ficially; one must turn to works on dynamical oceanography for a more profound discussion. A modern map of the geoid, with its humps and hollows of tens of meters variation in (geocentric) sea level, as derived from satellite orbits, would have made an edifying addition, but variations of gravity other than spheroidal are hardly mentioned. The survey of secular variations in sea level naturally considers the difficult partition between slow crustal movement and the true rise of oceanic sea level since about 1890. The manmade tragedy of Venice is given due attention.

After the four central chapters, the remaining ones are rather miscellaneous. Those on seiches and tsunamis have already been mentioned. They, and some sections on data reduction and on tide tables, are short and somewhat light in substance. More substantial sections discuss the statistics of extreme high and low sea levels and questions of pollution in relation to water exchange—in nearly enclosed seas like the Baltic water exchange and rate of change of mean sea level are closely related. These studies will attract readers with engineering problems in mind. The author closes with an interesting article on ancient historical and semi-legendary events involving sea level changes, and their interpretation in modern terms.

Apart from occasional awkwardness in the choice of a word or the turn of a phrase, the standard of English is excellent throughout.

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Reference

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SULLIVAN, W. 1974. **Continents in motion: The new earth debate.** McGraw-Hill, New York. xiv + 399 p. $17.50.

The past decade has seen a revolution in our view of the earth—the development of plate tectonic theory. This unifying concept hypothesizes that the earth's crust is constantly recycled. Some ten (or more) blocks move as discrete units away from the midocean ridges where new crust is formed toward the trenches where the crust is pulled down to be resorbed into the earth's mantle. The ocean floor is constantly being renewed. And the continents are accumulations of lighter rocks that are more than twenty times older than the sea floor.

Twenty years ago, any respectable geologist risked ridicule to support this wild idea. Now, virtually every geological journal has a paper using it to explain distributions of fossil reptiles, glacial deposits, and accumulations of oil and gas. And prospects are encouraging that the theory will guide prospecting for geothermal power sources and provide useful insights for predicting earthquakes.

Walter Sullivan, dean of American science writers, presents an excellent historical survey and statement of the present status of plate tectonic theory. He traces the development of the concept from its formulation by Alfred Wegener, to the FAMOUS Experiment (French-American Mid-Ocean Undersea Study) carried out in the summers of 1973 and 1974. The impact of the theory on our view of the earth equals in scope the changed view of biology brought about by Darwin's theory. In the book ideas are explored in the context of this original development and fascinating glimpses are offered of some of the key people who brought about this revolution—J. Tuzo Wilson, Harry Hess, Maurice Ewing, and Sir Edward Bullard.

Satellite photos illustrate the massive changes in the continents—rifting and mountain building—brought about through continent-moving forces. Drawings and photography portray some of the individuals involved and illustrate major principles.

Sullivan has done a superb job of portraying the concept and transmitting the excitement of discovery that accompanied its development. So, if you want to learn (painlessly) about the present status of geology, this book is a must. And, even if you are a geologist but could not follow the development of plate tectonics on a weekly basis as it has expanded in an explosive fashion, there is a lot here for you.

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INDERBITZEN, A. L. [ED.]. 1974. **Deep-sea sediments: Physical and mechanical properties.** Marine Science, v. 2, Plenum Publ. Corp., New York. ix + 497 p. $35.00.

This excellent book on physical and mechanical properties of deep-sea sediments contains 23 papers from a seminar held under the sponsorship of the Office of Naval Research, Ocean Science and Technology Division. It is divided into four groups of contributions and contains at the end the results of three workshops.

The first group of four papers presents an overview of the subject. The contributions on prediction of deep-sea sediment properties, marine geomechanics, and mechanics problems present overviews that may be too difficult to follow for

readers not familiar with marine geotechniques, as the authors start at a rather high level and do not present earlier work. This is much less the case with the contribution on marine geotechnical properties. The editor should have given an introductory chapter on the total subject facilitating understanding by interested nonspecialists.

The second group of eight papers presents information on the determination of mechanical properties in marine sediments such as the role of laboratory tests, influence of cementation, vane shear, sampling, settlement characteristics, consolidation of marine clays and carbonates, and deep-sea foundation. Discussions of validity of laboratory tests on collected marine sediments, the role of speed of vane shear tests and the best system (box cores) to obtain least-disturbed samples are clearly given. The engineering properties of ocean sediments differ significantly from those of land sediments and it is suggested that interparticle bonding may be the cause of the difference. Vertical loading effects on settlement characteristics and on foundation and anchor engineering are well treated and demonstrate how little we know about the subject. High void ratio marine clays are compared with Deep-Sea Drilling Project cores and carbonate muds. Fine-grained carbonate muds reveal consolidation characteristics similar to those of silty clays. The last paper in this group deals with standardization of marine geotechnical symbols, definitions, and units, and the author makes suggestions on how to reduce the worldwide confusion on such matters. A special workshop on this theme was held during the meeting.

The third group of four papers deals with the application of physical and mechanical properties in the marine environment. The papers discuss soil mechanics in relationship to the designing of deep ocean mining equipment, settlement of concrete blocks, and trafficability. Measurements in the upper 5–10 cm of the sediment column are difficult to encompass but seem to be critical in the strength profile. One paper in this group discusses in situ acoustic measurements during coring in saturated as well as gas-bearing sediments. Such in situ measurements should be developed further, especially for surficial sediments which are difficult to core in an undisturbed manner, and for sediment layers too deep to collect with present coring devices. The trafficability paper describes the use of the sea-floor vehicle RUM (remote underwater manipulator), a cable-tethered, bottom-crawling vehicle equipped with many devices such as sonar, camera, TV and mechanical arm for a vane shear device, cone penetrometer, and coring device.

The last section, of seven papers, is devoted to relationships between physical, mechanical, and geologic properties. Erodibility of fine abyssal sediment depends on a complex of forces acting on the surface particles. Another paper discusses the physical effects of benthic fauna on marine sediments. One author expresses pessimism concerning the application of relationships between acoustical properties and the mechanics of marine sediments and stresses the need for improvement of soil concept and testing methods. Two papers deal with the sediments in the Indian, North Pacific, and North Atlantic Oceans. Interesting data are presented on the various sediments encountered. The last two papers deal with deep-sea carbonates and precipitation-cementation of such sediments. Apparently calcium carbonate can strongly influence the engineering properties. Very little has been done on this effect and the importance, although realized, is not yet understood.

At the end of the book the results from three workshops are summarized. The one on phenomena focuses on mass physical and engineering characteristics and the areas of needed research. The second one deals with instrumentation—improvement of instruments as well as of measuring techniques—and the development of new concepts concerning deeper penetration to monitor physical and mechanical properties. The use of deceleration curves of projectiles dropped or shot into the bottom received much attention. The third workshop was an attempt to obtain some degree of agreement on standardization, earlier presented as one of the papers in section two.

In conclusion this volume presents a good picture of the state-of-the-art of this particular aspect of science. However, the lack of an introductory chapter to the field will restrict the size of the audience. In addition, the high price for the photo-offset printing will prevent most students and nonspecialists from purchasing it. Although the title of the seminar was correct, the title of this book is very misleading as the subtitle may be overlooked too easily or not given.

Geologists and soil engineers dealing with physical and mechanical properties of deep-sea sediments certainly will welcome this excellent text, and offshore industry can benefit from the contents.

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HANSON, J. A. [ED.]. 1974. **Open sea mariculture.** Perspectives, problems, and prospects. Dowden, Hutchinson & Ross, Inc. Stroudsberg, Penn. xi + 410 p. $24.00.

This book starts with the idea that the mariculture of marine organisms can be conducted in unprotected ocean waters whether near or far from the shoreline. The authors consider the scientific, engineering, legal, and economic aspects of such an adventure and conclude by suggesting the adoption of a national program to further their aims.