science have pondered the relationship between basic, "pure" research and industrial productivity. It has often been argued that, paradoxically, the only way to make fundamental discoveries—that is, discoveries that affect our basic understanding of the way the world works and at the same time lead to practical devices—is to engage in pure or basic research, research with no end product in mind save the gain in knowledge itself.

Now here is a book by Leonard Reich that not only sheds light on these questions, but nails down how, in practice, large American corporations such as AT&T and General Electric came to establish research laboratories shielded from the immediate needs of production and competition. Reich discusses how those labs evolved over time, and how in the long run the labs played a key role in the rough and tumble of so-called free market competition. In this superb study, Reich hews out a path that many of us have stumbled to find for the last 20 years.

Reich begins by considering the state of research in the 19th century and the changing state of business—especially industrial business—at that time. This in itself is a unique contribution. Reich convincingly argues that it was not the knowledge that research had provided that led to the establishment of industrial research laboratories. Rather it was the perceived needs of business and the recognition that the old ways of trust and monopoly would not suffice anymore that forced the captains of industry to turn to the research enterprise as a way of fending off the competition.

Reich then examines in detail how competitive pressures and demands led to the founding, almost accidentally, of two of the earliest and most revered American research establishments: General Electric's Research Labs and the corporate precursors of the Bell Telephone Labs. Each got a foothold in the corporate structure by providing early patent protection for technological advances over the aggressive competition. At first, research problems were narrowly defined and carefully controlled. But with success, the best researchers at both laboratories were given considerable latitude in defining the direction and scope of their work.

Reich concludes his study by showing the dynamic role played by both GE and AT&T research groups in the struggle for corporate control of the radio and broadcast industries. Alert, active, innovative research organizations by themselves were not sufficient. What was required was close cooperation and sympathetic understanding between those responsible for research and other corporate departments, especially the legal and sales staffs.

Reich's definition of the industrial research laboratory as "set apart from production facilities, staffed by people trained in science and advanced engineering who work toward deeper understanding of corporate-related science and technology, and who are organized and administered to keep themselves somewhat insulated from immediate demands yet responsive to long-term company needs," is a distillation of what Reich considers to have been necessary if such laboratories were to be effective.

Perhaps the most important conclusion that can be extrapolated from Reich's study is the observation that it is not so much the motivations of the researcher that determine the significance of the outcomes of research, but the environment in which the research is done. The leaders of research at GE and at AT&T learned early on that allowing the best of their research people a maximum of freedom was bound to pay: in product and process patents, in respect and in reputation.

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Introduction to Flight

John D. Anderson
Second edition. 560 pp. McGraw-Hill, New York, 1985.
ISBN 0-07-001639-9 $46.95 hardcover

This book is a comprehensive, elementary introduction to the technology of heavier-than-air flight written by a professor of aerospace engineering. It is novel in that it includes a great deal of historical material that adds much interest to the main technical material.

In the preface, John Anderson says he has "made every effort to talk to the reader in a fashion that is readable and completely understandable—the way of explaining ideas is constructed with the uninitiated reader in mind." From personal experience I am aware of the difficulty in fulfilling such a worthy aim, and I believe that one needs to blend physical insight with technical formalism to reach most readers. Anderson's book is weak in presenting physical principles and explanations. For example, he introduces the concept of the lift of a wing by dimensional analysis, after the simple statement that lift occurs when the air pressure surrounding the wing gives rise to a net upward force on the wing. This is hardly more than a truism. It would be much more instructive to point out that a moving wing imparts a net downward momentum to the air it intercepts, and that lift results as a reaction. The time rate of change of the momentum of the air thrust downward produces an upward force on the wing (lift) by Newton's third law of mechanics.

An analogous phenomenon is familiar to many people who have observed the depression of the surface of the water behind a water-skier. In this, as in any, application of Newton's third law the primary action must be properly distinguished from its reaction. Such a discussion of the physical principles involved would add considerably to the understanding of the phenomenon of lift for the uninitiated reader.

A second example occurs in the discussion of the rate of climb of an airplane. On page 280 there is an italicized statement that "drag is smaller for climbing flight than for level flight at the same speed." To show this "more clearly" a laborious example calculation is made. Actually all that is needed is a statement that in climbing flight there is a vertical component of the thrust of the engine, which supports part of the weight of the airplane, thus reducing the lift needed from the wing. When lift is reduced the induced drag is reduced and, therefore, so is the total drag. Such physical insights and explanations are often lacking.

The book is very well done with regard to simplified mathematical formalism and is very comprehensive in treating all forms of flight and their associated propulsion systems; it includes both supersonic flight and ballistic flight (spaceflight). For the uninitiated it provides a clear and complete lexicon of the specialized jargon of aeronautical engineering. I have no hesitation in recommending this book as a good introduction for the reader who has little or no background in aeronautics, but some science background.

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Noise and the Solid State

David A. Bell
175 pp. Wiley, New York, 1985.
ISBN 0-470-20229-7 $34.95 hardcover

David Bell is a veteran researcher in fluctuation phenomena, and his book is a personal overview of the field. His aim is not to give a complete coverage of noise in solid-state physics, but to give the reader an idea about many interesting aspects of the field.

Topics discussed in detail include thermal noise, $1/f$ noise, noise in ferromagnetic materials, hot-carrier transport, cryogenic devices, oscillator noise and noise in radiation detectors. Notable absences are noise in transistors and noise in field-effect transistors.

The author gives many valuable