Book Reviews

The Solid Earth

The Earth. Its Origin, Structure and Evolution. M. W. MCELHINNY, Ed. Academic Press, New York, 1979. xvi, 598 pp., illus. $74.50.

Undoubtedly one of the half-dozen leading centers for research in the earth sciences is the Australian National University at Canberra. Its leadership has evolved since 1952, first under the guidance of John C. Jaeger and then from 1972 to 1978 under Anton Hales. This book is dedicated to Jaeger and Hales and is entirely written by present and former faculty and associates of the Research School of Earth Sciences in Canberra.

Despite the limitation of authorship to Canberra, the book constitutes the best single-volume review of research in the physics and chemistry of the solid earth in at least seven years. Hence for the nonspecialist it is a convenient guide to current understanding of most aspects of the solid earth and to the leading questions on the subject.

A book about current research in an active field cannot, of course, avoid biases if it is to address the speculative edge. Such tendencies toward bias are particularly apparent in the opening chapter, on the composition and origin of the earth, which is fittingly by A. E. Ringwood, who has done the most to bring renown to Canberra. Ringwood strives to reconcile data with two modeling ideals—a uniform composition for the mantle and a bulk composition that differs from carbonaceous chondrites only in the loss of relatively volatile elements. His petrological and geochemical arguments are persuasive but tend to be one-sided: he does not take into account some recent data, such as isotopic indications of enduring inhomogeneities in the mantle, and does not sufficiently emphasize the speculativeness of some extrapolations, such as those concerning the miscibility of iron and iron oxide in the core.

The remaining 16 chapters are roughly one-third geochemical and two-thirds geophysical. Of the geochemical, one by Liu, who reviews high-pressure phase equilibria experiments, is complementary to Ringwood's. Liu concludes that the most plausible solution is a 3-percent increase in iron relative to magnesium in the lower mantle; however, the uncertainty of this solution is greater than its difference from the homogeneous composition postulated by Ringwood. Four papers are on aspects of crustal evolution, ranging from a discussion of porphyry copper deposits to estimates of continental crust composition from rare earth elements. An impressive conclusion of the paper on rare earth elements, by Taylor, is that even the oldest differentiations in the Archean were andesitic (like island arcs), rather than anorthositic (like the moon), in character. Another important discrimination is made in a paper on mid-ocean ridge basalts by Green, Hibberson, and Jaques, who conclude that there cannot be a direct genetic relationship between the parent magma of these basalts and the more mafic rocks found in the ophiolite complexes commonly thought to be relics of ocean ridge associations.

Among the geophysical papers, geomagnetism is most strongly represented, with four chapters. Most novel to this reviewer were the inferences from statistical analyses of temporal variations by McElhinny, who suggests that the variations are caused by changes in boundary conditions arising from mantle convection. Perhaps sounder is a summary of continental drift for the last 350 million years by Irving, who pioneered this application of paleomagnetism before it acquired respectability. Other sound and up-to-date geophysical reviews are on the rotation of the earth, seismology and the internal structure of the earth, mantle convection, the thermal regime in Australia, and earthquakes and plate tectonics. Also pertinent to the problem of lower mantle composition is a discussion of seismic velocity-density systematics by Liebermann.

Although the chapters are mostly reviewish in nature, some, such as that by Green and collaborators, present new data, and in nearly all cases the authors have made important original contributions to the work discussed. All in all, the book is a pleasing reminder of the rapid progress in the earth sciences in recent decades, not only in plate tectonics but also in subjects, such as paleomagnetism and high-pressure petrology, in which Canberra has been a leader.

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A Population of Mammals

The George Reserve Deer Herd. Population Ecology of a K-Selected Species. DALE R. MCCULLOUGH. University of Michigan Press, Ann Arbor, 1979. xiv, 272 pp., illus. $16.

Six white-tailed deer released on a fenced 5-square-kilometer reserve in 1928 erupted to a peak of around 220 animals in the mid-'30's. They were subsequently held by hunting at levels between 70 and 160. By chance the reserve is owned by the University of Michigan, and the result of that happy coincidence is the best ecological study ever undertaken on a population of large mammals. Not that the competition is particularly fierce: Sinclair's work on the African buffalo runs it close, and the Isle Royale study on moose and wolves is another contender, as is the study of Laws and his associates on elephants in East Africa, but most of the other studies that have been done coalesce into an amorphous mass of nothing much.

McCullough's book can be divided into four sections. The first few chapters give his data—essentially the result of 19 years of bookkeeping. Mortality, reproduction, population size, and sex ratio are tracked with high fidelity. Having shown what the population did he shows in the next section how and why, by integrating these data within an empirically derived stock-recruitment model. Estimation of the yield curve and carrying capacity follows naturally. The third section discusses the bearing of the study on the broader issues of population regulation and natural selection, and the book ends with a couple of chapters on its implications for wildlife management.

The book is difficult to find fault with. As I read it my standards kept inching upward, and at that level of heightened sensitivity. I will mention one aspect of the study that disappointed me. McCullough makes it plain that he views a pop-