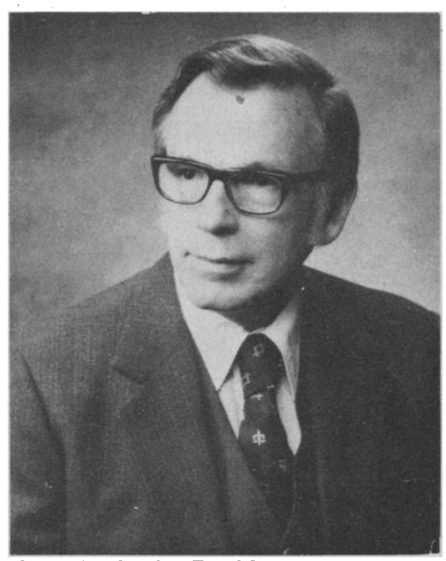
The facility is part of a bold—some say reckless—gamble by the British government to foster a state-of-the-art microelectronics industry in Britain. By setting up a plant on U.S. soil, the British government hopes to lure American talent and technology into the venture and to transfer that technology back to the United Kingdom. The idea is to buy a stake in a rapidly growing industry that many believe will be a major economic force in the 1980's, but which is now dominated by the United States and Japan.

The effort has so far drawn a mixture of skepticism and amusement from executives of many other microelectronics companies in the United States. They argue that a new venture will have little chance of breaking into a market that is already crowded with established firms, and they believe that even many American companies will have great difficulty holding their own against the Japanese.

The Colorado Springs facility is the most conspicuous part of a multinational microelectronics company established by the British government in 1978. Called Inmos, it has so far received investments of public funds amounting to about $120 million. Inmos has its headquarters in Bristol, England, and construction has just started on a production plant in Newport, in the industrial heartland of South Wales.

The intent is to conduct research and development and design work on computer memory chips in Colorado Springs, and to test production technologies there. Eventually, the bulk of the production will be transferred to the Newport facility. A group in the Bristol branch of Inmos is working on the development of a new microprocessor—the "computer on a chip"—which will also be produced in the United Kingdom.

The idea behind Inmos came not from the British government but from an American entrepreneur, Richard Petritz. A former director of technology development at Texas Instruments, Petritz has been associated with the microelectronics industry for close to three decades. In the late 1960's, he set up a venture capital partnership that spawned a half-dozen successful companies, including Mostek, now one of the largest microelectronics companies in the United States. He ended his partnership in 1976 and wondered what to do next.



Gambler in the Rockies

American entrepreneur Richard Petritz

"I felt that microelectronics technology was entering a whole new phase," said Petritz in a recent interview with *Science*. Engineers were then beginning to cram up to 100,000 electronic components on a single silicon chip one-sixteenth the size of a postage stamp—a level of complexity known as very large scale integration, or VLSI. Mass production of such chips would require new production technologies, but would also open up large new markets. Consequently, said Petritz, "it seemed to me that there was never a better time to start a new company in the history of the industry."

His view was not universally shared. In the 1960's, a new microelectronics company could be established for a few million dollars. Intel, one of the most successful microelectronics companies in the United States, was launched in 1968 with a $4-million investment. But because of the increased sophistication of the technology, the start-up costs had climbed to at least $100 million by the late 1970's. To make matters worse, the venture capital markets were then virtually dead.

Undaunted, Petritz began to pursue the idea of starting up a new company, and early in 1977 he discussed the notion with Paul Schroeder, a leading circuit designer at Mostek. Later that year, at a microelectronics meeting in Toronto, Petritz met Iann Barron, a British computer expert who had founded a small computer company in the United Kingdom in the mid-1960's. They talked about the venture over some drinks. Petritz, Schroeder, and Barron are now the three chief executives of Inmos.

Barron was a key link in the chain. He had done some consulting work for the National Enterprise Board (NEB), a British government body that provides seed money for new commercial ventures, and he brought Petritz's proposal to their attention. The NEB invited Petritz to submit a formal proposal, which he did on 31 October 1977. Five months later, after receiving an independent review of the venture, the NEB gave its approval. The final decision rested with the Department of Industry, NEB's governing body, however, and there the proposal ran into some opposition.

One problem was that certain government officials were reluctant to see public funds used to launch a company that private industry should be supporting. A second problem was that Petritz insisted that the top executives of Inmos have some equity in the company—a traditional arrangement for new companies in the United States. This displeased the

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left wing of the governing Labour party, which was opposed to the notion that individuals should gain personally from the investment of public funds.

In the end, the decision to go ahead with the venture was made by the full Cabinet in May 1978. The government promised an investment of $120 million in two equal installments, the first to be made immediately and the second 2 years later. The government also agreed that Inmos's top executives would hold 30 percent of the equity.

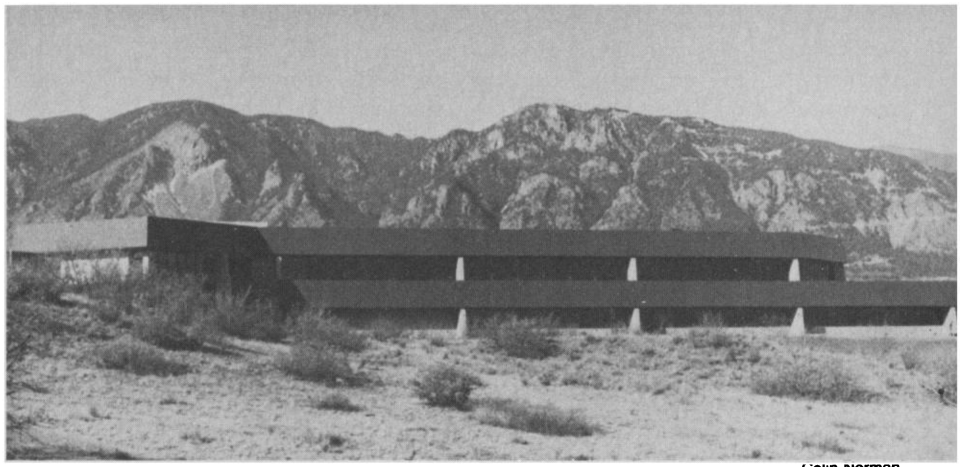
The first $60 million was spent mostly on recruiting design and engineering teams and on building and equipping the Colorado Springs facility. Although the most obvious plant site was "Silicon Valley," the heart of the U.S. microelectronics industry lying just south of San Francisco, Petritz believed that Colorado Springs' physical attractions, coupled with relatively cheap housing, would help in recruiting key staff. For much the same reason, it was hoped to set up the United Kingdom's production facility in the leafy environs of Bristol.

The British government changed hands in 1979, however, and Inmos's fortunes took a turn for the worse. The new Conservative government was philosophically opposed to spending public funds to launch companies. Payment of the second $60 million installment was delayed while the project was reviewed, and for a while it looked as though the whole Inmos venture would be abandoned. After much behind-the-scenes wrangling, however, approval was granted last July.

Three events played a role in the decision to continue support for the venture. First, the NEB commissioned yet another review of Inmos's plans, and the report was favorable. Second, Inmos executives acceded to government pressure to locate the British production facility in South Wales, a depressed area, instead of in Bristol. And third, Sir Keith Joseph, the new Minister for Industry, paid a visit to Silicon Valley in the spring of 1980 and returned enthused, according to some accounts, with the idea that microelectronics will be the wave of the future and that Britain should have a part in it.

Equally important was the fact that since most of the initial investment had been made in the United States, Britain would have little to show for its $60 million if the project were scrapped.

Inmos has assembled what many others in the industry acknowledge to be a good design and engineering team. Colorado Springs seems to be an attractive environment. But even the recruiting had its setbacks. Early on, Petritz hired five people from Mostek to work on circuit design. There is nothing unusual about that—in the microelectronics industry there is large-scale job hopping from established companies into new ventures. But Mostek objected and sought an injunction, claiming that Inmos was infringing its trade secrecy. The case was thrown out of court, but not before Mostek effectively rehired three of the people by agreeing to purchase their services on an exclusive basis.



Colin Norman

Britain's Microelectronics Outpost

Inmos's new facility takes shape in Colorado Springs.

Inmos's start-up difficulties are now behind it. But some say that its problems have only just begun. For its first major product, the company has chosen to enter a race in which at least a dozen other companies are at the starting line. It will be producing the 64K RAM (random access memory) chip, a silicon fleck capable of storing 64,000 bits of information. This device will be used in computers, telephone switching systems, industrial controls, games, and other electronic products. Capable of storing four times as much information as the current industry standard, the 16K RAM, it will be "the biggest seller in the history of the industry," predicts Handel Jones, president of Gnostic Concepts, a California-based market research company that keeps track of the microelectronics industry. By 1985, annual sales of 64K RAM's could reach $2 billion.

The lure of this market has attracted all the big names in the microelectronics industry, and most are gearing up for production. Several companies already have a product on the market. "There is going to be a brutal price war and a start-up company is not going to stand a chance," predicts Jones.

A major factor in the market will be the success of Japanese companies. Microelectronics and computers have long been a central focus of Japan's industrial strategy, and Japanese companies have scored major gains in recent years. Although they entered microelectronics relatively late, they now hold about 40 percent of the world market for 16K RAM's and are making a concerted push for the 64K RAM market. Nippon Electric, Hitachi, Fujitsu, and Toshiba are generally expected to be among the world's biggest producers.

This is sending shivers through the U.S. electronics industry. Gnostic Concepts is predicting that Japan will capture a staggering 60 to 70 percent of the American market for the 64K RAM, a level of penetration that may drive even some American companies to the wall. Other analysts are less pessimistic, but not by much. Dataquest, another California research company, believes that the Japanese share will be 40 to 60 percent.

Clearly there will be fierce competition in the microelectronics industry in the next few years. The strategy will be to slash prices as much as possible, hence companies with the lowest production costs will stand the best chance of survival. In microelectronics production, costs usually shrink rapidly as production expands and as manufacturers build up experience with new technologies. Thus companies are anxious to ride down this "learning curve" as quickly as possible while their competitors are coping with start-up problems.

Because Inmos will be competing in this cutthroat environment with companies that already have extensive experience in producing the 16K RAM, many observers have doubts about its viability. Success in the U.S. market will be vital for the company's profitability, but even in Europe it will face stiff competition from subsidiaries of American and Japanese manufacturers. "I am sure that they will be able to sell some of their parts, but there is a real question of whether a 'me too' strategy will work," scoffs one Silicon Valley executive.

None of these dire warnings troubles Inmos executives, however. They are counting on two factors to ensure success. The first is the fact that because Inmos is a brand-new company, it will be using the latest production technologies, which should ensure higher quality products with less wastage. Established companies, Petritz argues, are likely to phase in new production technologies more slowly in order to get maximum use out of their existing equipment. And the second factor is that Inmos believes its memory chips are technically superior to those of its competitors. "We have the part that the industry has been waiting for," claims David Wooten, who helped develop it.

Inmos's 64K RAM will not be in mass production until later this year, but test models have already proved to be faster—that is, data can be retrieved from them more quickly—than the memory chips produced by other companies. Moreover, Inmos officials believe that the company's technical competence has already been demonstrated with its first product, a 16K "static" RAM that it has just begun to produce in bulk. Unlike the standard 16K "dynamic" RAM, this device holds data without having to be continually recharged, and it is also much faster. But its high price will restrict its market mostly to large, mainframe computers. Even Inmos's competitors agree that its 16K static RAM is a well-designed and engineered product.

In backing Inmos, the British government has taken a far bolder and riskier approach than its European counterparts. The French government, for example, is encouraging French companies to enter joint ventures with American microelectronics firms, and most European nations are keen for U.S. and Japanese companies to establish production facilities on their soil.

"There is going to be a brutal price war and a start-up company is not going to stand a chance."

As for Inmos's financial viability, Richard Hall, the company's vice president for finance and administration, believes that the venture will begin to show an annual profit by 1983. In that year, the Bristol group's microprocessor should enter the market. Petritz is even more optimistic. He predicts that Inmos will achieve a turnover of $500 million by the mid-1980's.

The real test of Inmos's success will come in a few years time, when the British government will either sell off the venture to private industry or allow it to go public by selling shares on the stock exchange. At that point it will be clear whether Britain has managed to establish a viable microelectronics enterprise with its bold transatlantic gamble.

—Colin Norman

ELF Resurrected After Drowning by Navy

Admirals caught playing budget games with important strategic system

Rarely do military chiefs get in trouble for failing to spend money on new equipment. But that is what happened to the Navy's highest officials this spring as they were drawing up the new budget. They were reversed by the Administration after dumping a project known as ELF, an Extremely Low Frequency communications system to be used for issuing orders to missile-carrying submarines. The sudden abandonment of ELF was peculiar because for a decade the Navy had insisted the system was essential.

Defense Secretary Caspar Weinberger and some White House staffers so disagreed with what the admirals did to ELF that they persuaded the President to step in and straighten things out. On 10 April Reagan commanded the Department of Defense (DOD) to save ELF, to provide $34.8 million for it in the budget (the latest appropriation before this was for $2.7 million in 1979), and report back in August with a complete study of the system's value.

The Navy's motives are unknown. The prevailing theory in the defense community, however, is that the admirals were trying a familiar budget game. Knowing that ELF had some strong support in Congress, they decided to put their efforts into getting new airplanes and let others make the case for the unpopular old ELF.

In the struggle for survival, ELF has gone through many transformations since its inception in the early 1960's. The main reason: people were scared by its size, for it required a huge antenna. The arms of the antenna in the Navy's original plan would have been 6000 miles long; they were intended to carry a large electrical charge; and they were to be buried in long, unfenced strips of land. These strips would have cut across farms, woods, and parks and would have embraced 41 percent of the state of Wisconsin. Many people worried as well that the antenna lines would produce unexpected health hazards or drive down property values. These concerns made an orphan of ELF. Governors and congressmen from the states in which the Navy would like to build ELF understandably stalled work on the project and caused the Navy to whittle down the dimensions (*Science*, 2 September 1977, p. 964).

It has been scaled down drastically in recent designs. The antenna in the latest version of the scheme, sometimes called the austere ELF, would require only 5 percent as much land as the one originally designed by the Navy. The full-scale version was so large that the Navy had a hard time finding a place for it. ELF's home has shifted from Wisconsin to Texas, then to Michigan, and back to Wis-