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**COVER** Multinucleated cells of *Dictyostelium discoideum* cells that arise when cytokinesis is impaired by the lack of myosin heavy chain protein. The bright spots are nuclei fluorescently stained with the DNA binding dye Hoechst 33258 after fixation of the cells. The phenotype was produced by transforming cells with a vector that encodes myosin heavy chain antisense RNA. See pages 1081 and 1086. [D. A. Knecht and W. F. Loomis, University of California San Diego, La Jolla, CA 92093]

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## The Challenge to U.S. Competitiveness

If the Soviet launch of Sputnik was a technological shock, and the oil crisis of 1973 an oil shock, then what is happening to us today can only be called a competitiveness shock. Although the competitive challenge is understood in some parts of industry and government, it is not widely understood for its significance and its threat to the national economic well-being and our standard of living.

One of our tasks is to meet the challenge of the globalization of the world economy. Industries and individual companies in the United States or in other countries ignore at their economic peril the need to operate in a global economy. The challenge is across the board—in market access, low-cost production, quality products, research and development, innovation, marketing, and education. The competition is for market share not only abroad but also in the United States. Access to global markets is critical to economic success. Although it is essential that products be competitive in cost, quality, and performance, in many cases economic and political necessity dictates that the products and institutions that produce them have an indigenous component.

A phenomenon, the long-term consequences of which are poorly understood, is that product design, engineering, and software development increasingly are likely to be done overseas. The implications for maintaining the essential U.S. engineering capability are worrisome because of the implied erosion of the U.S. base in knowledge and know-how. Whether automobiles or refrigerators, computers or microchips, nuclear power or energy transmission systems, the likelihood is increasing that the systems are assembled from components designed, engineered, manufactured, and shipped from all parts of the world.

Increasingly, excellence in research and engineering is to be found throughout the world, and the level of innovation is rising abroad. Witness the increase in the number of patents granted to foreign companies and individuals in the past year. More than 43 percent of the patents granted in the United States went to foreign entities.

It is time that our national policy recognizes the key role of engineering research and engineering application, alongside of scientific discovery, in meeting the global competitive challenge before us. This means allocating funds to, and creating programs for, engineering activity to an extent far greater than exists today. There must be a realization that engineering and technology are different from science and equally important. It also means encouraging private investment in engineering research and its application.

The absence of attention to excellence in manufacturing has been at the heart of some of our problems in industrial competitiveness. Until recently we have failed to treat the manufacturing process as a system; we have failed to provide adequate manufacturing education in our engineering and business schools; we have failed in many cases to provide the incentives of prestige and compensation to manufacturing engineering; and we have failed to make the capital investments in new manufacturing technology.

We are assured, however, by some economists and others that we need not worry about manufacturing moving offshore, since all we are witnessing is a natural, though painful, transition to a service economy in the United States. Although it is true that services increasingly are sources of employment and wealth generation, we face the dilemma that a thriving service economy is directly dependent on a vigorous manufacturing base. We need to recognize that the problems of manufacturing productivity and quality require a system approach. We need to examine manufacturing from the design phase to the producibility of the product to its marketing, and distribution. Only when this view is adopted throughout industry and academia will our manufacturing sector regain competitiveness.—ROBERT M. WHITE,\* *President, National Academy of Engineering, Washington, DC 20418*

\*Adapted from "Taking technological stock." Report of the President at the NAE 22nd Annual Meeting (National Academy of Engineering, Washington, DC, 1986).