editorial

Research support—from right to left

There is, as Pierre Aigrain points out (page 32), no "European" physics. There is a European physics community. It seems to possess the same dual characteristics as does the US community—the love of science versus the need for jobs and financial support—in short, concern for the proper role of physics in society.

On both sides of the Atlantic, these characteristics reflect the dual flow between the world of science and the world of economics. We know that the scientific advances created by a Carnot or Maxwell have led to major development efforts, which in turn produced whole new industries. This is the classical "left-to-right" flow from research to development to industrial use. It is the view as seen by the basic scientist, thus by most physicists, here and in Europe. If life were this simple, society would keep increasing funds to basic science and the economy would grow. Physicists would be happy *and* employed.

The world does not, cannot, and should not work this way. This is due to statistics and balance. How many physicists must be supported for us to have a high probability of including a modern Maxwell? How can we allocate our resources throughout an industrial society to absorb scientific advances into the economy most efficiently?

There is, in fact, a "right-to-left" flow in which development *follows* an industrial base and basic research *follows* development. This is the view seen by the economy. Once an industrial system is in place, increased efforts in research and development are demanded by the system, and they are justified because there is a place for results to go.

Let us grant, then, that there is some modest level of scientific effort that society can and must support, independently of needs or missions, which will at times provide concepts for further technology and industrial output. But there is a much higher level of science and technology that can and will be supported, which flows from the needs of society *and* from our ability to absorb new developments.

With inadequate job opportunities, first in the US, now in Europe, we have seen an instinctive reaction by scientists calling for increases in basic science, arguing the "left-to-right" flow. But there is more to be gained, and on more solid ground, by increasing the "right-to-left" flow. It is more natural to support a balanced growth of the entire structure rather than a single component.

Here, the US and Europe follow different paths. In the US, as national commitments shifted to the civilian sector, new technical needs were better defined. The strong existing industrial R&D base has made expansion in all sectors possible and justifiable, and employment difficulties of new science graduates have eased. Europe has had no such major shift. The relative strength of its industrial R&D structure varies with each country, and Europe's current financial difficulties inhibit an overall growth of its technical structure.

Fundamentally, the "right-to-left" flow is increased by strengthening the system by which science and technology is transferred and put to use. Two approaches that will be helpful and, I believe, inevitable are, first, closer technical ties between Europe and the US and, second, more effective working relations among government, university and industry.

The first will be of most direct help to Europe, though US benefits will follow. We must ease the way for more joint technical enterprises. There are government efforts, such as the new international energy program, but industry must be involved to be sure the total structure is activated. Multinational companies have a strong role to play in technical ventures, and there has been notable increase in European companies expanding in the US. These broader ties effectively increase the European markets and strengthen the technical transfer process, thus providing a stronger base for scientific effort. They should be encouraged.

Closer working relations throughout the technical community can strengthen science and technology both in Europe and the US. Government–industry relations are well established in Europe and are increasing in the US. But there are still formidable barriers between university and industry, and I mention only one example. I cringe when my university friends sometimes speak of courses in "industrial" physics. The sheer arrogance and condescension of the phrase is increased by the fact that it is well meant. Would students intending a career in universities study "academic" physics? And what in Heaven would constitute a course in "government" physics?

Whether in Europe or the US, in government, university or industry, our separate communities have common interests that are poorly visible, and barriers that are barely seen or badly misunderstood. By removing these barriers we strengthen the base for the future of physics, and increase the flow in both directions between science and society.

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