

Geoscience and a National Economy

The Earth Sciences in Canada. A Centennial Appraisal and Forecast. A symposium, Ottawa, 1967. E. R. W. NEALE, Ed. University of Toronto Press, Toronto, 1968. xii + 260 pp., illus. \$8.50. Royal Society of Canada Special Publication No. 11.

In a country that spreads over 3.85 million square miles, much of which is unsettled arctic and subarctic wasteland, geological exploration is an arduous task. Canadians have been at it since 1842, when the Geological Survey of Canada was founded. This volume, the product of a symposium sponsored by the Royal Society of Canada in the centennial year 1967, reviews and appraises 125 years of achievement. The appraisal exhibits no complacency, for its primary objective was to provide guidelines for the future development and application of the earth sciences in order to foster Canada's economic growth.

The output of mines and quarries north of the border accounts for 7 percent of Canada's gross national product and nearly one-third of the value of all its exports. Mineral raw materials are a vital part of the economy, and it is natural that the economic aspects of the geosciences should pervade the 13 papers that comprise the volume. Nonetheless, the 19 authors address themselves not to mining or to oil and gas production but to the scientific principles upon which the success of future work will depend. Some of the authors have been more successful than others in adhering to science rather than to its applications; most notable among the papers in this respect is R. W. Landes' "Geosciences in the petroleum industry."

Colin W. Stearn presents a thoughtful and thought-provoking analysis of "Geological education in Canada." Since 1957, enrollments have dropped 45 percent and barely suffice to keep geology departments in 29 institutions alive. In 15 universities that grant the Ph.D., there were only 133 candidates for the doctorate in geology and 50 in geophysics in academic year 1966-1967. No count of Canadian students in United States institutions was available, but a head count of geology alumni of the University of British Columbia revealed that 68.5 percent of them had taken their graduate work in United States institutions. Many never returned, and blame for a con-

tinuing brain drain is assumed to belong on Canadian shoulders. Stearn makes no mention of the fact that there are as many American geologists currently working in Canada as Canadians who have been lost to U.S. industry. Thanks to Canada's mineral wealth—and the United States' monetary wealth—the exchange is more nearly equal than he implies.

The need for a broader base of financial support is a recurrent theme, and although the several authors point out the direction that research must take, P. Meyboom sagely observes that "it has been demonstrated how futile it may be to list 'research needs,' since the direction of research seems to be determined by the interests of individual scientists." The inevitability of narrow specialization is recognized but mildly deplored, as is the tendency for the geosciences and geoscientists to move from the field into the laboratory. Interdisciplinary team research, in the view of several contributors to

the symposium, must be field-based and laboratory-supported.

This is a Canadian book, about Canadian achievements and objectives in the earth sciences, but it is modest in its claims and gives credit where credit is due without regard to national boundaries. The reader will learn from its pages a great deal about Canadian geology and mineral deposits. In spite of a tinge of provincialism, however, it has something more to offer. It is a general appraisal of the earth sciences. The chance that a comparable volume will ever be published in the United States seems so remote that every geologist, geophysicist, geochemist, or geophysicist will benefit from reading this one and pondering some—or all—of its contents. The state of the art differs little on opposite sides of the international boundary, and Americans will find their own scientific problems and shortcomings mirrored in this Canadian appraisal.

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Technology and Politics in Europe

France in the Age of the Scientific State. ROBERT GILPIN. Princeton University Press, Princeton, N.J., 1968. xii + 474 pp., illus. \$12.50.

Unlike many who polemicize about the technological gap, Servan-Schreiber does not invoke de Tocqueville to underscore the American challenge. On occasion Gilpin does so, in the book here reviewed, to illustrate why Americans are presumably more naturally addicted to technological exploitation. Servan-Schreiber chooses not to quote de Tocqueville because, although the two compatriots, observing the U.S. scene more than a century apart, saw it in almost precisely the same way, de Tocqueville did not always wish to emulate what he reported so perceptively, whereas in Servan-Schreiber there is a great deal of desire to emulate. Both his book and de Tocqueville's are largely political documents; less so is *France in the Age of the Scientific State*, whose value lies in its quantification and elaboration for those who seek to separate the actuality and the myth of the technological gap.

Gilpin's book yet stands alone as a major study of a European scientific state. It is appropriate that such a study should concern France, for

France has been the most self-conscious of the Western European nations regarding the technology gap. The very term, according to Gilpin, was probably coined by a Frenchman, Pierre Cognard, whose 1964 document on the subject refired the fears of the susceptible concerning all manner of subjugation by the United States. Cognard himself, whose excellent reputation in science planning is known to but a few outside of France, has always considered solutions to the problem in the broadest terms. As a former official of the General Delegation for Scientific and Technical Research, he deserves much credit for the formulation of the fifth national plan, current until 1970. One infers that his work has directly and indirectly influenced much of Gilpin's analysis, which as a consequence is really two books—one on the Atlantic technological imbalance and the other a narrative examination of the development of French scientific and technological planning from the Napoleonic era through the Gaullist.

The revolution and Napoleonic reforms brought to flowering the scientific seed which had begun to be implanted in France in the middle of the 18th century, and France maintained