natural unit) it follows that no system has exclusive merit. Thus, various schools of classification have arisen which at times have engaged in bitter and polemic controversy over the relative merits of their systems. Although the controversy has largely faded, the traditions have not, and about half the book is given over to fairly detailed descriptions of the six or seven classification systems still used most widely. Some of the systems have rather wide use, while others have become entrenched among plant scientists in local areas. A few of these scientists, such as the European advocates of the Braun-Blanquet system, seek to promote wider use of their methods.

Without elaborating further on specific classification systems, it is apparent that the more information one has about nature the greater the degree to which it can be subdivided. Those classification systems that emphasize thorough familiarity with the flora, for example, categorize vegetation to an extent impossible for ecologists who have had a more cursory taxonomic background. Because ecology in the United States grew out of the dynamic community approach of F. E. Clements, the emphasis here has been placed on pattern and process and much less on species composition. It is unlikely that amalgamation of these very different approaches to classification will occur soon.

In his characteristically rational approach to such problems, David Goodall suggests that the use of numerical methods, such as those developed in modern taxonomy, would provide an objective and uniform method for classification. He may be correct in this view, but the adoption of such methods in community classification is probably even less likely than has been the abandonment of more traditional approaches to taxonomy.

If communities intergrade with each other, that is, if vegetation is continuous, why is classification necessary or desirable? The answer to this concern is, of course, that communities are continuous in an abstract but rarely in a concrete sense. Environment often changes along steep gradients, and disturbance frequently interrupts continuous vegetation patterns, both of which give the illusion of discontinuity. Furthermore, the interaction between two species sometimes results in sharp boundaries which may be accentuated if one species is conspicuous relative to the other. In a remarkable show of accommodation, most of the authors seem to agree that elements of both continuity and discontinuity are present in communities, that both species individuality and species groupings are realistic, and that both gradient analysis and classification are possible. Westhoff and Maarel conclude that "the difference between less extreme students of gradient analysis and that of the Braun-Blanquet approach [is] one of emphasis and perspective, not one of fact or understanding."

Not all ecologists will agree with the views presented in this book, and many will point out that ordination and classification are considerably behind the cutting edge of modern community studies. Nonetheless, this volume is valuable both as a historical summary of the development of two techniques used in the study of vegetation and, as was intended, as a handbook of the techniques themselves. In both respects, the book is successful.

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Geological Testing Ground

The Western Pacific. Island Arcs, Marginal Seas, Geochemistry. Proceedings of a congress, Canberra, Australia, Aug. 1971. PATRICK J. COLEMAN, Ed. Crane, Russak, New York, and University of Western Australia Press, Nedlands, 1973. xviii, 676 pp., illus. $44.

Upon his return from a lengthy geologic study of the western Pacific, an associate lamented to me that he had not learned much geology—he had, he explained, spent "too much time trying to learn the geography of this bloody region." Truly bewildering in complexity, the subaerial and submarine features of the western Pacific form a geomorphic maze that would snare Godzilla. This vast area of the globe is an extremely important one to most geologists, because it is here that the quasimythical geosyncline is thought to exist. Because geosynclinal rocks form a major part of the very stuff of the earth's crust, the western Pacific is a fundamental testing ground for geotectonic theory—if it fails here, the idea decays to rhetoric.

Realizing that the current pandemonium of plate, or, if you will, global tectonic thinking was revolutionizing the geotectonic roles that many geologists had assigned to island arcs and their companioning trenches and marginal seas, and that the western Pacific is constructed chiefly of these geomorphic elements, Coleman saw that a collection of modern papers on this area was needed. In part because the champions of geotectonic concepts are irrepressible, and in part because the western Pacific is a paradise of structural and magmatic complexities, it is not difficult to induce geologists to write about this area, whether they are burdened with new information to dispense or not.

In *The Western Pacific: Island Arcs, Marginal Seas, Geochemistry* Coleman has brought together a set of papers that originally, in one form or another, were presented at the 12th Pacific Science Congress in 1971. From Macquarie Island northward to Kamchatka, the contributors describe the structural, magmatic, and tectonic complexities of the western Pacific in varying detail, indulging themselves by either dabbling into or pontificating about underlying causes. A little more editorial screening would have been appreciated, but the book as a whole is a timely collage of the wide-flung geoscientific thinking that is being applied to the western Pacific.

The four dozen papers and abstracts in *The Western Pacific* are organized into four groups: Features of the Pacific Ocean Basin; Island Arcs and Related Structures of the Western Pacific Region; Marginal Areas of the Western Pacific; and Petrology and Geochemistry of Island Arcs in Relation to Tectonic Environment. The first group is a potpourri of papers and abstracts, some of them bearing only obliquely on the western Pacific, that deal with subjects as diverse as "meso-features" (whatever they are) of the Pacific sea floor and the effects on everything of an expanding earth. The 18 papers that are included in the second group make up the bulk (257 pages) of the

volume. Coleman divides them into three subgroups, those concerned principally with the southwestern Pacific (Melanesia), those concerned with the northwestern Pacific (Taiwan to Kamchatka, but also the Philippines and Indonesia), and papers on aspects of general tectonics, which perhaps should have been gathered with others of like purpose and set aside as a group of their own.

The marginal areas papers consider the structural development of the western Pacific that involves, in some manner, a continental margin. Discussed in this section is the crustal evolution of the northwest Pacific mobil belt, the Sea of Japan, and the entire plexus of island arcs, rear-arc ridges and swales, and marginal seas of the southwest Pacific. But equivalent papers describing other "marginal" areas (the Philippines, Japan, Indonesia) are housed in other parts of the volume, a reflection, I presume, of the organizational format of the congress.

The petrology and geochemistry papers turn mostly to the problem of the genesis of the voluminous volcanic rocks that form the bulk of the island arcs and the crust of the marginal seas of the western Pacific. Work in this field is moving ahead so rapidly that I was surprised that the dozen papers included are not only still current but still reflect frontier thinking.

I suspect that many readers will find, as I did, that this organizational scheme, although certainly adequate and useful, is a difficult one to use if you are interested in regional problems. Papers treating the geologic evolution of Japan and papers on the adjacent Sea of Japan and Japan Trench are widely separated, and regional information bearing on many of the other areas of the western Pacific is similarly dispersed, a pattern that is perhaps most frustrating to sea floor spreaders, who like to think that the geologic histories of associated trenches, island arcs, and marginal seas are inseparable. A further frustration for the regionally minded reader is the inadequate designation of geographic elements and important geologic features on the illustrations provided by some of the authors. Gervasio's interesting paper on the geotectonic history of the Philippines is rife with unidentified islands and geographic locations. Similarly, Khain and Seslavinsky's rendition of the geologic evolution of the northwestern sector of the so-called Pacific mobil belt is muted by the use of overcomplicated diagrams that provide few keys to the many geographic features called out in the text. Gnibidenko's equally comprehensive treatment of this same area is without the benefit of a single illustration.

The reader searching for papers with a broad overview will find them also dispersed. There are four principal papers of this nature: Pushcharovsky's almost reactionary views on the tectonics of the Pacific, the short plea of Carey for a proper consideration of his expanding earth hypothesis, Karig's largely conceptual comparison of the arcs and marginal basins of the western Pacific, and the elegantly expressed views of Dickinson on the reconstruction of past arc-trench systems for this same area. A number of other papers have exceptional scope and, although regionally somewhat more limited than these four, when read as a group provide great insight into the formative history of the western Pacific. My favorites of these include Avias's paper on the inner Melanesian arcs; the admittedly speculative views of Packham on both the inner and outer Melanesian arcs and their intervening basins; Katili's molding and stretching of the Indonesian arcs into the geometry of plate tectonics; and the account by Gnibidenko of the geosynclinal history of the Kuril–Kamchatka–Bering Sea Region (his paper should be compared with that of Khain and Seslavinsky, who advocate an opposing view).

The major geomorphic elements of the western Pacific, that is, trenches, arcs or ridges, and marginal or inner-arc seas, are not treated equally. This is not surprising considering the vastness of the area and the relatively few geoscientists investigating its diverse parts. Modern trenches, for example, are virtually ignored. Many of the contributors expound on the disposition of ancient trench deposits, however. Bogdanov devotes his entire paper to the argument that the wreckages of late Paleozoic through Cretaceous trench sequences are preserved in his "thalassogeosyncline." Dickinson finds them in mélange zones of terrigenous debris and shredded ophiolite sequences, and Katili, following this view, identifies similar trench complexes in Indonesia. The ability of these authors to recognize ancient trench sequences is intriguing because trenches of the western Pacific are characteristically devoid of terrigenous sedimentary debris with which to make comparisons. In loyal opposition, one of the few iconoclasts to speak up forcefully is Kimura, whose regional analysis of the geosynclinal complexes of Japan prompts him to witness that the hypotheses "that geosynclines are deep sea trenches, or that the strata of eugeosynclines have been carried into the subduction zone by the movements of the oceanic plate, are not true as tested against Japanese geology."

The reader desiring geologic information on specific island arcs will be greatly pleased with the quantity of excellent papers in this category. From New Zealand northward through the Tonga, Fiji, New Hebrides, and Solomon islands to Papua, New Guinea, and thence back to the south via New Caledonia and the Norfolk Ridge, the coverage is very good. Most of these contributions are assembled in the island arcs group, but a number of highly informative ones on the genesis of the volcanic and plutonic rocks of these arcs are in the petrology and geochemistry group. The number of papers falls off drastically in the Moluccas and Indonesian area (Katili), the Philippines (Gervasio), and the Ryukyus (Meng), although these papers are, in general, exceptionally informative if the broad brush is appreciated. The geology of Japan is described only once, but very effectively, by Kimura. Discussion of the Yap, Palau, and Mariana-Izu arcs is submerged in the broad-overview papers. There are five papers on the Kuril-Kamchatka area, but only three of these, by Markov and Khotin, Fedotov, and Peive and Markov, provide much in the way of specific geologic information. With the exception of Fedotov's paper on the teleseismically deduced structure of the upper mantle, these Soviet contributions are absorbed in the complex geophilosophies that hover about concepts of marginal tectonics, continental accretion, and geosynclines.

As Coleman notes in his perceptive and highly readable foreword, few of the distinguished savants, save perhaps Karig, provide anything close to a comprehensive discussion of the marginal oceanic basins of the western Pacific. Marginal seas (including inner-arc basins), much more than trenches and island arcs, are to many geologists what geosynclines are supposed to look like. Only Hilde and Wageman provide new findings, chiefly seismic reflection profiles, about one of these basins, the Sea of Japan. They reiterate a popular argument that this basin formed in response to a substantial amount of sea

floor spreading. Those with a measure of skepticism will find it difficult to see how their reflection profiles unequivocally bolster this concept, however.

As Coleman correctly declares, the value of this volume lies not only in the collection of contemporary papers it houses on perhaps the most geologically significant area of our globe, but also in the battleground it provides for rival geotectonic theories. The conflict centers about the essential processes involved in the creation of crustal and upper mantle masses. Are they associated with lateral shifts of great and small lithospheric plates constructed at oceanic ridges, as in the global plate tectonic or sea floor spreading view, or with in situ vertical transitions that are manifestations of upper mantle and crustal changes, as in the "fixist" or classical geosynclinalist view? Or—a possible way around these proposals—are the processes related to the expanding earth championed by Carey? Carey, for reasons unknown to me, refuses to fully draw his sword, as he only presents an abstract of his views. Thus, in this volume, the fascinating concept of an expanding earth is quickly retired by its own general.

In contrast, Pushcharovsky, a firm fixist, confronts the "mobilists," the defenders of the global tectonics camp, along a broad front. To a man, the mobilists virtually ignore this challenge and the mostly unstated but implied ones by several of Pushcharovsky's Soviet colleagues. I suspect that the answering silence of the spreaders is simply a measure of their lack of interest in attacking older concepts that seem to systematically ill-treat or ignore those newer findings in marine geology and geophysics, seismology, and igneous petrology and geochemistry that laid the cornerstones for the present wide acceptance of sea floor spreading and global plate tectonics. It is significant that aspects, if not the totality, of sea floor spreading models are endorsed by Gorshov to concoct the eruptive magmas of the Kuril arc and by Fedotov to account for its seismicity.

Although the mobilists are in general agreement among themselves, the fixists are divided into two factions according to whether continentalization or oceanization is regarded as the essential process in the fabrication of crustal rocks. Gnibidenko explains the essence of these hypotheses and how they dominate Soviet thinking about the crustal evolution of the Pacific basin and its perimeter (the cynical reader will smile when he reads the footnote attached to his article). Dickinson best relates how the mechanical, magmatic, and depositional consequence of moving lithospheric plates dominates Occidental and Austral thinking about these same problems. For those who are not steeped in the jargon of the mobilist, I suggest a prior reading of Gill and Gorton's paper on the crustal evolution of eastern Melanesia.

This volume is indispensable for all serious students of the Pacific basin, especially those who have a special interest in its western periphery. For those who simply wish to enhance and update their comprehension of island-arc geology, or who thirst to read about plate tectonics in action, a reading of the book will be greatly rewarding.

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A View of the Uniformity Principle

The Nature of the Stratigraphical Record. DEREK V. AGER. Halsted (Wiley), New York, 1973. xiv, 114 pp., illus. + plates. $9.50.

Stratigraphy deals with description and interpretation of stratified rocks, and the stratigraphic record, although a fraction of the earth's bulk, is the repository of much of earth history. How that record is read depends upon the stratigrapher, the rocks and fossils with which he is familiar, his breadth of experience, and the stratigraphic philosophy that guided his training. Commonly, we are so immersed in the details of local problems that we do not take time to examine the premises upon which our solutions are based. Consequently it is appropriate to step back occasionally for a broader view of the stratigraphic record and of the means we use to interpret it.

Ager's book is not a stratigraphic treatise, for, despite its promising title, it deals with only selected aspects of the stratigraphic record. In fact, the book is a collection of eight short essays that deal with the persistence of certain facies; the fallibility of the fossil record; stratigraphic gaps; the catastrophic nature of the stratigraphic record and uniformitarianism; the relative independence of sedimentation and subsidence; the "golden spike principle"; and the phenomena controlling accumulation of the record itself. Appropriately, examples are drawn from Ager's experience and, although identifying himself modestly as a nonstratigrapher, he justifies his stratigraphic comments immodestly by noting that "the noncombatant usually has a clearer picture of the battle than the soldiers actually engaged in the fighting."

In his first essay, Ager comments on the wide and essentially synchronous distribution of distinctive lithic facies such as the Cretaceous chalk, the Germanic Trias, the Upper Carboniferous coal measures, and the Old Red Sandstone of Devonian age. Although it might have been appropriate to note that most of these facies are also widespread at other stratigraphic levels, the conclusion that "at certain times in earth history particular types of sedimentary environments were prevalent over vast areas of the earth's surface" is agreeable, if somewhat anticlimactic.

Ager brings greater expertise to an essay that deals with biologic aspects of the stratigraphic record. He notes the ubiquity of certain fossils and the widespread congruence between fossils and lithic facies; comments on inadequacies of reconstructed faunal provinces; considers favorably the "punctuated equilibria" evolutionary model of Gould; and discusses sudden or mass extinctions. Observations on these subjects lead to the catchy, but curious, conclusion that "paleontologists cannot live by uniformitarianism alone." Aspersions are also cast on the uniformity principle at other places, but Ager nowhere says what he understands that principle to be. One gathers, however, that he understands uniformitarianism to imply not only that processes that acted on the earth and its biosphere in the past are the same that operate today, but that they have always operated at the same rate and on the same scale. Presumably, mass extinctions, periods of apparently accelerated organic evolution, turbidity flows, and the widespread accumulation of Pleistocene glacier ice can be regarded as catastrophic and nonuniformitarian because they imply rates of development or scales of coverage different from those affected by the same processes today. It is doubtful, however, that many geologists share Ager's limiting view of uniformitarianism, particularly because of the extensive airing that principle has had