Whereas deep drilling is an expensive operation, requiring elaborate equipment, specialists, and techniques to handle the quantities and diversity of materials and data acquired, scuba is an inexpensive tool. It has been used widely in reef studies about the world for the past 15 years or so, yielding information on submarine terraces, which for the most part represent Pleistocene stillstands of sea level. Unfortunately scuba divers studying reef zonation in the Indian Ocean apparently have not looked into this aspect of the overall problem.

Stoddard has carefully laid out the distribution of sea-level and elevated reefs on the one hand and rainfall on the other. If one overlays the two maps it will be observed that areas of elevated reefs in good part correlate with low rainfall. G. E. Hutchinson (1950), in *The Biochemistry of Vertebrate Excretion*, noted a comparable correlation with respect to guano deposits, especially on small elevated islands in the equatorial Pacific, explaining the distribution of the deposits on the basis of rainfall patterns (differential rates of subaerial erosion). One wonders if the same explanation might not apply in the Indian Ocean.

Studies of the physiology and energetics of corals, for the most part begun under the leadership of C. M. Yonge (the Great Barrier Reef Expedition, 1928–1929), have not been carried out in the Indian Ocean.

The "mare incognitum" of Wells (1957), ranging from the sea surface down the seaward slope to around 17 meters, has become much better known in recent years. Quantitative investigations of coral communities, begun by Mayor in 1924, have made significant strides over the past few decades. Though Stoddart (1969) views prior quantitative work as contributing little to our knowledge of reef communities beyond that obtained from qualitative studies, the quantitative data such studies do contain actually afford a better understanding of the structure of these communities. However, the focus of nearly all quantitative and qualitative coral reef studies, to date, has been on the zonation patterns of the corals themselves.

It is somewhat disappointing therefore that, instead of seeking details of the organization of reef communities, the studies presented in this volume have sought primarily to redemonstrate coral reef zonation. Ecological aspects of zonation receive short shrift in most studies, and the element of time is completely ignored. However, the use in other studies of general features of reefs and their biotas, which are believed to result from various environmental factors, is a helpful means of presenting zonation. Sampling schemes continue to lack both the desired mechanical randomization and necessary extent for statistical treatment and generalization. The use of sociological associations as a means of determining community structure is encouraging, but perhaps more meaningful would be groupings based on such procedures as recurrent-group or principal-component analyses.

Particularly noteworthy among the papers presented are the attempts to quantitatively determine appropriate-sized sampling units, efforts to ascertain the lateral extent of zonation patterns along a reef, and comparisons of the structural and environmental features of Indian Ocean reefs and the accompanying patterns of their flora and fauna with those of reefs in other seas. Inadequate presentation of data will be disconcerting to the reader, as will the lack of comparison of results with those of earlier quantitative studies.

Biological interactions have long been observed on reefs, but that corals were eaten to a significant degree only became apparent some ten years ago when it was observed that large aggregations of a starfish, *Acanthaster planci*, were devouring some 80 to 90 percent of the stony corals on certain islands of the Great Barrier Reef. This came as a surprise because only a few animals (including *Acanthaster*) were previously known to eat corals, concentrations of *Acanthaster* obviously overwhelming the carrying capacity of a reef had not been reported in the literature, and such biological imbalance was contrary to general ecological theory as regards the tropics. Tropical communities, by virtue of their diversity and the relative constancy of their environment, are considered to be relatively stable. Though reef communities were known to be dynamic, undergoing periods of growth and death, it had been thought that this was a successional response to physical rather than to biological perturbations.

The *Acanthaster* phenomenon, however, did not become of general ecological interest until a comparable outbreak was observed more recently on Guam. The overall problem was then widely publicized and a burst of scientific papers on the matter followed. In light of the apparent problem, information on an area as important as the Indian Ocean has been eagerly looked forward to. The one paper on *Acanthaster* appearing in this symposium provides new data, but falls a little short of the mark in interpretation. This is apparently because the authors, though they include data collected in the summer of 1970, were not aware of literature appearing early that year.

Not being up to date with respect to the literature is not a general shortcoming in this volume. All but two papers include 1970 citations, and about a quarter cite papers published elsewhere in 1971.

This volume is a timely and important contribution in this period of increasing awareness of environmental problems. The multiplicity of papers it contains indeed presents an excellent overview of regional variation in Indian Ocean coral reefs.

WILLIAM A. NEWMAN
THOMAS F. DANA
Scripps Institution of Oceanography, La Jolla, California

Small Island Ecosystem

Marion and Prince Edward Islands. Report on the South African Biological and Geological Expedition, 1965–1966. E. M. VAN ZINDEREN BAKKER, SR., J. M. WINTERBOTTOM, and R. A. DYER, Eds. Balkema, Cape Town, 1971. xii, 428 pp. + plates + maps. 22.50 rands.

Marion and Prince Edward islands are situated in the "Roaring Forties," just outside the Antarctic Convergence, near 47°S and 38°E, south and somewhat east of the Cape of Good Hope. They are within sight of each other on the infrequent clear days. As a result of the South African Biological and Geological Expedition and this report of its work these two bleak oceanic volcanoes, once very little known, are now among the better-understood small island ecosystems in the world.

Constantly wet, the rough volcanic surfaces of the islands are largely covered by bogs and mires. The volcanic activity ceased relatively recently, and the surface geomorphology is of rough lava flows, somewhat faulted and at higher elevations locally modified by late Pleistocene glaciation. As with all subantarctic islands, the biota is extremely limited. The vascular flora totals 36 species, of which 13 are aliens. Other groups both of plants and of animals are comparably restricted.

The expedition was of sufficient duration that, in spite of uncomfortable weather and extremely difficult terrain, Marion Island, at least, was investigated and studied in detail. Prince Edward was only visited relatively briefly. The book is evidence that afterward the investigators were able to devote the necessary time to working up their results to a point of definitive conclusions. It is an expedition report in the grand tradition, and it is published in a style appropriate to the enterprise.

Van Zinderen Bakker, leader of the expedition, in his introduction summarizes the history and geography of the islands and the results of the expedition, as well as the place of these islands in relation to the other islands of the subantarctic zone.

Climate, volcanology, vegetation, and birds, being among the most obvious and pervasive components of the island ecosystem, receive the most attention in the report, both in meticulous description and in interpretation. Palynological researches, the specialty of the leader, give a time dimension to the vegetation picture. A thorough study of the ecology of the birds and seals shows how their activities and excretory products mold the vegetation in certain areas. All of this, against the background of the geological and climatological investigations, yields an "in depth," functional description of this ecosystem that should be a model for such studies. The inherent simplicity of the system relative to most others of comparable size, of course, made this possible within the time and manpower limitations of the study. The last half of the book is composed largely of thorough and meticulous systematic studies that give a solid biological basis for the ecology and biogeography that are the permeating themes of the work.

Abundant tabular presentations make the data readily accessible and easily separable from the interpretation. A number of small sketch maps and diagrams are provided, as well as fine volcanological and topographic maps folded in a pocket at the end, and the abundant superb photographs bring the whole system visually to life for the reader. Best of all, the South African government in 1947–1948 declared these almost completely undisturbed islands a strict nature reserve and is maintaining them as such.

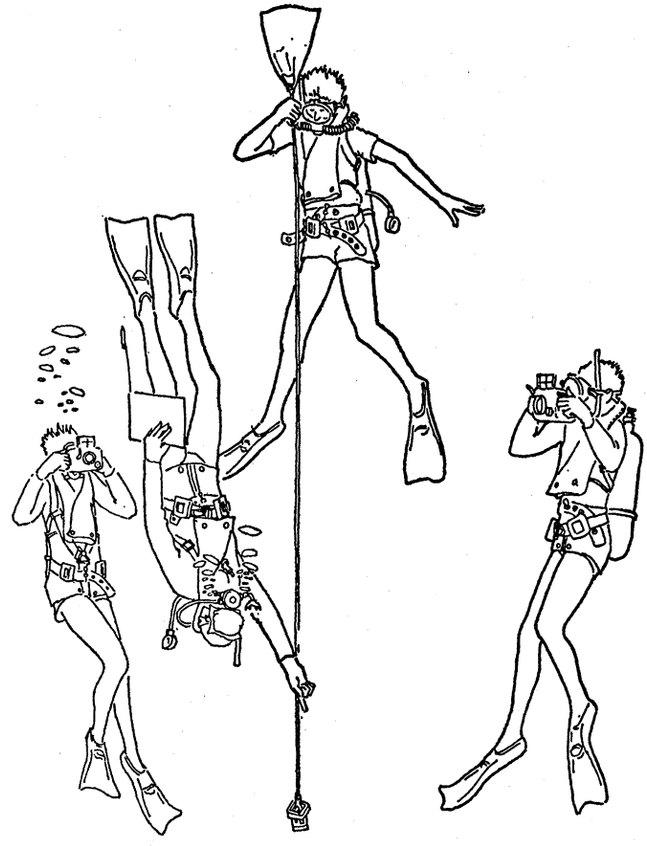
F. R. FOSBERG
National Museum of Natural History, Washington, D.C.

Scientific Diving

Underwater Science. An Introduction to Experiments by Divers. J. D. WOODS and J. N. LYTHGOE, Eds. Oxford University Press, New York, 1971. xiv, 330 pp., illus. \$13.

We have here the first book-length treatment known to this reviewer of the broad aspects of scientific underwater work. Approximately one-tenth of its some 300 pages deals with general techniques and equipment, one-third with the psychological and physiological responses of the diver, and the remainder with examples of methods and results drawn from geological, biological, archeological, and physical oceanographic studies. Though exotic gas mixtures, closed-circuit and hardhat diving, underwater habitats, and deep submersibles are touched on, the vast majority of the material pertains to diving using the standard equipment available within the budgets and abilities of most diving scientists, air tanks and open-circuit regulators.

Some 25 years have now passed since such equipment became available to scientists. The question then is not the purpose of this book's parturition, but rather why it has been so long in gestation. In the United States, and I suspect in Europe as well, the acceptance of diving as a legitimate scientific technique has come slowly. Perhaps the major reason for this is that early scientific diving was practiced mainly by students, and the results were primarily anecdotal and extremely hard to verify. (What major professor wants a student whose shoulder he can't look over now and then?) This book indicates the coming of age of scientific diving. The students are now the professors, and it must seem inconceivable



A study designed to test knowledge of the vertical under water. "One diver holds a plumb-line (out of sight of the subject) to indicate the vertical in the photographs. The subject turns a somersault, and then attempts to orientate himself to the vertical, pointing upwards or downwards. When he is in position, two photographs are taken simultaneously from the side and rear. For some trials the subject wears a blackout or semi-transparent screen over the face-mask. The order of the trials is written on a Formica board, carried by the subject." To complete the study "the angular deviation from the vertical was measured from the photographs, and the true (or maximum) deviation was calculated from the apparent deviations along the two lines of sight. The mean deviations for five divers of moderate experience ranged from 8° to 33°, depending upon the experimental condition." [From *Underwater Science*]