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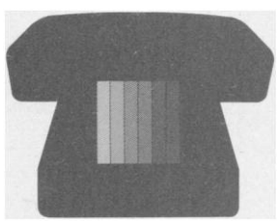

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LETTERS

R & D Expenditures in the United States

Recently published data (*1*) bear witness to the continuing erosion of support for science and technology in this country. The general trends of the data show two specific problems that deserve a high degree of attention by responsible authorities. These relate to (i) the total expenditure for research and development (R & D) in the nation as a whole and (ii) the expenditure for basic research in industry.

Although the debate regarding the appropriate level of R & D expenditure has continued over the years, with various factions advocating different economic indicators as a basis, no one has raised the issue that the level should perhaps depend upon equivalent activities in other developed nations with which we trade. Perhaps this is due to the continuing change in the value of U.S. currency with respect to that of other countries, as well as to the variation in direct and overhead costs per researcher, which makes such comparisons difficult.

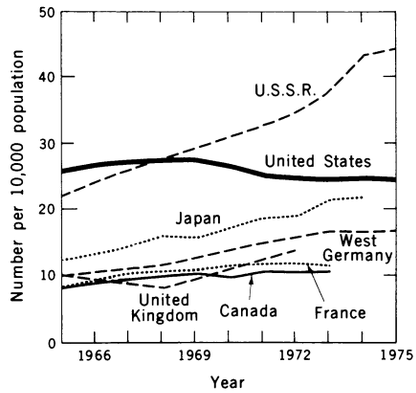


Fig. 1. Scientists and engineers engaged in R & D per 10,000 population by country, 1965–75.

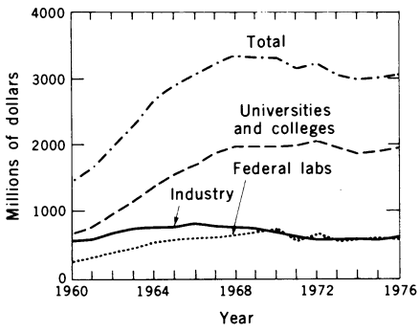
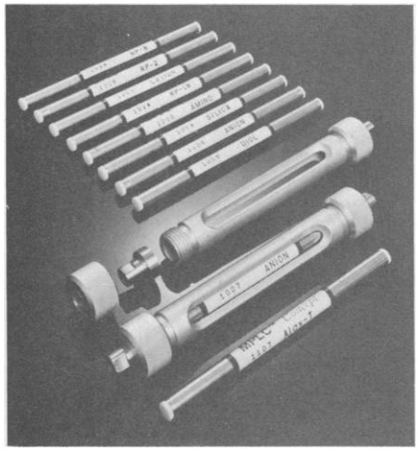


Fig. 2. Basic research expenditures by performer, 1960–76 (in constant 1972 dollars).

To overcome this confusion and to obtain a more meaningful comparison, I suggest we use the data on the total number of scientists and engineers engaged in R & D activities in the various countries (*1*, pp. 7 and 86). If we assume equivalent brainpower, dedication, and facilities, these data yield some interesting observations (Fig. 1). Perhaps the most striking comparison can be made between the United States and Japan, where the data show, respectively, 25 and 22 scientists and engineers per 10,000 of the general population for 1974. More recent data show the numbers to be 25 and 24, respectively, for 1975, with the number for Japan still rising. Since the population of Japan is about half that of the United States, it follows that, in absolute terms, the United States has twice as many people involved in R & D as does Japan, a preliminarily comforting thought.

Unfortunately, if we then look at the historical record of areas *where the government portion* of R & D expenditures has been used, we realize that, whereas the U.S. government spends approximately 64 percent of its R & D outlay on defense and space-related work, the Japanese government spends only 8 percent of its outlay (*1*, p. 9). These figures are approximate, but nevertheless they present a telling story about the magnitude of Japan's R & D effort. In terms of actual manpower in work not related to defense or space, Japan in 1975 had three scientists and engineers working in R & D for every four in the United States. While it is possible to cite a few past fallouts from space- and defense-related research in the United States, we should not overlook the fact that Japan has built a powerful R & D force aimed directly at commercial markets. The potential consequences of this strength in terms of overall economic returns for Japan, both now and in the immediate future, are apparent and need not be reemphasized.

The second problem relates to the level of basic research expenditures in industry. Here, the data (*1*, pp. 69 and 225) show a continuous drop since 1967 to the extent that, in 1976, the value of all basic research in industry, in constant dollars, remains approximately the same as that in 1960 (Fig. 2). The universities, fortunately, have fared much better, holding their level to approximately the same value as that in the 1967 peak year, or almost three times that in industry. The decline of basic research in industry has, unfortunately, come about through elimination of this type of work in many of



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the small and medium-sized companies, where the absence of such skills now makes their interaction with universities more difficult. This may, therefore, exclude these companies from participation in joint university-industry research programs of the type that the National Science Foundation is attempting to promote (*2*). Although this trend is the direct result of judgments made by the managements of these industries (and perhaps reflects the view that more short-term than long-term investment is desirable at this time), the long-term impact of this change in policy is extremely detrimental to the country as a whole. The companies that will be able to participate in this program are those which need this assistance least, as they already have a reasonable internal component of basic research. Most of these companies will, in fact, shy away from the program because of its extra administrative burden. The result can be a generally unfavorable response to the program.

To counteract this unfortunate trend, it may be necessary for Congress to provide certain tax incentives to industry to promote basic research. With a basic research core reestablished in many of the companies that have now abandoned it, the hope for a more successful promotion of joint university-industry research programs through the National Science Foundation grants may come closer to reality.

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1. National Science Board, *Science Indicators 1976* (National Science Foundation, Washington, D.C., 1977).
2. "Industry/university cooperative research activity" (Notice No. 72, Office of the Director, National Science Foundation, Washington, D.C., 29 March 1978).

Velikovskianism

One of Anthony F. Aveni's concluding statements in his review (20 Jan., p. 288) of *Scientists Confront Velikovsky* (*1*), a collection of papers from a 1974 AAAS symposium, is: "As far as Velikovskianism is concerned it is dead and buried. The final nail has been driven." Nothing could be further from the truth.

In its November 1977 issue, which appeared about the same time as *Scientists Confront Velikovsky*, *KRONOS*, an interdisciplinary journal devoted to the investigation of Velikovsky's theories, presented a very effective answer to the criticism in the book. That issue, which has been published as a book under the title *Velikovsky and Establishment Science* (KRONOS Press, Glassboro State College, Glassboro, N.J.; vi, 144 pp., illus., $9.95; also available in paperback version at $5), contains Velikovsky's AAAS address "My challenge to conventional views in science," rebuttals by Velikovsky to the arguments of four of his critics at the AAAS meeting, a special answer by Velikovsky to ten points raised by Carl Sagan, and rebuttals by six Velikovsky supporters to criticism contained in *Scientists Confront Velikovsky*. These articles show that the present-day critics of Velikovsky have not learned anything from the mistakes of those of the 1950 era, some of whom were shown not to have read the work they were criticizing.

I was not fortunate enough to attend the AAAS Velikovsky symposium. However, I did purchase the five cassette tapes prepared by the AAAS covering the morning and evening sessions of the symposium. After listening to them numerous times, including Velikovsky's rebuttals from the floor, I concluded that Velikovsky had the better of all arguments.

It is my personal opinion that anyone considering criticizing Velikovsky's work would do well first to read all his books carefully. Then he or she should read all the pro-Velikovsky writings such as those contained in *Pensée*, *KRONOS*, and *SIS Review*. I think it is probable that, having done so, a critic who is honest with himself or herself would be changed from anti-Velikovsky to pro-Velikovsky.

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1. D. Goldsmith, Ed., *Scientists Confront Velikovsky* (Cornell Univ. Press, Ithaca, N.Y., 1977).

. . . In paragraph two of his review, Aveni misrepresents the time scale and disarranges the sequence of Velikovsky's cosmological scenario. According to *Worlds in Collision*, Venus was not ejected from Jupiter 2500 years ago as Aveni states; 2500 years ago would have been 166 years after the last cosmic catastrophe (−687) proposed by Velikovsky. . . .

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