The Progress of Taphonomy

Fossils in the Making. Vertebrate Taphonomy and Paleoecology. Papers from a conference, Burg Wartenstein, Austria, July 1976. ANNA K. BEHRENSMEYER and ANDREW P. HILL, Eds. University of Chicago Press, Chicago, 1980. xii, 338 pp., illus. Cloth, $18; paper, $7. Prehistoric Archeology and Ecology.

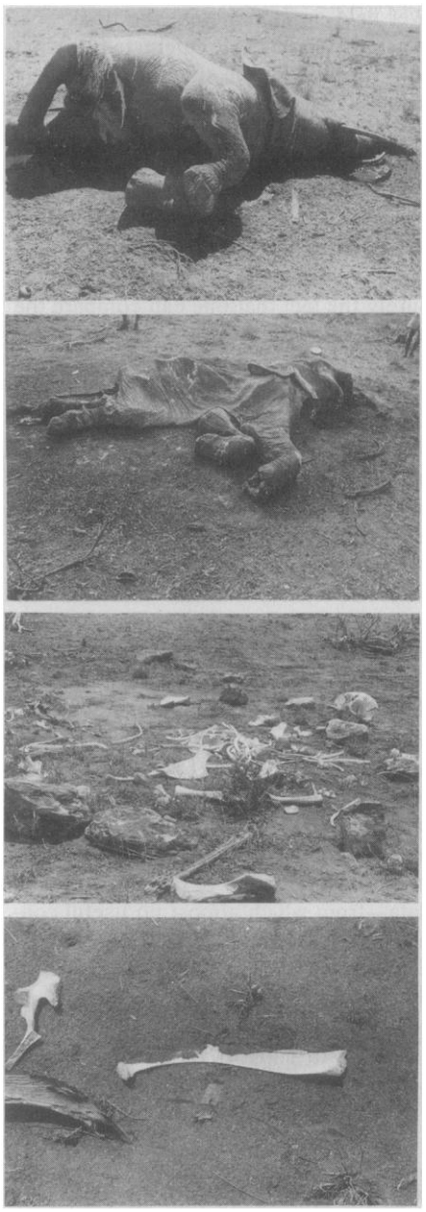
Taphonomy is the study of fossils in their geological contexts with a view to sorting out the factors intervening between death and definitive burial that bias the fossil record in certain ways and render paleoecological reconstruction difficult. In 1940 in an obscure American journal the Russian paleontologist I. A. Efremov announced taphonomy as a new branch of paleontology. In 1961, G. G. Simpson described taphonomy as a field with little concrete accomplishment. By 1970, only two American paleontologists had used the word in their titles. Ironically, in the 1970's, just as S. J. Gould was proclaiming paleontology freed of its "institutional millstone," the incompleteness of the fossil record, a veritable explosion occurred in taphonomy, the study of patterns and causes of the incomplete fossil record.

Nowhere has the activity of taphonomy been more in evidence than in Africa. It is perhaps appropriate that the Wenner-Gren Foundation for Anthropological Research sponsored a symposium entitled "Taphonomy and Paleoecology, with Special Reference to Sub-Saharan Africa." The participants included experts in geology, hydrology, geochemistry, vertebrate paleontology, physical anthropology, archeology, and ecology.

The 15 papers in the proceedings volume are arranged in five sections, each of which is introduced by a page-long preamble by the editors, who also introduce and conclude the book. The five sections are: History and Background; Modern Ecology and Models for the Past; Taphonomy in Modern Environments; Taphonomy in the Laboratory; and Paleoecology. Easily the best paper of the lot is that by Hanson, who develops a systems approach to the passage of remains from death through various states of storage, transport, and destruction into permanent burial, with critical transitions from one state to another. Hanson discovered disparities between transport velocities of bones predicted by the popular Behrensmeyer method of quartz equivalence and those observed in a flume and so developed a fluid hydraulic correction to accommodate shape, orientation, and mode of movement. Not content with the flume, he and Behrensmeyer set bones in a river to compare predicted and actual bone transport in a natural setting. Finally he modeled integrated fluvial systems to demonstrate how a distant community could be sampled more completely than a nearby one; this challenges the key assumption of Shotwell's method of paleoecological reconstruction.

Other important papers include that by Behrensmeyer and Dechant Boaz, who document at Amboseli the tendency for the remains of small mammals to be underrepresented in comparison with the standing crop and for the relatively indestructible large animals to be overrepresented; the size optimum for unbiased representation is around 100 kilograms. They also relate habitat preference of the large mammals of Amboseli to the habitat distribution of the corresponding carcasses and note among other things a tendency for migratory water-dependent species to die in greater than expected numbers in swamps at times of drought. Western examines his census data of Amboseli mammals with respect to the correlated parameters of body size, longevity, fecundity, mortality, and vegetation requirements. Hare demonstrates the dependence of racemization rates of amino acids on the amount of water present, thus casting further doubt on this process as a reliable geochronometer. Brain, in his characteristically thorough and interesting manner, characterizes the bone-collecting habits of African porcupines, which amass remains of bovids in proportion to their abundances in life. In a challenging essay, Vrba conceptualizes the tribes of modern bovids in such terms as habitat preference, size distribution, demography, and characteristics as prey species in an attempt to use fossil bovids (particularly Antilopini and Alcelaphini) as habitat indicators.

As proceedings of the first symposium



Elephant remains three days, three weeks, one year, and two years after death. The Tsavo East National Park has been affected by severe drought in which up to 7000 elephants died. On the basis of observations by Malcolm Coe of the decomposition of some of the carcasses, "It appears unlikely that, except for bodies being buried in gullies by subsequent rainfall or being transported and redeposited in silt by one of the main rivers, much if any of this material will be mineralized. The rapidity with which skeletal remains are fragmented by heating and cooling suggests that fossilized material which is recovered without appreciable signs of weathering must have been rapidly buried after death. . . . Indeed, since damage is much delayed under conditions of microclimate amelioration, observations of the degree of weathering of fossil bones might be used as a measure of the degree of ground cover by woody vegetation pertaining at the time of death or the speed with which the remains were interred. For material that can be located and examined 'in place,' a detailed study of the surrounding soil structure might well also indicate the conditions under which the carcass was buried, a field now being explored by the taphonomist." [From *Fossils in the Making*]

ever held on taphonomy, the book is of considerable intrinsic interest. But what does it tell us of the state of taphonomy today? Glaringly apparent is the lack of critical review and synthesis. Olson, in his historical overview, fails to provide the former and despairs of achieving the latter. In his opinion, each taphocoenosis represents a "singular historical event" with unique characteristics. Surely the fact that one can compare the taphonomic mode of an American Jurassic deposit (Morrison Formation) with an African Pleistocene one (Koobi Fora) and contrast both with a Canadian Cretaceous formation (Oldman) and one from the Pakistani Miocene (Siwalik Series) offers hope that, at the appropriate level of generality, taphonomic features will be seen to transcend accidents of time and space. We are told that the grand synthesis must await the collection of still more facts—but is this really the structure of scientific progress? In fact the danger is that taphonomy will collapse under the weight of "sheer phenomenology." There will always be room in taphonomy for thoughtful controlled observation. Hill, however, epitomizes taphonomists who collect facts—in this case 13 pages of raw uncontrolled data—from which almost no useful conclusion is drawn. Good taphonomy, in common with all good science, necessarily involves the formulation of resolvable questions so that focused observations are used to support or eliminate competing hypotheses.

The editors proclaim the book the first comprehensive bibliography of vertebrate taphonomy and paleoecology. With the reservation that the papers do not reflect work done since 1976, it comes commendably close to being comprehensive. The essays lack abstracts, in default of which good summaries should have been required. The book is well indexed by author and poorly by subject. It is printed from double-spaced typescript, but here is one case in which the price clearly justifies the inexpensive appearance. The University of Chicago Press and the senior editor, who did much of the tedious editorial work herself, are greatly to be commended.

The book should be read by those interested in the ecology of the modern fauna of East and South Africa and in its fossil antecedents and by those interested in the methodology of taphonomy—but a critical mind is recommended.

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Star Charts

The Sky Explored. Celestial Cartography 1500–1800. DEBORAH J. WARNER. Liss, New York, and Theatrum Orbis Terrarum, Amsterdam, 1979. xviii, 294 pp., illus. $70.

When Alessandro Piccolomini (1508–1579) wrote his modest book *De le Stelle Fissi Libro Uno* in 1540, he wrote in Italian in a vernacular style, in order to bring his science from ecclesiastical and university confines out to the people. (He also advocated higher education for women.) Today his book is a landmark because it contained the first printed star atlas: 48 woodcut star maps, one for each Ptolemaic constellation. Piccolomini is just one of the nearly 200 entries in *The Sky Explored: Celestial Cartography 1500–1800*. This encyclopedic work lists alphabetically each author of a star map during this period and gives a few facts concerning his life, details of the publications and of the science contained on the charts, the antecedents of the work, and a bibliography. It does not make for easy reading, but for students of celestial globes, charts, and atlases it is a gold mine of information and a joy to peruse or to study.

The casual student of maps may know of the two beautiful sky hemispheres (1515) of the Nuremberg artist-mathematician Albrecht Dürer but will now know that the maps were the result of a three-man collaboration of Johann Stabius, who drew the coordinates, Conrad Heinfogel, who positioned the stars, and Dürer, who drew the constellation figures and cut the wood blocks. And the work of Bayer, the Amsterdam Blaeus (father and son), and the London Senex may be familiar. But there is much more to be learned among the unfamiliar. In 1733 Christoph Semler, a Protestant clergyman in Halle, published *Coelum Stellatum*, an atlas of 35 maps showing white stars on black sky. We learn that the copy of Semler's atlas at the Library of Congress has the penciled notion "Given to Whitney Warren . . . 1913 and used in designing the ceiling of the New York Central Terminal."

To lovers of old books, collectors, and students of star maps, this is almost as much fun as locating an old star map. It joins two earlier works on the subject, both now collectors' items (but each recently reprinted): E. L. Stevenson's *Terrestrial and Celestial Globes* (published for the Hispanic Society of America by Yale University Press, New Haven, 1921) and Basil Brown's *Astronomical Atlases, Maps and Charts* (Search Publishing Co., London, 1937). *The Sky Explored* is expensive, the quality of some of the many reproductions is poor, and, sadly, none are in color. Sources for all reproductions are given, however, and the serious reader could spend many delightful hours searching out the originals in the Library of Congress or in other major collections. But let the reader beware: the search for old globes and star charts is habit-forming.

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Atomic Collision Physics

Coherence and Correlation in Atomic Collisions. Papers from a workshop. H. KLEINPOPPEN and J. F. WILLIAMS, Eds. Plenum, New York, 1980. xiv, 706 pp., illus. $59.50. Physics of Atoms and Molecules.

In 1978, at age 70, Harrie Massey, who personifies atomic collision physics, was honored in London by an international workshop on coherence and correlation in atomic collision physics. The editors of this handsome volume, the fourth in the publisher's series on the physics of atoms and molecules, have produced more than a routine collection of conference reports or dedicatory essays. The 55 papers in the book (almost half from Germany, a third from the United States) present a comprehensive, up-to-date review of a very active field and contain a reasonable amount of experimental detail, with theoretical advances, admittedly not as impressive, given less weight.

The term "correlation" has several different technical meanings in physics, but as it is used in the book it mostly refers to the measurement of angular and polarization correlations, although correlations of a related but more conceptual kind, such as the effects of the inclusion of interactions among electrons in describing atomic structure, are also discussed.

In an atomic collision experiment, a beam of particles (positive or negative electrons or ions, or photons) is directed at a gaseous or solid target, and some or all of the collision products are observed. In the early days, nothing more was measured than the attenuation of the incident beam as it penetrated a thickness of target material, and inferences were drawn about the overall efficaciousness (total integrated cross section) of the collisional interaction. Great advances in beam, detection, and data-col-