30 September 1955, Volume 122, Number 3170

SCIENCE

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

Change of address: The notification should reach us 4 weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

Dividend at 100 percent a Year

In dollars and cents, how much does society get back for its investment in research and development? Raymond Ewell of the National Science Foundation recently examined this question [*Chemical and Engineering News* **33**, 2980 (1955)]. Reasonable assumptions led to the estimate that in the United States the return averages from 100 to 200 percent a year for 25 years. Over the course of 25 years, society gets back $2500 to $5000 for every $100 spent on research and development. Some of Ewell's figures are pretty speculative, but even if there is a large error in the estimated return, research and development appears, on a strictly financial basis, to be a first-class investment. Confirmation came from a chemical company and an oil company that had independently estimated their returns at 200 and 160 percent per year, respectively.

Ewell's method consisted essentially of estimating the portion of the gross national product of the year 1953 that we would not have had without the research and development activities of the preceding 25 years, estimating the total research and development costs of those 25 years, and computing the percentage return. He also pointed out some interesting facts about the growth of research and development expenditures in the United States. Growth has been exponential; from 1776 to 1954 we spent close to $40 billion, and half of that was spent after 1948. Research and development expenses are increasing at a rate of 10 percent per year and have grown from 0.1 percent of gross national product in 1920 to 1.1 percent in 1955. If growth continues at this rate, the total is likely to fall between $5.1 and $5.4 billion in 1960 and between $6.3 and $6.9 billion in 1965.

Elementary caution tells one that the quotient of a problem in division can be thrown badly off by an error in either the divisor or the dividend. Ewell had to estimate past research and development expenditures, the total return from research and development, and the portion of that return to credit to research and development as distinct from the capital investment and other expenses necessary to produce and market new or improved products. He also had to decide what types of scientific costs to include; for example, he did not include the cost of educating the scientists and engineers engaged in research and development, or the cost of maintaining the colleges and universities that provide fundamental nourishment to the country's whole scientific effort. These estimates can be made most accurately for industrial developments. In contrast, what a guessing game it would be to try to estimate society's returns from the insignificant cost of the research of Maxwell, Faraday, and the other pioneers in electricity.

Despite its margin of uncertainty, Ewell's analysis of the economics of research provides a fascinating basis for speculating over the future of research management and policy. Speculation in a lighter vein is also provoked. A broker, apparently assuming we have money to invest, has recently been favoring us with persuasively written descriptions of the future prospects of a number of common stocks. Imagine the prospectus that could be written on the basis of Ewell's calculations if *Research and Development Unlimited* was listed on the New York Stock Exchange.—D.W.