SPINNING OFF THE

CERN

SYNCHROTRON

European high-energy physics puts Swiss francs, pounds, marks, kroner and lira in the pockets of industrialists

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Pure science, like pure art, is often hard to justify in practical terms even though the one leads to technology and the other to architecture. Those for whom the fountains of Rome are a more satisfactory way of drawing water than the spigots of New York will ask no better justification for the study of form. Similarly people who like to meditate on the ultimate nature of matter will consider particle physics an eminently worthwhile activity.

There are, however, those citizens whose attention is less often drawn to the Piazza di Spagna than to the bottom line on balance sheets. For such types particle physicists have to take a less esthetic tone. Not that esthetics is the province solely of an effete elite: After all, MGM's motto was *ars gratia artis*, and it was the quintessentially plain-folks regime of Mayor Daley that put a daring abstract sculpture in front of Chicago's Civic Center. And yet while Bernini chisels away, there's a double-entry bookkeeper at the Pope's elbow counting ducats. Also there's usually a cardinal or senator in the bushes muttering about how these people who draw pictures of naked youths and maidens or shoot protons into bubble chambers are really doing it only for their own prurient kicks.

Ernest O. Lawrence, who might be called one of the grandfathers of particle physics (he invented the cyclotron, from which all modern circular accelerators are descended), used to say that when money was a problem, it was time to talk about curing cancer. He wasn't being cynical; radiation therapy was one of his major interests, and that line of work has developed into cooperation between physicians and physicists in a number of teaching hospitals and laboratories that has resulted in novel therapies, some of which have benefitted patients whose problems were hopelessly resistant to other means.

That is surely both a practical and moral justification, but unfortunately the work involved does not touch many of the areas where the action is in current particle physics. Pions may be able to burn out tumors, but it's highly unlikely that charmonium will. Unified field theories are not the philosopher's stone nor an incantation for raising the *Erdgeist*.

So in talking to those whose eye is on the daybook, the physicist's operative word is "spinoff." (Ugh! See how far we have come from esthetics already.) Particle-physics equipment is big stuff. Much of it is made by industry, and the argument is that the specifications and practices imposed by such work inspire industry to improve old products and procedures and develop new ones for which there turns out to be a wider market, thus benefitting the economy generally.

Europe's largest particle-physics laboratory, CERN in Geneva, which is owned and operated by a consortium of West European nations and collaborates closely with some Eastern countries, decided to test the hypothesis by finding out how its business had benefitted its industrial contractors. The general conclusion, contained in a recently published report, is that the "economic utility" of CERN contracts (which is defined to include both decreased costs and increased sales) amounts to approximately 5 billion Swiss francs for the years 1955 to 1973, roughly $1.9 billion. During those years CERN's overall budget was Sfr 3.5 billion, and of this only Sfr 877 million were spent on the contracts that led to the economic utility.

A critic may object that this is all selfserving. To some, spinoff is a dirty word tainted with public-relations hype. NASA, which must justify the billions spent on its space extravaganzas to an ever more critical public, cranks out reams of flak about spinoff. Indeed, the introduction to the CERN report makes a remark about that. "Organizations such as NASA have already drawn attention to the existence of the 'spinoff' or 'fall-out' from space expenditures, but have tended more to follow the impact of specific technologies throughout society rather than studying the production figures of contracting firms."

CERN's approach was to be specific. The laboratory engaged the Austrian physicist and economist Helwig Schmied to interview officials of a sample of the companies it had dealt with, get them to say how working for CERN had changed their business and put numbers of Sfr on it. Schmied got information from 127 companies. He found some that had been helped a lot, some that had been helped a little and some that even felt they had been held back. Overall, he arrived at an economic utility figure of Sfr 1,665,000,000 for those firms, against a CERN expenditure of Sfr 394 million on contracts with them. From these figures the overall figure of Sfr 5 billion quoted above is extrapolated.

The businesses were divided into eight categories, and ratios of utility versus amounts of CERN contract were calculated. The ratios ranged from 1.7 for cryogenics and superconductivity, for which there is still little use aside from scientific equipment, to 17.3 for computers and 31.6 for precision mechanics.

Specific examples give the flavor of the kinds of things that happen: As the laboratory's Intersecting Storage Rings were being built, it was decided to assemble the magnets for them in the assembly hall rather than in the tunnel where the rings were to be built. A special kind of transporter was necessary for the delicate job of moving the assembled magnets. A prototype, not yet in production, was found, and CERN took the chance of ordering an advanced version.

The trucks worked successfully, and the manufacturer was later able to find other markets for them. The company said the CERN order had sped up development of the item by three years. One of the non-CERN uses is moving prefabricated sections of ships in shipyards. Shipyard officials told Schmied they probably would not have bought the trucks if they had not had evidence of their successful performance at CERN.

The particle tracks in bubble chamber photographs must be measured on special scanning tables. In CERN's years it has delivered 90 million such photographs to various European laboratories for analysis. Thus, there is a fairly sizable market for scanning tables simply among the laboratories. Companies that used scanning-table designs developed at CERN to produce models for sale to European laboratories found they could sell the tables in the United States and the Soviet Union also. They then began to find non-physics uses for scanning tables: tables to scan the salt contents of human bones *in vivo* with X-rays, and computer-controlled drafting tables for use in road building, automotive design, shipbuilding and other things.

In many instances CERN orders objects that are not standard in production lines, such as special magnets, vacuum chambers and power supplies. It imposes very strict quality standards on these contracts, and what the contractors learn in new methods of quality control has enabled them to offer higher quality goods to their other customers.

A negative example involves a power-surge balancer. Accelerators take electricity in sharp surges, and this can unbalance power grids. CERN has been working on devices to neutralize this, and the company doing the job complains that it lost a year's development time by accepting the contract. It happened that at the same time, power-generating authorities were pressuring all customers who took surging loads (electric railways, for instance) to equalize their draw. The particular company had all its capacity tied to the CERN contract and so could work for nobody else. The CERN work was so sophisticated that its parameters were inapplicable to other customers's needs. When it got off the CERN job, the company was about a year behind competitors. Nevertheless, even in this case, the company found in subsequent years that it could use some of the things it had learned.

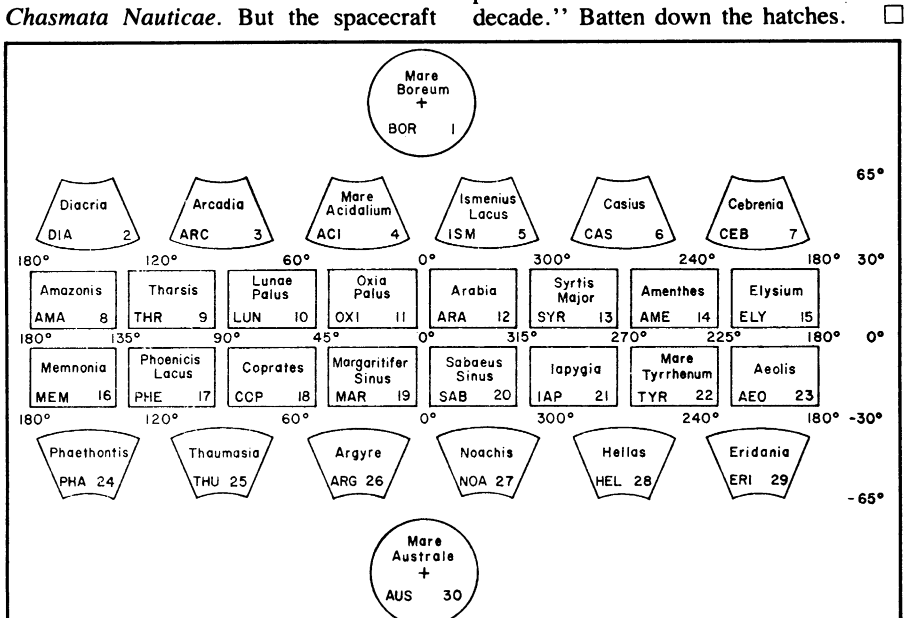
According to the report, monetary benefits to European industry are not the only thing work for CERN has provided. The laboratory's custom of awarding contracts all over Europe has given companies in non-Common Market countries products with which they could do business in the Common Market. Similarly European companies have been able to sell new items outside Europe. Finally CERN's insistence on high precision and quality have upgraded some areas of European manufacturing and helped to narrow the "technology gap" between Europe and the United States. □

. . . Mars

Mariner 9, the spacecraft that discovered it, the vast feature has been formally approved as *Valles Marineris*. At one point, however, the Working Group's Latin language consultant, a Jesuit priest, opposed the apellation for two reasons. First, rather than translating as "Mariner Valleys," he pointed out, the name instead means "valleys soaked in vinegar—*marinated* valleys." Secondly, the IAU nomenclature system contains terms for several types of "negative features," of which *valles* is not the most precisely descriptive. If one went by the official system, which applied to everything else on the list, *Valles Marineris* would instead have become *Chasmata Nauticae*. But the spacecraft would have been forgotten.

And the battle is not over—nor will it be for decades, if ever. There are more Martian names in various intermediate stages of processing, and work on the moon is far from finished. Mariner 10 added Mercury to the list, and high-resolution radar studies as well as spacecraft will soon be creating Venus problems. The current Mars group, profiting from past lessons, is working more smoothly and harmoniously, says the University of Arizona's Bradford Smith, who heads it. But at least it's a good thing that Jupiter doesn't have craters, right?

"Well," says Masursky, "Jupiter has lots of satellites. We anticipate having to put names on 30 more bodies in the next decade." Batten down the hatches. □



Official IAU "regions" on Mars suit cartographers rather than classical astronomers.