regarding science and technology with which the Soviet leaders are evidently most concerned." Both parts of the book are well up to date: it concentrates on developments since the major Communist party decree of 24 September 1968 on improving the efficiency of R & D, and takes the story up to May 1972.

Both in their selection of Soviet materials and in their own commentary, the authors correctly stress the tremendous emphasis now being placed by the Soviet authorities on the need for scientific and technological progress in the U.S.S.R. and on the difficulties of the traditional Soviet economic organization in coping with what the Russians officially describe as the "scientific-technological revolution." Other Western commentators, preoccupied with the political and intellectual conservatism of the Brezhnev period, have grossly underplayed this recurrent theme of Soviet official pronouncements, for example, in their accounts of the 24th party congress of April 1971. While total United States expenditure on R & D fell between 1968 and 1971, Soviet expenditure has continued to rise, both in absolute terms and as a proportion of national income. All estimates show that both the number of qualified scientists and engineers and the number of auxiliary personnel employed in R & D are substantially larger in the U.S.S.R. than in the United States.

The authors are, however, much too alarmed both about the Soviet pronouncements and about the continuing rise in R & D expenditure. They place too much stress (for example pp. 3–4) on ritual Soviet denials of any convergence between Soviet-type and Western economies, and on Soviet assertions that world communism remains their ultimate goal. Moreover, ambiguous or muted statements such as a warning by Brezhnev that weapons technology must not stagnate are reinterpreted to mean that "Moscow relentlessly seeks to attain on its own initiative not only quantitative but also qualitative advantage in its weapons system" (pp. 17, 24).

It must be frankly stated that in their handling of Soviet R & D expenditure and manpower statistics the authors are not sufficiently competent. Thus they present *total* Soviet allocations to "science" as equal to "budgetary allocations" (p. 67, and graph number 1). The Soviet figures for "scientific workers" (*nauchnye rabotniki*), which *include* over a quarter of a million teachers in higher education and *exclude* over a million auxiliary R & D personnel, are taken to refer to "the number of research and development personnel," and reconciled with the expenditure data only by the assumption that their average wage is 500 rubles a month (a professorial salary!) (pp. 64, 72). Eventually, in spite of their stress elsewhere on inefficiencies in Soviet R & D, the authors conclude that Soviet "buying power" in R & D amounted to at least $30 billion in 1972 (p. 195), evidently on the assumption that the "productivity" of a Soviet research worker equals that of his United States equivalent, although all available evidence points to its inferiority.

Neither the conclusion of the authors that Soviet goals are utterly unchanged, even after Nixon's visit to Moscow, nor their assumption that there is an immediate risk that Soviet technology will outpace that of the United States is soundly grounded in their evidence from the Soviet documents. But the translated documents, and the authors' discussion of Soviet reforms of R & D organization, merit careful study.

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Oceanic Boundaries

Waves on Beaches and Resulting Sediment Transport. Proceedings of a seminar, Madison, Wis., Oct. 1971. R. E. MEYER, Ed. Academic Press, New York, 1972. viii, 462 pp., illus. $16. University of Wisconsin Mathematics Research Center Publication No. 28.

Beaches are the place where the ocean impinges most obviously and forcefully on human affairs. The vital role these boundaries play in recreational and industrial affairs has meant that they are more often the concern of politicians and bureaucrats than of scientists. In the absence of complete scientific understanding, the human propensity to meddle with nature has often led to disastrous results. The literature, including daily newspapers, is replete with examples of attempts to protect beaches from erosion that have had precisely the opposite effects, or of supposedly well-sited sewage or power plants whose effluents have ended up in the wrong place, that is, on the beach.

Scientifically, beaches are a sometimes ill-defined boundary between the concerns of the geologist and those of the oceanographer. From the hydrodynamicist's point of view, the beach presents a wealth of intriguing, if difficult, phenomena. The mathematical linearizations upon which is based so much of theory ultimately fail at some point on the beaches. The medium under study is itself ill-defined as one goes from fluid to solid through a transition that is neither. The transition region is of course the crucial area when it is a calculation of the actual transport of sand that is required. Anyone familiar with breakers will understand some of the difficulties of making quantitative observations in the field. Despite all the difficulties, much is known about certain aspects of the dynamics of beaches, even though much more remains to be done.

In October 1971, an "advanced seminar" brought together geologists and mathematicians to review the state of the art of beach dynamics. The volume under consideration is a compendium of the papers presented. Since none of the discussion is reproduced, it is difficult to know how much communication there was between the disciplines. However, several of the review papers included in the book are excellent surveys of the field. The papers range from a nice series of photographs of New England beach forms (a challenge to the theorists) to an up-to-date review of the theoretical progress made by means of the concept of "radiation stress."

The civil engineer is required to make estimates of beach movements whether or not complete theoretical understanding has been obtained. Empiricism precedes a complete theory. The civil engineering approach is represented in both older (Einstein) and somewhat more modern (Kennedy and Locher) points of view. To find the actual movement of sand, given the fluid motions, is the crux of the matter.

Peregrine presents a useful summary of the mathematical approximations that have been used in the hydrodynamical problems, and other papers exploit various limits from purely linear theory to slightly nonlinear (Mei and Unluata). Longuet-Higgins's mildly polemical paper on longshore currents represents the most determined effort to relate sand movement directly to the incoming wave field. Inevitably many of the difficulties are parametrized away, but the resulting physical ideas are sensible. The remainder of the 11 papers included explore various aspects of more particular problems and range

from the almost trivial to important reviews of specific problems (for example, how does a wave break?).

Although the book suffers from some of the inconsistencies of notation inevitable with diverse authorship, the more substantial papers are very clear and usually self-contained. This worthwhile book could be used in an advanced interdisciplinary course in beach dynamics.

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Herpetological Compendium

Rattlesnakes. Their Habits, Life Histories, and Influence on Mankind. LAURENCE M. KLAUBER. Second edition. Published for the Zoological Society of San Diego by the University of California Press, Berkeley, 1972. Two volumes, boxed. xlviii, 1534 pp., illus. $50.

The thirty or so species of rattlesnakes include the most spectacular poisonous serpents of North America. The present encyclopedic compendium again makes available a useful summary of information on these beautiful and terrible animals, the sound and venom of which have fascinated man since his arrival in the New World.

This is the second edition of a work first published in 1956 and out of print for some time. Revision was started, but was never completed because Klauber's death intervened. Mainly it is the taxonomic and paleontological sections that have been brought up to date, but a 24-page addendum to the bibliography includes other topics as well. Numerous new illustrations of various species have been added, but these are now printed on mat rather than glossy paper, losing something in the reproduction.

The approach to the subject represents Klauber's intention to interest "the casual seeker for the facts of rattlesnake life." This is not surprising, as Klauber was an electrical engineer who spent 43 years with the San Diego Gas, Electric Light and Power Company, ultimately retiring as chairman of the board. He only became interested in herpetology in 1920, at the age of 37. His contributions to this subject started modestly with short notes on species found in local areas and progressed with the development of new collecting methods. The extensive samples thus accumulated led him to the study of geographical variation, and in turn to a pioneering application of statistical methods to the meristic characters of reptiles. Although he regarded these and other incisive herpetological studies merely as an avocation, his contributions were widely read and were most influential on the "professionals" in the field.

Though Klauber may have addressed these well-written volumes to the "casual seeker of fact" they will be an extremely useful resource for a much wider audience. In particular, the sections on behavior, populations and ecology, venom glands, and folklore are of significant interest. Klauber's approach does, of course, have inherent limitations. One mainly looks for discussions of the morphology and physiology of these animals. The style of presentation also poses problems. Klauber went to incredible lengths to garner literature and written opinions; he tabulated opposing views on even the most minor of topics. The result leaves one with a discerning but most discursive treatment, more suitable for leisurely reading than as a quick reference. Though some trivial aspects unquestionably receive too fulsome a treatment, one wishes that there were equally useful compendia for other North American reptiles.

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Persistent Insects

The Mosquito. Its Life, Activities, and Impact on Human Affairs. J. D. GILLETT. Doubleday, New York, 1972. xx, 358 pp. + plates. $9.95.

Man is tracking down the last of the great whales; he is slashing tracks through the Amazon forest; he is studying the landscape of Mars. Who needs a book about anything so insignificant as the mosquito?

Yet I suppose there will always be a place for a good adventure story. And what could be more exciting than the discovery that yellow fever, malaria, and several other human scourges are transmitted by mosquitos? The story is now an old one, but it is told here with gusto and with many a novel facet. Gillett is a fine raconteur, and he dips into his own experiences for a variety of stories that will be new to most readers.

Then, too, there are probably some who have read all of the many sex manuals on the market and are still left with a profound ennui. They may enjoy reading how the male *Opifex* mosquito uses his claspers "like a can-opener" to split the pupal skin of the female and copulate before she has emerged. Or the details of artificial insemination in *Aedes aegypti*, possible because "male mosquitos share with us an increased tendency to mate after losing their heads."

Presumably there are still a few whose sense of beauty has not been thoroughly corroded by contemporary art and music. They will admire the colored plates in this book: for mosquitos are indeed things of beauty. Those whose admiration is for the machine will learn that the elaborate behavior of the mosquito is programmed in its genes. "A single cell . . . is infinitely more complex than the most sophisticated piece of hardware devised by man. Even the modern electronic computer is a model of naiveté by comparison."

Probably there are only a few thoroughgoing cynics like myself who derive pleasure from the fact that even though man has thoroughly subjugated the natural world, there are still creatures capable of pricking his ego and sneaking off with a bit of his blood, which they quietly convert to mosquito eggs. Gillett is not quite so perverse as to say that, but he feels sure that man "is not so easily going to dispose of the mosquitos; it seems he is going to have to share this planet with them and with many other six-legged creatures for a long time to come. How long may, perhaps, depend on whether in the meantime he also succeeds in disposing of himself, in which case the mosquitos will carry on regardless as indeed they did for the fifty million years or more before man first began to provide a change of diet and extra breeding places for them."

I conclude that we did, after all, need a book on the mosquito, and that the author has performed that rarest of feats: he has written a book that is authentic and fact-laden, yet a delight to read. Bravo, Professor Gillett. (And to any mosquitos that may happen to read this: bravissimo.)

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