the ratings of the machinists there, sparking a revolt that amply demonstrated that N/C had not deprived them of their power on the shop floor. Desperate for production, GE thereupon embarked on one of the more remarkable experiments in conceding workers a high degree of autonomous workplace control. As for Noble, he can only comment lamely on the "central contradiction" of a control system that attacked "the very people upon whose knowledge and good will the optimum utilization, and the cost effectiveness, of N/C ultimately depended" (p. 269).

By the dogmatism of his approach, ironically, Noble has done something of a disservice to the thesis he is advancing. For it is becoming a well-established fact that the struggle over shop-floor control constitutes one of the central—and perhaps distinguishing—themes of American working-class history. We need empirical studies of this problem, not the certitudes that Noble espouses in this book. Beyond that, Noble has done something of a disservice to his own quite genuine achievement at writing technological history. It would be a shame if readers were deflected by what is dubious in this book—and by its tone of moral hectoring—from benefiting from Noble's excellent account of the development of the N/C technology.

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The Interior of the Earth

Materials Science of the Earth's Interior. ICHIRO SUNAGAWA, Ed. Terra Scientific Publishing, Tokyo, and Reidel, Boston, 1984 (U.S. distributor, Kluwer Boston, Hingham, Mass.). xvi, 653 pp., illus. $120. Materials Science of Minerals and Rocks.

Compared with the vast amount of information that we have gathered from space, we have very little information about the earth's interior, according to Sunagawa. In response to this argument the Japanese government in 1978 funded a three-year interdisciplinary research program aimed at improving our knowledge of the materials of the earth. This book is a collection of research papers prepared at the end of the program. The volume is the first in a series of advanced textbooks entitled Materials Science of Minerals and Rocks.

The 31 papers in the volume provide a view of the operation of Japanese science and of the unique contributions Japanese scientists have made to this field. The most striking aspect of the research program is the breadth of interests it evidences. In addition to the traditional earth science disciplines, there is strong representation from materials science, solid state physics, and chemistry.

An understanding of the earth's interior requires an understanding of the properties of the constitutive materials. These properties can be determined only after the successful synthesis of samples, preferably in the form of single crystals. Several papers are devoted to crystal growth. Sunagawa discusses natural single crystals, emphasizing their growth conditions and processes with particular attention to diamonds. Takei *et al.* have been very successful in using the floating-zone method to grow large crystals of materials that melt incongruently, such as ferromagnesian olivines. Akimoto *et al.* describe crystal synthesis at elevated pressures and temperatures, using as an example the growth of a large single crystal of a nickel silicate spinel within a host single crystal of the low-pressure olivine phase.

Roughly two-thirds of the book has the objective of understanding the properties of the earth's materials. The other third is devoted to inferring the earth's state and processes, and here the coverage is diverse and somewhat spotty. Chemical analyses of argon isotopes and trace elements in natural diamonds lead Ozima *et al.* to conclude that diamonds are derived from material that was originally subducted into the mantle as oceanic crust. From high-temperature–high-pressure (27 GPa) experiments, Ito concludes that the 670-kilometer discontinuity in seismic velocity could be a result of the phase transition of ferromagnesian silicates to a perovskite phase and magnesiowustite. Several papers discuss the role of water, both in the mantle and as a chemical reagent associated with the formation of ore bodies.

Though the volume provides an excellent discussion of the current understanding of the materials science of the earth's interior, it does not cover every aspect of this vast field. For example, it does not express the excitement generated during the past decade by the use of diamond anvil cells to obtain extremely high pressures, which has produced significant results concerning properties of earth materials.

The book demonstrates that Japanese laboratories are extremely well equipped. Most noteworthy is the fact that facilities such as those described by Kumazawa and Endo for conducting large-volume experiments at pressures greater than 8 GPa have been developed in a dozen Japanese laboratories. In contrast, there are as yet no such facilities in the United States. Though this disparity is a reflection of the different orientations of the research, it is also a reflection of the nature and style of funding in the United States over the past several years. The book demonstrates the type of research that can be accomplished with such equipment and provides a model for non-Japanese national programs.

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Volcanic Deposits

Pyroclastic Rocks. R. V. FISHER and H.-U. SCHMINCKE. Springer-Verlag, New York, 1984. xiv, 472 pp., illus. $49.50.

Pyroclastic rocks do not readily fit into traditional classification schemes. They are the result of explosive volcanic eruptions and have both igneous and sedimentary affinities; the material making them up is mostly of igneous origin whereas the mode of emplacement is essentially sedimentary. In the dynamic environment of their deposition, they may be modified, eroded, redeposited, or intermixed by either igneous or sedimentary processes. During the first third of this century investigators who were making great progress toward understanding both igneous and sedimentary processes largely ignored the pyroclastic rocks, perhaps because of their complexities or their ill-defined classification niche. Even though violently explosive eruptions were the cause of most great historic volcanic disasters, such as Vesuvius (A.D. 79), Krakatau (1883), and Pelée (1902), little heed was paid to the shattered remnants of exploded magma, and, until recently, geology textbooks contained but cursory descriptions and discussions of them.

Intriguing papers about the massive deposits from the 1912 eruption near Katmai, Alaska, sparked interest in pyroclastic rocks, and in the 1930's and 1940's pyroclastic deposits began to be used as clues to interpret prehistoric volcanic events and to solve regional stratigraphic problems. By the 1950's geologists were discovering that many massive sheet-like deposits initially thought to be lava flows were actually of pyroclastic origin. Since 1960 the rate of publication of papers on the rocks has been almost as explosive as the process-

es that generate the rocks. Throughout the 1970's new concepts, applications, and terminology were burgeoning, great creativity and energy were devoted to multiple studies of both ancient and modern deposits, and numerous meetings were conducted to keep pace. Several general textbooks on volcanoes and volcanology appeared in the 1970's and early 1980's whose modern treatments of pyroclastic rocks helped document this progress, but such summaries were necessarily brief. Research papers on specific topics helped keep specialists up to date but neglected neophytes. About a decade ago, R. V. Fisher and H.-U. Schmincke, both of whom were deeply involved in research on pyroclastic rocks and processes, recognized the urgent need for a more complete review and conceived the present book. This felicitous volume is the first fully comprehensive treatment covering the whole field of pyroclastic rocks.

The 14 chapters of the book take readers from the broad general principles of volcanoes through the origin of pyroclastic rocks and descriptive details concerning various kinds of pyroclastic rocks to the role of the rocks in stratigraphic and structural processes. Throughout the book, the emphasis is on geologic processes; descriptive material is clear and enlightening but is always presented in a way that will aid the reader to understand a process of origin or change. The early part of the book deals with the tectonic setting and forms of volcanoes, the composition and behavior of magma, and the physical and chemical processes that govern volcanic eruptions, particularly explosive eruptions. The central portion of the book is concerned with pyroclastic deposits, the particles that compose them, and the processes and results of pyroclastic fallout, pyroclastic flow, hydroclastic eruptions (caused by exploding steam), submarine eruptions, and lahars (volcanic debris flows lubricated by water). Post-emplacement and alteration processes are also discussed. The final part of the book shows how pyroclastic rocks are involved in stratigraphic relationships and how they fit into the general scheme of global tectonics.

A vast amount of personal experience and diligent scholarship went into producing this book; the material is reliable, authoritative, and current, and the book is logically organized and clearly written. The authors' own special interests are reflected by particularly fine summaries of subaqueous processes, pyroclastic flows, and hydroclastic eruptions. Throughout the book the treatment of subjects is nicely balanced. I perceived neither significant omissions nor factual errors and spotted only a handful of typographic errors. Each subject has been thoroughly documented; the list of references comprises more than 1000 entries, some of which appeared as recently as this year. Separate subject and locality indexes are provided. The illustrative material is effective in supplementing the text, the line drawings and charts are clear and easy to read, and the photographs are informative and of exceptional quality.

The book will be useful as both a textbook and a research guide; it has applications in the diverse fields of volcanology, igneous petrology, sedimentology, stratigraphy, economic geology, and tectonics. In the end, the reader will have learned a great deal about pyroclastic processes and will have attained a clear idea of how knowledge of pyroclastic deposits can be applied in the solving of many kinds of geologic problems.

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Prices of Books

Average per-volume prices of books reviewed in *Science* 1979–1984. Data are for hardcover books except where books were available only in paperback; books priced only in foreign currencies and (for 1984) books distributed free of charge were excluded from the calculations. The average prices per page of the technical books in the natural sciences for the years covered were 8.6¢, 9.0¢, 11.3¢, 11.1¢, 11.1¢, and 12.0¢.

Category	Price (dollars)					
	1979	1980	1981	1982	1983	1984
All books	30.33	35.52	42.22	44.05	41.93	45.38
Technical books in natural sciences	39.18	42.61	52.76	51.70	51.18	55.29

The Dumping of Wastes at Sea

Wastes in the Ocean. IVER W. DUEDALL, DANA R. KESTER, BOSTWICK H. KETCHUM, and P. KILHO PARK, Eds. Wiley-Interscience, New York, 1983. Vol. 1, Industrial and Sewage Wastes in the Ocean. xxiv, 432 pp., illus. $54.95. Vol. 2, Dredged-Material Disposal in the Ocean. xx, 300 pp., illus. $39.95. Vol. 3, Radioactive Wastes and the Ocean. xxii, 522 pp., illus. $85. Environmental Science and Technology.

The object of the volumes reviewed here, which are the first three of a set of six, is "to present a comprehensive overview of the state of our knowledge concerning the disposal of waste in the ocean and to present new and original contributions to the evaluation of the impact of the disposal of waste materials on human life and well being, on the marine biota, on amenities, and on legitimate use of the ocean."

Volume 1 deals with the physical, chemical, and toxic properties of dumped industrial waste and with the environmental effects of such waste. Special attention is given to stabilized coal waste and to the mid-Atlantic and New York Bight dumpsites in United States waters. Volume 2 deals with the regulation of the disposal of contaminated dredged material in the United States, dredged-material dumpsites in U.S. waters, biological aspects of contaminated sediments, and alternatives to dumping sediments in open waters. Volume 3 deals with practices for the disposal of radioactive waste, physical and biological processes in such wastes, and the feasibility of placing radioactive wastes beneath the sea floor.

Although the first two volumes discuss the international legal structure, they primarily address current practices and regulations in the United States. The experimental results and case studies presented in these two volumes are based mostly on investigations carried out in or near the mid-Atlantic and New York Bight dumpsites.

The dumping of radioactive waste in the deep sea is of necessity more clearly influenced by international and multilateral agreements and by the multilateral collaborative investigations aimed at assessing the feasibility of future disposal of high-level waste in the seabed, and the papers in volume 3 provide a relatively complete summary of existing international practices as well as of their scientific basis.

In general, the volumes reflect rather well the political and regulatory measures that have been taken to control sea dumping. The more technically oriented