The Development of Geomorphology

The Biblical account of creation implies that the earth's surface was shaped by a supernatural hand, instantly, a few thousand years ago. According to this view, mountains and valleys and plains could be described, and enjoyed in an esthetic sense, but not understood; if landscapes had any meaning at all, it was only as manifestations of the "glory of God." It is a long way from that concept, which prevailed in the Western world until the latter half of the 18th century, to the present view that most of the topographic features of our environment were formed by erosion during spans of time measured in millions of years. This book, volume 1 of **The History of the Study of Landforms** (Methuen, London; Wiley, New York, 1964. 694 pp. Illus. $13.50), by Richard J. Chorley, Antony J. Dunn, and Robert P. Beckinsale, is the first of three volumes which will review and analyze the development of the study of landforms, from the dim beginnings of such study to the statement of the concept of the erosion cycle, made by W. M. Davis in 1889; the title of volume 1 is *Geomorphology before Davis*.

Part 1 (of the four parts into which volume 1 is divided) centers around the statement made in 1788 by James Hutton, the Scottish gentleman-farmer and naturalist, of what was then a radically new principle: that the physical features of the world around us were formed by the operation of processes presently in operation. This principle—"uniformitarianism"—is basic to nearly all geologic investigation; with respect to landforms it means, for example, that most valleys were excavated by the rivers that flow in them. The alternative explanation, for those who felt a need for any explanation at all, was that valleys were fissures opened by paroxysmal upheavals of the crust, or gashes cut by such catastrophic events as great floods, the last of which was the Noachian Deluge. It might seem, in retrospect, that the uniformitarian principle, based on straightforward observation and reasoning, should have prevailed, but this was not the case. The climate of opinion was dominated by a literal interpretation of the Old Testament; there simply was not enough time since B.C. 4004 (the date of origin of the earth, as it was calculated by Bishop Ussher) for the shaping of topographic features by the slow operation of present processes. The arguments advanced by Hutton and his few associates caused only some cracks in the massive wall of prejudice that stood in the way of any rational approach to nature.

During the period 1820 to 1875, which is treated in parts 2 and 3 of volume 1, uniformitarianism gradually replaced catastrophism in the interpretation of rocks, fossils, and geologic structures. Progress in the understanding of landforms lagged behind, chiefly because in Great Britain and Northern Europe, the very region where geomorphology had its birth, most topographic detail was *not* produced by processes now in operation; deposits of river gravel on divides and large angular blocks of foreign rock scattered at random over the countryside indicated an event altogether different in kind from anything in the experience of most observers. The breakthrough was started in the early 1840's when Louis Agassiz combined his own observations made around the margins of glaciers in the Alps with those of earlier Swiss and French naturalists in the bold idea that Great Britain and Northern Europe had been covered by a glacier of continental proportions in the recent past. To many geologists, and probably to all theologians, this theory was at the outset much less plausible than the "Deluge" as an explanation of the disordered superficial mantle; it gained ground steadily through the latter part of the 19th century because it passed every test of logical inference and directed field observation. Toward the end of the period there were still some pockets of resistance, but the basic proposition that the principle of uniformitarianism could be applied to study of landforms had been firmly established.

Part 4, "The Western Explorations," shifts the focus to the United States; the advances in geomorphology made by geologists attached to federal surveys of the West during the decades following the Civil War were so far-reaching that this branch of geology, more than any other, is generally regarded as largely American in origin. It in no way detracts from the achievements of these men to note that an understanding of fluvial landforms came easy to them. In the absence of the confusing effects of glaciation in the Colorado Plateau, for example, there was no inclination to think of a deluge or other catastrophic event; it was almost self-evident to the explorers, who were aware of the European controversy regarding the origin of valleys, that the Colorado River was fully capable of cutting its Grand Canyon. The regional geologic relations made it certain, moreover, that thousands of feet of strata had been removed above the Canyon rim, and there was no real question about how the removal was accomplished—it was only necessary to look to the north to see spectacular escarpments, consisting of the rock layers that had covered the Grand Canyon area, now being eroded back by the sluicing action of torrential rains.

It was only a short step from this grasp of the magnitude of past erosion to the idea that, if the crust of the earth were to stand still long enough, the same processes could reduce the high-standing Colorado Plateau to a plain of low relief near sea level. From this idea a fruitful generalization began to take form—that most of the widely varied landscapes of the West make sense, simply as representatives of different stages of advancement in the erosional lowering of areas elevated by crustal movements to different heights at different times. The study of landforms, so completely dependent on geology to this point, could now begin to make some return contributions—parts of the geologic history of an area could be read from its landforms. It remained for Davis, the synthesizer, to bring together these gains in a series of papers which he began to publish in 1894, papers that established geomorphology as a special field of study.

Like most teachers in that field, I have long wanted an account of the history of geomorphology for use as collateral reading in graduate courses. But the book under review is *thick*; if the two volumes yet to come are of equal length the series will include

about 2000 pages. Because assignments must be reasonable, the book (or the series) presents a length problem which has several aspects, most of which are easily understood and readily solved:

Nearly one-third of the volume is direct quotations. The text commonly introduces each quotation by a succinct statement that places its message in historical perspective; the original author then speaks for himself. This plan of presentation involves a certain amount of space-consuming repetition, but space as such is inconsequential—the device actually saves time. The reader can grasp the development of concepts that are peripheral to his interests from the text alone, but is provided with well-selected samples of source material in matters with which he may be concerned.

About one-quarter of the book deals with geologic topics that have no direct bearing on the evolution of the study of landforms; the Neptunist-Plutonist controversy, for example, and the discussions of early developments in cosmology and stratigraphic and structural geology, per se, are in this category. These matters are treated much more fully in several standard histories of geology, and they are (or should be) familiar to geomorphologists at the graduate student and professional levels in this country, where geomorphology is a branch of geology. The reason for their inclusion is probably that the book is directed primarily to students in Great Britain and on the Continent, where geomorphology is commonly treated as a branch of geography—all three authors teach in geography departments in England. There is no question but that the geologic background material given is essential to any understanding of the development of geomorphology and is, therefore, quite in order in a geographically oriented book.

Representative of a third category of material which is not strictly relevant to the business at hand is a 31-page chapter on the life of John Wesley Powell, chiefly on his boat trip through the gorges of the Colorado River. Powell's scientific work is treated elsewhere in the text. The canyon trip is high adventure, and the chapter is exciting reading; it is simply not the kind of reading suggested by the title of the book.

The value of the book as a reference work is greatly enhanced by the "Informative Index" which includes an estimated 3000 items. The remarkably complete topical references provide a convenient means of following the development of thought regarding specific landforms, processes, and ideas prior to 1890; for example, there are 12 references to river terraces, 15 to marine planation, and 23 to uniformitarianism. This means that there is no longer any excuse for publishing as new discoveries matters that were first stated prior to 1890, or for the venial sin of crediting points to people who had failed to give credit to the original author. Many geomorphologists are apt to be embarrassed, as I was, on one or both of these scores in the course of reading the book.

The authors seem to be of two or three minds regarding W. M. Davis. In the index he is "an American geomorphic genius" and on page 4 "a great figure . . . worthy of a place with Hutton." But on the same page we learn that "it would be hard to imagine a more stultifying situation" for a young science than that brought about by the Davisian generalizations; these generalizations are said to have "lulled the geomorphological world into a . . . slumber" from which it is only now awakening. On page 621 Davis' work is regarded as "the mainspring of half a century of research" but that research was, in the authors' view, kept at the level of a "pseudo-science" (p. xi) chiefly because the importance of the quantitative approach was obscured by a qualitative veil which he "threw over geomorphology" (p. 603). In the comments (p. 624) on his near-dismissal from Harvard (at age 32) for poor teaching, the denigration reaches a fervor and rhetorical quality that is almost Russian:

> If Davis was criticized for his poor lecturing ability, this was certainly a gross miscalculation of his ultimate potential; however, if he had been threatened with dismissal because of his lack of fundamental research, some unkind geomorphologists might credit the Harvard President with greater insight than was to be vouchsafed to students of geomorphology for at least another half century!

Perhaps because I happen to be the present chairman of the Davis Protective Association, this seems a little harsh, but before taking up my cudgel I will await the more complete evaluation of his work which is promised for volume 2. In the meantime volume 1 is the most useful and, in one way or another, the most stimulating book on my shelf.

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Intelligent Extraterrestrial Life

We Are Not Alone: The Search for Intelligent Life on Other Worlds. Walter Sullivan. McGraw-Hill, New York, 1964. xii + 325 pp. Illus. $6.95.

This serious attempt to treat a most challenging and interesting subject, the search for intelligent life on other worlds, is marred by the use of some very sloppy physics and astronomy. Extrapolation to chemistry and biology, subjects in which I am not particularly versed, would leave very little to recommend this book. And just those people who should not be given erroneous science are the ones who will read *We Are Not Alone*, mainly because it does not rely on an elaborate physical superstructure and its attendant mathematical tools. It is a pity, because with a little additional work the author could have cleared up the mistakes and still have avoided the use of mathematics. The use of ambiguous and trite words may be fashionable, but to say that a planet "flys" its orbit definitely does not appeal to me. A very large part of the book is devoted to discussion of all aspects of Mars, but E. C. Slipher's monumental life work is not mentioned, although many lesser studies are cited.

In the first part of the book the author thoroughly confuses focal length and focal ratio. One gets the impression that the focal length of the 200-inch Hale telescope is less than that of the Sproul 24-inch refractor, whereas in fact, even at the prime focus, it is already 50 percent larger than the Sproul telescope. Later on there is a completely incorrect statement about the origin of the 1420MHz (21-cm) line of hydrogen. There is also the implication that Bode's relation is a physical law.

In discussing the detection of extrasolar-system planets, much emphasis is placed on the use of nonlinear proper motions. But Sullivan fails to point out that the detectibility of "wiggles" is inversely proportional to the distance, and thus the method fails at those distances where he seems convinced that another civilization is most likely to be found. He does find the occulting disk technique of merit, but does not mention the simpler apodized mirror techniques. The photoelectric method is mentioned in one sentence.

The photoelectric method really deserves more attention, for it is not as