Book Reviews

Theory and Geology

The Earth in Decay. A History of British Geomorphology 1578–1878. GORDON L. DAVIES. Elsevier, New York, 1969. xvi, 392 pp. + plates. $16. History of Science Library.

Historical sciences entail some problems not encountered in nonhistorical sciences, and this circumstance gives rise to certain special difficulties in seeking to understand their development. By its nature, geological thought deals with events inaccessible by direct examination, and so historical theories must be invoked to render geological science empirical. The history of historical sciences therefore acquires a complex dimension. The scientist's conception of history as a scientific tool becomes a part of his theoretical apparatus, and varying patterns of historical thought constitute obstacles which the scholar must surmount before hoping to create an accurate reconstruction of the development of any historical science.

These obstacles have on the whole been met satisfactorily by Davies in his examination of British answers to fundamental geomorphological questions over a period of 300 years. Are landforms primary features, remnants of terminated agents of the past? Or are they the result of continuous geological processes still at work today? How do topographical features relate in general to geological features? At what rate is the face of the land changing, and what agents are responsible? The historical conditions under which such questions were raised and answered are the stuff of a fascinating story.

Because this scholarly study appears to deal with a specialized field of science that did not genuinely exist until toward the end of the period through which it is traced, one might suppose that the author has risked artificiality in selecting those aspects of science that fit his modern definition of geomorphology. Davies has come close to avoiding this danger, however, by trying to keep in view the larger settings of the geomorphological ideas he investigates, and the result is a book of wider interest than the title suggests. Anyone concerned with the development of the earth sciences will want to read this engagingly written and carefully documented work. Some of its propositions may be open to question, but its stimulating qualities will not be mistaken for impediments to further research.

The chronological limits set for this investigation are defined by William Bourne's *Booke Called the Treasure for Traveilers* (1578), which sought natural causes of relief features and assigned a role to erosive denudation in the shaping of topography, and the triumph of fluvialism (reference to rain and river action for the origin of most landforms) in the work of Archibald Geikie, together with its popularization in T. H. Huxley's *Physiography: An Introduction to the Study of Nature* (1877). Within these limits Davies sets forth an account of successive British ideas on the origins of landforms, providing full discussions of Burnet, Woodward, Hooke, Ray, Hutton, Lyell, Agassiz, Ramsay, Jukes, and Geikie, among many others. He acknowledges the significance of non-British scholars to the field, but considers the work of foreign scientists "only if, as in the cases of Steno and Werner, their studies left a clear mark upon thought within the British Isles" (p. ix).

Davies sees the development of British geomorphic thought in cyclic terms, and has organized his book around periods of waxing and waning interest and accomplishment in the field. The cyclicity discerned by Davies will seem less than remarkable to most historians of science, who are by now accustomed to unequal rates of change and to varying stages of growth in science. The cyclic thesis is useful, however, in drawing attention to Davies's treatment of geological science in the late 18th century as largely a revival of themes developed during the 17th century, rather than as a totally new departure. Hooke's contributions to geomorphic thought are properly emphasized, even if this is perhaps carried too far in the assertion of the near-identity of Hooke's views with Hutton's (p. 91).

Davies is at his best in outlining the fashion in which solutions to geomorphological problems have often come from outside the apparent boundaries of the discipline. An outstanding example is his discussion of the glacial theory as the key to the rise of fluvialist geomorphology, chiefly through the successful explanation of lake basins as having been produced by glaciers, which removed the incriminating "limnological objection" to fluvialism. Another instance is the skillful historical analysis of changing British attitudes toward the significance of denudation and the relations of these attitudes to theological ideas and concepts of nature's purposefulness to man.

As long as the world's history seemed brief, and destined for an imminent Christian termination, it hardly mattered if the denudation process appeared to lead toward an uninhabitable world. With shifting religious opinion toward the end of the 17th century, however, the emerging conception of a benign Deity in place of a wrathful God led to growing emphasis on the material Creation as splendidly useful and esthetically pleasing to man, at the expense of the view of man's world as a decadent ruin befitting mankind's corresponding estate. The evident denudational destruction of divinely created topographic features, enormously enlarged as concepts of geologic time expanded, now assumed a paradoxical status, referred to by Davies as the "denudation dilemma," a development that called the reality of the denudation process into question. As Davies shows, the historic solution to this dilemma lay in Hutton's *Theory of the Earth*, which couples denudation with a vision of the processes of sedimentation and earth-movement so that the earth's habitability is continually (and providentially) assured.

An impressive feature of this book is Davies's balanced fulfillment of the research and expository tasks he set for himself. He provides both a comprehensive survey of his subject and a number of novel suggestions for historical interpretation. Throughout he achieves a steady clarity that will please the general reader without sacrificing too much technical discussion. A glossary is provided for those who are unfamiliar with geomorphic terms, although the absence of definitions for certain key words (such as fluvialism and denudation) is regrettable.

A notable drawback to Davies's work is his incomplete renunciation of com-

mitment to the geomorphology he knows and trusts. There are recurrent references to the "true nature" of landforms and their causes. Although Davies struggles valiantly to depict thinkers of the past on their own terms, the story he tells is heavily marked as a pathway to the present. Most readers will not be distracted by this, for the more blatant forms of historical intolerance (such as Davies's reluctance to believe that Buckland accepted some of his own arguments because they were so ridiculous [p. 207]) are rare.

More subtle expressions of historical terminalism do intrude, however. Although a major theme in this book must necessarily be a search for a balanced understanding of views foreign to most of us regarding the relations of science and religion, a lack of sympathy with the tenability of such views is demonstrated in excessive use of the term "bibliolatry." The prominence of certain normative terms in Davies's lexicon leads one to suspect that he has not thoroughly digested the lesson, so well taught by the history of science, that the theoretical requirements imposed by one set of principles necessarily represent inhibitions of others.

Another observation that can be made about *The Earth in Decay* probably applies equally well to contemporary geological science as a whole. Both display an emphasis on the supreme importance of fieldwork that one is tempted to regard as justified as much by sacred tradition as by the genuine and permanent necessities of the science. One of the results of this emphasis in Davies's account is a curious tone of apology for the great theoretical leaps of a Hutton or an Agassiz, as though these leaps were somehow the less legitimate for their authors' shortcomings at times in field observation. (Hutton went out to inspect geological evidence seldom, and for the most part only in the wake of his main theoretical formulations, although with great success when he did, and Agassiz willingly set forth his ice age theory before acquiring more than a modicum of supporting evidence.) Undoubtedly some of the theoretical baggage of distinguished figures in the history of geological thought would be embarrassing to most modern scientists —Davies views Hutton's deistic and teleological commitments with some disapproval—but how can one regard such baggage as anything other than essential to the theoretical achievements of its bearers? Davies's inclination to diminish the significance of Hutton seems to me to proceed wrongly from his distaste for the metaphysical bases of Hutton's theories.

Possibly a day is coming when the historical sciences will display a more candid awareness of the theoretical foundations upon which their empirical methodologies rest. That day, if it arrives, will probably bring with it a historical understanding of the development of geomorphology that will have superseded Davies's book. In the meantime, *The Earth in Decay* stands as a work from which we can greatly profit.

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Survey of a Continent

The Geology of Western Europe. M. G. RUTTEN. Elsevier, New York, 1969. xviii, 522 pp., illus. $22.50.

In 1957–58 the author of this weighty volume—almost five pounds of book —discovered, in conducting a course on the geology of Western Europe as a visiting professor at the University of Michigan, "how scattered the literature on European geology is, and how strong, moreover, is the influence of the language barrier." Motivated by the desire to remove these obstacles for English-speaking students and colleagues and to enable geologists in the New World to become familiar with the outlook of European geologists, Rutten undertook to produce this compendium. He completed it in 1966.

As Rutten observes, "the days of E. Suess, in which a single geologist could write about *Das Antlitz der Erde* (3 vols., 1885, 1888, 1901) are over." It is no wonder that Rutten has limited his study to certain regions and problems. Iceland has been omitted because it belongs geologically to the Atlantic Ocean and the British Isles are excluded "because there exist so many reviews and guide books in English that it seemed unnecessary to rehash this information."

Rutten has something to report on most other regions of Western Europe. The discussions vary widely in length, the variations at least for some regions certainly reflecting the amount of attention given them by geologists. Nearly half the book deals with Alpine Europe. A sizable part is concerned with Hercynian Europe. Scandinavia receives a modest treatment. Rutten excuses himself from a long discussion of the lowlands and low plateaus, since "these regions have received so much interest from stratigraphers, that there are now several general accounts," including those by Gignoux, Brinkmann, and in the *Lexique Stratigraphique International.*

Tectonics and sedimentology are the subjects that come to the fore in the succession of regional summaries, with stratigraphy supplying supporting information. In conclusion of his round of discussions, Rutten presents a survey of the Cenozoic volcanics. The thumbnail sketches of different occurrences may seem too brief, but perhaps they are intended to stimulate readers to delve into the original literature.

Rutten's work is as much a study in documentation and communication as a compendium of geologic information. Surveying his references, we find that he offers almost 1000 titles in the lists that come at the end of the chapters. There are repetitions, but the net must still attest to a very intensive study of the literature. Rutten gives consideration to older key publications, but his references date preponderantly from the last two decades. Of the references cited, 39 percent are written in French, 32 percent in German, and 24 percent in English. The remaining 5 percent are mainly in Italian and Spanish. Quite naturally the predominant language of literature on the Ardennes, the Armorican Massif, the Massif Central, the French Alps, the Jura, and Lower Provence is French. Similarly, literature on the Rheinisches Schiefergebirge, the Swiss Alps, and the Austrian Alps is mainly in German. The surprisingly high percentage of English titles indicates the growing acquiescence of Western European scientists to the unwillingness of English-speaking people to cope with foreign languages.

The "scattering" of literature that Rutten found to be an obstacle to its use by Americans must refer both to the multiplicity of sources and to the difficulty of access to them. On the whole the sources, regardless of number, are not obscure. That they are lacking in many libraries in English-speaking countries is a greater problem.

At the end of the book, Rutten supplies a catalog of sources of geologic information on Western European countries. Unfortunately this catalog is marked by errors and omissions. For