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 continuing 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 geo-anybody 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

a dominant scientific position in the world until about the middle of the 19th century. The nonresilient French social structure, with which the scientific establishment has always been integral, did not permit the state to meet new challenges to that position. Then it felt the impact of the emergence, after World War II, of two dominant scientific states, and de Gaulle regained national leadership. Gilpin gives the history of the social, economic, and political interaction of science and the state, pausing midway to devote a chapter to the "American model of the scientific state." By then he has taken us into the period of French preoccupation with planning. At first almost a fetish—planning was to enable France magically to regain her grandeur among states—it gradually acquired substantial meaning. But planning itself could not produce results quickly enough, and its orderly process was perturbed by the *force de frappe,* seemingly petulant policies toward NATO and the Common Market, and other manifestations of impatience. Planning has produced no instant miracles anywhere; their failure to appear has perhaps been most obvious in France, as the events of 1968 have demonstrated. But the process of planning and testing its various methodologies has been in effect in France probably longer than anywhere else, and it is difficult to believe that this growing body of knowledge, experience, and planning personnel (especially as they infuse industry) will not eventually give France advantages over nations that are less experienced and less educated in the process.

Gilpin believes that France must follow one of three paths to achieve the status of a scientific state. She can follow the "Swedish" path by focusing her technological efforts in a few areas of concentration, or the "Japanese" way through heavy utilization of foreign licensing agreements; or she can emulate the two dominant scientific states in all activities across a broad front. Clearly, to do the last requires the resources and markets of states of continental dimensions; if this route is the most attractive for France and for other European nations, the logical conclusion, which Gilpin pursues, is more intensive scientific and technological collaboration on a truly European scale.

This is the obvious conclusion for which many have argued, but there are still few signs of its coming about. The difficulty is that technology is not the sole driving force in economic and political consolidation. If even the Czech crisis did not impart an immediate, salutary push toward European unity, it is difficult to envison the "American challenge" as a quick catalyst, although over a period of a great many years it may prove to have been such. The ultimate solution for Europe will probably turn out to be a melange of the three analyzed by Gilpin, coupled with the advantages derived from newly developed, long-term planning methodologies. Whatever solution arises, it will be a solution essentially derived by Europeans themselves. And not many years hence it would not be surprising to see the "European challenge" become a most fashionable subject.

Political vicissitudes will determine how the pendulum of challenge swings between the developed and the undeveloped nations; but most studies, examinations, and so on will borrow from such as de Tocqueville, confident in his expectation that social benefit would of its own accord spill over from "high scientific vocation." He was wrong in that, but who can challenge his thesis that some sort of scientific "aristocracy" must be maintained?

On the other hand, can we fully accept Servan-Schreiber's dictum that "politics, the interplay between Right and Left, is increasingly the irreplaceable source of creativity"? But for the moment, Gilpin gives us a fine summation of the problem for France, and for a great many other nations: "The term 'technology gap' is really a symbolic representation of the whole spectrum of challenges posed by a dynamic, expanding, and socially democratic society for conservative societies ruled by traditional elites wanting the power that science and technology can bring, but unwilling to pay the price of a profound social-economic transformation."

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Last Looks at a Pleistocene Record

Desert and River in Nubia. Geomorphology and Prehistoric Environments at the Aswan Reservoir. KARL W. BUTZER and CARL L. HANSEN, with contributions by Egbert G. Leigh, Jr., Madeleine Van Campo, and Bruce G. Gladfelter. University of Wisconsin Press, Madison, 1968. xxii + 562 pp., illus. $17.50. Set of 15 maps from the book, drawn to a larger scale, $10.

The Prehistory of Nubia. Final Reports of Research Conducted by the Combined Prehistoric Expedition to Nubia. FRED WENDORF, Ed. Fort Burgwin Research Center and Southern Methodist University Press, Dallas, Texas, 1968. 2 vols., xiv + 1084 pp., illus., boxed with 38 loose figures and tables. $37.50.

"Nubia, a part of the Nile Valley, is a land of river, rock, and sand that winds its way upstream of Aswan into the distance of the Sudan." This is the only statement in these two works that even approximates a definition of the area of their concern, and it appears only on page 196 of the Butzer and Hansen volume. Admittedly, Nubia is vaguely delineated, being a region of northeastern Africa, between upper Egypt, the Red Sea, and the Libyan Desert and extending south indefinitely to about Khartoum. It includes that part of the Nile Valley from Aswan, near the First Cataract, to the confluence of the White and Blue Niles, at Khartoum, thus extending about 900 kilometers north-south. "Nubia . . . has no strictly defined limits and is little more than a geographical expression" (*Encyclopaedia Britannica,* 1956). The work reported in these two books concerns in actuality only Lower Nubia, that area north of the large S-bend of the Nile in northern Sudan.

The impetus for the intensive but short-lived efforts reported by these authors came from the construction of the new High Dam at Aswan that is bringing into existence Lake Nasser. This lake will inundate nearly 500 kilometers of the Nile Valley; the surface area of the reservoir will be about 6500 square kilometers when it is full in 1975; and the water volume will be 125 billion cubic meters, or five times the capacity of the former dam at Aswan. The economic implications for Egypt are certainly great, but the con-