lems confronting the country today; his call is not for optimism but for determination.

Altogether this volume is the witness of a remarkable man. One may hope that his counterpart is in the wings today should the times cry out for him.

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The North of Canada

Science, History and Hudson Bay. C. S. BEALS, Ed. Design and preparation by D. A. Shenstone. Department of Energy, Mines and Resources, Ottawa, Ontario, 1968 (available from the Queen's Printer, Ottawa). 2 vols. xxii, 1058 pp., illus., + maps. $16 Canadian.

The discovery of vast petroleum deposits on the north slope has once again focused attention on the arctic regions of North America. *Science, History and Hudson Bay* examines the nature of Canada's Hudson Bay region and asks what the future holds for its development. It is for this reason a timely work and should satisfy the curiosity of anyone, specialist or otherwise, interested in the north.

This monumental, and basically encyclopedic, work was prepared for the Centennial of Confederation (1967) and was conceived primarily as a point of departure for future studies. It contains the contributions of 56 scholars and scientists, including among others physicists, geologists, geographers, historians, and anthropologists. Volume 1 consists of eight chapters, subdivided into a number of subsections. It covers the prehistory and history of the region, its people, geography, climate, water and ice conditions, marine life, flora, and fauna. Among its contributors are members of the National Museum of Canada, the Meteorological Service, the Marine Sciences Branch, the Fisheries Research Board, the Canadian Wildlife Service, and several universities. Volume 2, with seven chapters and subsections, focuses on the geology, and summarizes geophysical studies, upper atmosphere research, transportation and communication, defense, economic possibilities, and theories of origin. Its contributors are drawn from the Geological Survey, the Dominion Observatory, the Hydrographic Service, and other Canadian institutions and organizations. Illustrations, which are profusely exhibited throughout the two volumes, are good, and there are some useful maps. Each chapter contains a fairly comprehensive bibliography, and the index is thorough.

Hudson Bay was discovered in the 17th century in the course of the search for the Northwest Passage. Although the grim experience of Henry Hudson is firmly implanted in the imagination of every Canadian schoolboy—at least it was a few generations ago—the region and its icy waters have not played a very positive role in Canadian life and development. Sending its chilly blasts of air southward into the lower Great Lakes region and St. Lawrence Valley, the Bay (and the sinister Greenland ice cap to the northeast) have pushed vegetation, soil, and agricultural belts to the south. Possibilities for agriculture in the Bay region itself—apart from the raising of caribou—are limited by the short frost-free period of from about 2 to 2½ months. Only in the southern part may potatoes be grown successfully.

Still, the resource potential of the region remains substantial. This is especially true of the fisheries, increased output of which apparently depends on the use of more and better boats. The extensive forest wealth could, if tapped, provide pulp and paper for Western Europe, conditioned of course by the navigation season, which extends over some three months or more. Other than low-grade nickel, exploration of the west shore of the Bay has not revealed any mineral deposits of economic significance. The east shore, however, is rather more promising. Considerable search has revealed a number of occurrences of low-grade iron ore; a number of industrial minerals, such as gypsum and asbestos; and a good possibility of petroleum or natural gas, or both, within the environs of the Bay.

Perhaps the most promising statement that may be made for the Bay region is that the arctic or subarctic environment has not been found to be a serious obstacle to economic development. It will simply be for the future to determine what path that development will take.

Though the topical organization of the work leaves something to be desired and one wishes that the editor had included a synthetic chapter, this remains an impressive assemblage of facts not readily found elsewhere.

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On Plant Morphogenesis

Cellular Differentiation in Plants and Other Essays. C. W. WARDLAW. Manchester University Press, Manchester, and Barnes and Noble, New York, 1970. vi, 162 pp. $6.50.

The development of the beautifully coordinated complexity of the higher plant body from the single cell of the fertilized egg has fascinated botanists for centuries. The earliest students of this process were the anatomists who carefully observed and completely chronicled the structure of the final body, as well as the innumerable stages that intervene between the one cell of fairly simple structure and the many cells of so many different structures and functions. Later came the experimental morphogeneticists who prodded, wounded, and dismembered plants, and especially their growing points, in order to see what unexpressed potentialities for the development of form and structure existed in plants, and to discover how versatile the plant could be in overcoming or circumventing obstacles placed in the path of normal development. Still later came the physiologists and biochemists and their chemical control of such processes as root initiation, bud formation, and the inception of floral primordia. The last to burst upon the scene have been the molecular biologists, with their emphasis on selective gene repression and derepression as an explanation of differentiation within the context of a demonstrated identical genome in all cells.

Claude Wardlaw, an emeritus professor of botany in the University of Manchester and a distinguished contributor to experimental plant morphogenesis, especially of fern apices, freed at last from the duties of his academic position and unrestrained by the necessity of pleasing colleagues or students, has written this book, as he has written others, to permit himself some freedom of expression, to muse aloud, and to share with readers his hopes, his misgivings, and his predictions concerning the future of his field. In a day when scientific writing, especially in journals, has become so stylized as to eradicate the personality of the author, it is a luxury and a distinct change of pace to read such a book. I found it relaxing, if at times a little precious. The book contains only a few new insights into plant developmental processes. Anyone at all acquainted with the field knows that there are many more unknowns and mysteries than there are knowns

and givens. Yet experimental botanists have come up with some generalizations about plant development over the years, and Wardlaw has reviewed these and mulled them over in the light of his own understanding; he has given us an entertaining, if not especially incisive, view of plant morphogenesis.

Not all will appreciate his style. Consider the apologia with which he begins his book:

> Alas! Like the stern, gloomy Scot that I am, deeply indoctrinated from long time past with the knowledge that things will be worse before they are better, that laughter in the morning means tears at sunset, and other quite unnecessarily sadistic saws, not always as wise as they sound, I fear that I have already preached at inordinate length on morphogenesis in plants as a great edifying and unifying theme. My trouble is that I don't know when to stop: I have still something more to say! But, pray, do not take the present modest offerings too much to heart: just enjoy them, even if only by disagreeing with my concepts and arguments. As for my choice of literary presentation, the subtle reasons will emerge in due course.

He frequently includes ponderous clichés which none but the irrational would need to see in print:

> The search for general truths, which can accommodate seemingly conflicting facts, i.e. laws of science *in biology*, must be maintained as a great central aim. Mutual tolerance and respect should be exercised, and an open mind maintained, during difficult, controversial periods of new ideas and new discoveries. No precious discovery in botany should, through automatic opposition, lack of appreciation, prejudice, or cliquism, be allowed to pass without being accorded discriminating attention.

He is also somewhat addicted to "cute" talk:

> That is not all: there is cogent evidence that histones are also synthesized in the nucleolus. What a busy biochemical market-place that little blob in the nucleus has become!

These eccentricities of style, together with the liberal use of question marks, parenthetic phrases, and exclamation points, tend to distract the reader from the major message, but to the extent that the major message involves the personality, prejudices, and interpretations of the author, the style is, in fact, the message itself.

The brute fact is that in the study of differentiation we are hopefully barely starting to emerge from the dark ages. We know most of what happens at the gross level, but at the fine structural level, and especially at the level of chronicling the new macromolecules that appear in order, much remains to be discovered. We know how to interfere with and change the rate of normal processes and to simulate developmental changes by tricks involving physics and chemistry. Yet of ultimate mechanisms we know only a little, despite the confident dogmatism of some molecularists. What Wardlaw is doing, after a lifetime of research and contemplation in the field, is simply to mirror our own current frustrations in a reasonably entertaining way, and against a historical backdrop.

There are five essays in the book: "On writing botanical essays," "Aspects of cellular differentiation in plants," "Reconciliations among apex lovers," "Enigmas of epigenesis," and "Organization, disorganization and neo-organization." These essays have in common only a concern with plant morphogenesis. They are frequently repetitive but paradoxically rather unconnected. They may be read with no more expectation of continuity than, for example, successive short stories in a collection by Maugham.

My main rewards in reading this book, aside from its entertainment value, which is not inconsiderable, were certain new generalizations such as the following: "The phloem typically differentiates in that region of the incipient vascular tissue which is closest to the region of most rapid growth." This helps one understand why the lower or abaxial side of the primordium produces phloem, whereas xylem differentiates on the upper, more slowly growing adaxial side. This simple generalization, if true, also helps us understand why in experiments with excised callus tissue high sugar concentrations result in the induction of phloem, whereas low sugar concentrations result in the induction of xylem. As Wardlaw says in a footnote: "Having now (?) seen the light, I am surprised it has not been seen by others long ere this!" Another reward from the reading of the book is the renewed realization that many of the recent statements on plant morphogenesis framed in the language of modern molecular biology are really derivatives of previous statements by predecessors such as Vöchting, Driesch, and, more recently, S. J. Holmes.

Read this book, then, not so much to learn a field as to sample the man and his times, and to gain some perspective for the new experiments and reports descending on us in a flood. As Wardlaw reminds us, the mysteries of plant morphogenesis are bound to be around for many years to amaze us, entertain us, and engage our passions, energies, and intelligence.

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Cortical Signals

Average Evoked Potentials. Methods, Results, and Evaluations. A conference, San Francisco, Sept. 1968. EMANUEL DONCHIN and DONALD B. LINDSLEY, Eds. National Aeronautics and Space Administration, Washington, D.C., 1969 (available from the Superintendent of Documents, Washington, D.C.). xviii, 402 pp., illus. Paper, $2. NASA SP-191.

Sensory stimuli evoke cortical potentials in the spontaneous electroencephalogram (EEG). When recorded from the scalp, these potentials are not directly detectable. They are extracted from the EEG by signal-averaging techniques. Other events may also provide the time references for averaging.

The conference recorded in this volume was devoted to current problems in conducting AEP (average evoked potential) studies and to reporting experimental results. Donald Lindsley, a pioneer in EEG research, sounds a note of warning in the introductory chapter, observing that the slenderness of our knowledge, despite many years of EEG research, about "the source, nature, and regulation of alpha and other spontaneous rhythms" should give AEP researchers pause. While both the EEG and the AEP are believed to derive from synchronized depolarizing and hyperpolarizing postsynaptic potentials of neuronal populations, the AEP probably reflects the functioning of smaller, more discrete neuronal groups time-related to a reference event. Herbert Vaughn in his chapter "The relationship of brain activity to scalp recordings of event related potentials" cogently points out that "although averaging was introduced primarily as a means of enhancing the signal-to-noise ratio, the technique has broader implications for the treatment of neuroelectric data: the analysis of electrical activity occurring between stimulus and response can provide clues concerning the timing and anatomical location of physiological events which have direct psychological correlates." Perhaps AEP research will