## The Actions and Applications of Radiations

**The Science of Ionizing Radiation: Modes of Application**. Compiled and edited by Lewis E. Etter. Thomas, Springfield, Ill., 1965. xvi + 788 pp. Illus. $26.50.

Almost everyone should find something of interest in *The Science of Ionizing Radiation*. It treats a wide range of topics, illustrative of the interdisciplinary nature of the actions and applications of radiations. In some respects this book is the successor to *The Science of Radiology*, which was published in 1933. Its scope is much broader, however, because in the intervening years the ionizing radiations have found application in virtually all areas of science and technology. Thirty-five scientists have contributed to this volume, which consists of 29 chapters grouped into the following sections: History, Equipment, Physics, Chemistry, Biology, Radiology, Industrial Applications, Crystallography, Archeology, Anthropology, Graphic Arts, and Agriculture. The most extensive coverage is given to radiographic and radiotherapeutic applications in man.

The various reviews of the basic and applied aspects of the ionizing radiations appear to be written primarily for the nonspecialist. Although the expert may, therefore, find something to be desired in the treatment of his own subject, the book as a whole represents a useful addition to the literature. There are numerous charts and diagrams and selected references for each chapter. The chapters describing the discovery of x-rays and radium are as entertaining as they are informative, with excellent documentation of highlights in the lives of Roentgen and the Curies. Graduate students, in particular, should find this volume a valuable compendium of the radiological sciences. Those who work with radiations for one or another purpose will, no doubt, also find it to be a convenient source book.

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## Tools for Early Man: Pin Hole Cave, Derbyshire

**Bone, Tooth, and Horn Tools of Palaeolithic Man**. An account of the osteodontokeratic discoveries in Pin Hole Cave, Derbyshire. James W. Kitching. Manchester University Press, Manchester, England; Humanities Press, New York, 1964. xiv + 55 pp. Illus. $4.50.

Several decades ago A. L. Armstrong, a surveyor by trade and an ardent amateur archeologist, carried out investigations in several caves about the Creswell Crags in Derbyshire. This little book discusses the mammalian skeletal remains recovered during those excavations and accumulated during two periods of human occupation—the Mousterian (by Neandertal peoples) and, later, the terminal Paleolithic or Creswellian (by modern *sapiens* peoples). Although records of depth and distance from an entrance point were kept, it is unfortunate that these are apparently inadequate to permit treatment by distinct levels, and that the faunal assemblage can be treated here only as a whole.

Aside from some amphibians and a dozen small mammal species, largely rodents which doubtless represented the prey of owls, and a few birds, fish, and bats which did not, the bulk of the remains are of larger mammals, especially reindeer (≥ 200 individuals), some horse (≥ 25 individuals), woolly rhino (≥ 20 individuals), bison (≥ 9 individuals), and more rarely giant deer (≥ 3 individuals) and woolly mammoth (≥ 3 individuals), with, in the later occupation only, wild boar (≥ 2 individuals). The remains of hare are especially numerous. There are a few remains of small carnivores (badger, stoat, and polecat), felids (cave lion below and wild cat above) and brown bear (≥ 6 individuals), and more numerous remains of wolf (≥ 10 individuals), fox (≥ 20 individuals), and especially cave hyena (≥ 25 individuals). Of some 11,500 skeletal parts more than 35 percent are fragmentary flakes from ungulate limbs; nearly 50 percent of the total represent various remains of five ungulates and four large carnivores. About 40 percent of the total comprise head parts—isolated teeth, antlers, mandibles, and cranial fragments, in decreasing frequency.

More than a third of the fragmentary remains (flakes and bits of antler) evince signs of erosion from gastric acids and traces of gnawing by hyenas. The author argues that hyena remains were deliberately brought into the small cave by early man. On the contrary, the evidence would perhaps more strongly favor occupation and some measure of bone accumulation by hyenas. This might also very well account for the notable absence of many skeletal parts, especially long bones and also parts of the axial skeleton, of the larger herbivore species. Because the successive fillings of the cave were not fully mapped, and were also in part at least excavated in arbitrary thick spits, it is of course impossible to reconstruct, even approximately, occurrences by levels, and the nature of periodic visitations, whether by man or hyenas.

Kitching, who has had a major role in R. A. Dart's work in South Africa on the accumulation and deliberate fracture of bone, tooth, and horn (osteodontokeratic) to produce varied implements at an australopithecine site, maintains the same view in the interpretation of some of the Pin Hole Cave faunal remains. There can be little question that some bone breakage and fracture was by man, just as some was by hyenas. However, probably not a few students of the problem will be unable to follow the author's recognition of an elaborate suite of nonlithic artifacts and his designation of their likely usages. In my opinion this problem is still very much in need of further comparative and experimental investigation.

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## The Quest for Numbers

**The Phanerozoic Time-Scale: A Symposium Dedicated to Professor Arthur Holmes**. W. B. Harland, A. G. Smith, and B. Wilcock, Eds. Geological Society of London, London, 1964. viii + 458 pp. Illus. $14.50.

If you tend to stumble on "post-Precambrian," as most people do, you may prefer to take a deep breath and say "Phanerozoic." It's a little arcane, but it means the same thing.

The "aeon of clearly discernible life" is divided into the Paleozoic, Mesozoic, and Cenozoic eras, each of which has several periods. They, in turn, have divisions and subdivisions, of which the definitions and redefini-

tions have occupied stratigraphers for more than a century. Almost from the beginning, even before radioactivity was discovered, there was a great urge to put numbers on the stratigraphic table and thereby to endow the table with meaning in absolute time. The task turns out to be most difficult, but that has not damped the enthusiasm. Few things in geology are read so avidly as a paper on the time scale, and "Time Scale" on the program of a geologic meeting is sure to pack any hall. These must have been the thoughts that prompted the Geological Society of London to organize the symposium on the Phanerozoic time scale.

Its product is an impressive-looking, handsomely printed book, consisting of a foreword, 22 articles, and a long list of data. Among the papers, I found a scholarly review of the history of the time-scale concept by L. R. Wager, a concise summary of the rubidium-strontium method of age determination by Stephen Moorbath, and a calmly incisive analysis of the problems of potassium-argon dating of sedimentary rocks by Halfdan Baadsgaard and M. H. Dodson. In a group of stratigraphic papers, B. M. Funnell gives a detailed chronology for the Tertiary period, E. H. Francis and A. W. Woodland present fresh conclusions relating to the Carboniferous period, and H. B. Whittington and Alwyn Williams critically reexamine the definition of the Ordovician period. The rest of the stratigraphers either admit that the information at their disposal is inadequate or struggle on without saying it.

Almost half the book (193 pages) is devoted to an annotated list of nuclear age determinations which the editors deemed pertinent to the time scale. It is love's labor lost. The list is arranged in "the order in which the original abstracts were received by the editors," which makes the first few items Devonian, then some Permian, followed by Triassic, Paleocene, Permian again, and so on. Included is a profusion of now discredited interpretations, such as the uranium-lead "ages" of Colorado pitchblendes, the Swedish kolm, and the Chattanooga shale; potassium-argon results on sylvite, old glauconite, and illite; and even the ill-fated single-shot lead-alpha "age" of the Martinsburg bentonite. Apparently the editors overlooked the basic lead-alpha paper by H. Rose and T. W. Stern (*American Mineralogist*, 1960) and chose to disregard the good advice given by Baadsgaard, Dodson, and Moorbath in this very volume. The data, and in fact the whole book, are steeped in a jumble of multiple decay constants. In an effort to cope with the chaos, the editors invented a complex symbology which only furthers the muddle.

Owing to the magic of its title, the book is likely to sell to a large market, and many geologists will have the satisfaction of finding in it numbers that suit them. In that sense it is a contribution, if only to comfort. To those who join me in my long-standing admiration for Arthur Holmes, I would suggest reading his newly rewritten *Principles of Physical Geology* (Nelson, London, 1964). It is a masterpiece of geologic writing.

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## Radioactive Isotopes

**Radiotracer Methodology in Biological Science.** C. H. Wang and David L. Willis. Prentice-Hall, Englewood Cliffs, N.J., 1965. xviii + 382 pp. Illus. $16.

The vast accumulation of knowledge in the biological sciences during the past two decades has been made possible, in large measure, by the availability of radioactive isotopes. Although various aspects of radiotracer technique have been treated in textbooks, review articles, and symposia, no single volume has treated all facets of this powerful research tool. The need for such a work has now been fulfilled by Wang and Willis in their book *Radiotracer Methodology in Biological Science.*

The work owes its quality, in no small degree, to the special training that each author has had; Wang has long been active in the field of tracer methods and Willis in vertebrate biology, appropriate ingredients for a treatise of this kind.

For a scientific text, this book is unusually well written; by the use of well-chosen words and a style that is compact and clear, the authors have avoided the dull repetitiousness often encountered in scientific publications. The scope of subject is especially wide, and it is treated in great depth. A section is devoted to theoretical principles of radioactivity, another to description and theory of all practicable methods of measurement with most emphasis appropriately on liquid scintillation counting, statistical analysis of counting data, health hazards in the handling of radioisotopes, radiotracer laboratory design, experiments in radiotracer techniques, and other useful information. Each chapter is well documented with abundant bibliography, and, where applicable, chapter material is illustrated with mathematical problems.

One application of liquid scintillation counting of which no mention could be found, possibly owing to its late advent in the literature, is the use of Čerenkov radiation in measuring high-energy nuclides such as sodium-24 and phosphorus-32 where aqueous systems can be counted without contamination by fluor.

Although the book is generally well organized, the inclusion of operational directions for various counting systems in the experimental chapters seems arbitrary because such manipulation is not actually experimental. Similarly, the statistical experiment could have been combined with analysis of data.

Except for a single miscaptioned figure (6–7), the format is excellent. A statement to the contrary notwithstanding, the old style of isotope designation with superscript following symbol persists in several diagrams.

The overall impression that I gained from reading this book is that the biological scientist at any level of training and experience has at hand, in this volume, a valuable and an essentially completely up-to-date source of information in radiotracer methodology.

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## Geologic History

**Geological History of Western Canada.** R. G. McCrossan, R. P. Glaister, Grey H. Austin, and S. J. Nelson, Eds. Alberta Society of Petroleum Geologists, Calgary, Canada, 1965. x + 232 pp. Illus. $25.

This book is a magnificent cooperative achievement. Forty-four authors —mostly from oil companies but including a number of contributors from universities, the Geological Survey of Canada, the research councils of Alberta and Saskatchewan, and independent geologists—have cooperated to