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Technological Innovation

In some of the discussions of regional economics, it seems to be assumed that a faster rate of growth would follow automatically if the level of research and development were raised. On a national scale it is clear that recent economic growth has come in substantial measure from new technology. Consider electronics, the zipper, jet aircraft, air conditioning, digital computers, xerography, and other success stories. None of these new ideas and inventions became a success, however, until it was followed by product design and engineering, tooling up, initial manufacture, and the opening of a new market. These later stages, it has been estimated, typically cost 10 to 20 times as much as the original research or invention. A new idea lies at the base, but it lies fallow unless venture capital and the skills of the entrepreneur, product engineer, marketing specialist, and manager successfully translate the new idea into the market economy.

The interrelation of these several elements, the factors that foster or inhibit innovation, and the recurring refrain that we know too little about them, are the theme of *Technological Innovation*, a report recently published by the Department of Commerce, which is reviewed more fully in the News and Comment section of this issue of *Science*, where some of the recommendations for fostering innovation are also given.

The report raises some interesting puzzles. Why, for example, should it be that when the Federal Reserve Bank of Philadelphia questioned the founders of a number of research-oriented firms in the Boston area, all answered that the universities played an important role in stimulating new science-based firms and that local banks were helpful, while every founder of a similar firm in the Delaware Valley replied that the universities played a small role and that bankers were unreceptive to the idea of putting venture capital into such firms?

Those who are worried, from an economic point of view, by the current geographic distribution of research and development funds and those who are concerned with building a base for the technological development of the poorer nations of the world will endorse the conclusion of *Technological Innovation* that is emphasized over all of its more specific recommendations: "Major effort should be placed on getting more managers, executives, and other key individuals—both in and out of government—to *learn, feel, understand*, and *appreciate* how technological innovation is spawned, nurtured, financed, and managed into new technological businesses that grow, provide jobs, and satisfy people."

Perhaps we will understand these matters better in a few years, for the interrelations of the factors involved are being studied. In the literature of economics, the contributions of education and knowledge are being analyzed along with those of capital and labor as factors that contribute to growth. The President has proposed changes in patent law. The Patent Policy Committee of the Federal Council on Science and Technology is studying the conditions that aid or inhibit commercial exploitation of government-owned patents. The State Technical Services Act is being tried out. And the National Aeronautics and Space Administration is encouraging universities with major NASA support to explore and improve their relations with industry in an effort to foster the translation of new knowledge into industrial practice and products.

—DAEL WOLFLE