

some detached body on matters as complicated and technical as scientific policy.

### 3. The Need for Government Assistance to Industrial Research and Development:

If one accepts the desirability, and indeed the need for a strong R and D effort in the country, the question can be asked: is it necessary for the Government to specifically assist industry's efforts? Will not the returns from successful R and D by industry be a sufficient inducement?

The basic justification to my mind for government support is that the general social gains from R and D far exceed the average gains that are likely to accrue to the individual firm. This issue was very well stated by Harry G. Johnson in *Federal Support for Basic Research: Some Economic Issues in Basic Research and National Goals*, published by the National Academy of Sciences in 1965. He said:

The market will arrive at a socially efficient allocation of resources provided that the risks undertaken by and the prospective returns open to the private decision-taker coincide with the risks and returns to society as a whole. These conditions are not fulfilled for private investment in research, and particularly for private investment in basic scientific research. The risk to the private investor in the creation of scientific and technological knowledge is greater than the risk to society, because the knowledge that results from the research may be useful to someone else but not useful to him, and the return to the private investor is likely to be less than the return to society as a whole, because the benefits to society cannot be fully appropriated by charging for the use of the knowledge. These divergences of private and social risks and benefits are by definition greater for basic scientific research than for applied scientific research; they are also smaller for the large diversified research organization or industrial corporation than for the small specialized research organization or company.

... In consequence, there is good theoretical reason for expecting that, left to itself, the market would not only tend to allocate too few resources to research in general, but would also tend to bias the allocation against scientific research as contrasted with applied scientific research.

He was there talking more particularly about basic research as against the more general type of industrial research, but the argument still holds. Another writer on the subject, F. Machlup in *The Production and Distribution of Knowledge in the United States*, put out by the Princeton University Press in 1962 says:

The discrepancy between social and private benefits of R and D is due, among other things, to two consequences of the introduction of improved technologies: (1) The prices of the products concerned are usually reduced, which will benefit the consumer, not the innovating producer. (2) The new technology is adopted sooner or later by his competitors, which may help them as well as the consumer, but not the innovator. This does not mean that the investor in R and D and first user of the new technology will not benefit from his investment; it merely means that the benefits to society as a whole are not limited to the benefits accruing to the investor, and will often exceed them substantially.

This general reasoning leads me to the conclusion that there is a good case for a general incentive plan to encourage industrial research and development apart altogether from any plans that may be devised to encourage any particular projects that are thought to be in the national interest.

### 4. The Nature of Industrial Research:

It is hard to think of any field where there is a greater need for the principle of decentralized decision-making than in industrial research and development. Its success rests entirely on individual initiative, from the junior research assistant to the senior research director of the firm. Top company management must, of course, set goals and determine general directions, but within that framework there must be freedom to move around, to innovate and to explore. Under these circumstances it seems to me that any contribution that government can make to stimulate the general industrial R and D effort should be in the nature of improving the general climate rather than any plan based on the assessment of the worthiness of individual projects.

In April 1965, the then Minister of Finance said, in introducing a plan for the general support of industrial R and D:

Those who wish to receive assistance based on larger expenditures than this—