grams and, as might be expected, the majority of the papers deal with comet Kohoutek, including two by its discoverer. (An additional score of papers on that comet appeared in *Icarus* **23**, No. 4 [1974].) Although the comet did not measure up to the expectations of extreme brilliance, this book shows that the prediction led to an unprecedented mobilization of observers and instrumentation and demonstrates that exceptional brightness is not a prerequisite for the application of new and sophisticated techniques. The observations described and analyzed range from conventional photography of the tail with small Schmidt telescopes, to ground-based photometry and spectroscopy at optical wavelengths, to radio detection of molecules and ultraviolet spectroscopy from spacecraft.

About half of the pages of the book are occupied by reviews, comments on papers, and panel discussions. It would be impractical to outline the 70-odd contributions, which on the whole complement one another without the duplication sometimes encountered in reports of meetings. The substance and spirit of the discussions (enlivened by occasional passages of vigorous disagreement) have been successfully preserved. *The Study of Comets* is recommended to anyone who wishes to become acquainted with current problems and accomplishments in cometary research. Among the many excellent papers are several on the allied problems of the nature of the nucleus and the coma. Sekanina's "A continuing controversy: Has the cometary nucleus been resolved?" is a more comprehensive review than the title suggests. It can be read in conjunction with the following 50 pages of panel discussion, with Delsemme's review, "The neutral coma of comets," and with related contributions, such as the review by Roemer, "Luminosity and astrometry of comets," "Gas phase chemistry in comets" by Oppenheimer, "The gas production rate of comet Bennett" by Lillie and Keller, and Herbig's "Review of cometary spectra." One could select similar sequences of papers bearing on cometary dust and ions, and a reader who wishes to appreciate what a campaign devoted to a single comet can yield will find 18 papers devoted to comet Kohoutek.

Part 2 concludes with five contributions on possible spacecraft missions, of which "Expected scientific results on ballistic spacecraft missions to comet Encke during the 1980 apparition" by Mumma appealed most to this reviewer. It should be read in association with "Nongravitational forces on comets" by Marsden and "Orbital error analysis for comet Encke, 1980" by Yeomans. Comet Encke is clearly the prime target for a mission. The three papers that follow Mumma's also include orbital diagrams for Encke 1980 missions, although Farquhar's contribution also looks at Encke in 1984 and three other possible targets, including Halley's comet.

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Hominid Evolution

Paleoanthropology. Morphology and Paleoecology. Papers from a congress, Chicago, Sept. 1973. RUSSELL H. TUTTLE, Ed. Mouton, The Hague, 1975 (U.S. distributor, Aldine, Chicago). xvi, 454 pp., illus. $29.50. World Anthropology.

Primate Functional Morphology and Evolution. Papers from a congress, Chicago, Sept. 1973. RUSSELL H. TUTTLE, Ed. Mouton, The Hague, 1975 (U.S. distributor, Aldine, Chicago). xvi, 584 pp., illus. + plates. $34.50. World Anthropology.

These two volumes consist of papers presented at the 11th International Congress of Anthropological and Ethnological Sciences. The differing titles notwithstanding, both books are directed mostly to questions of hominid evolution.

The papers in the books are gathered into groups, each of which is followed by a discussion ostensibly devoted to the ideas and issues raised in the papers.

Both volunteered and solicited papers are included. In the prefaces, the editor and the organizer of the sessions, R. H. Tuttle, writes that one of his aims in soliciting papers was to focus on issues of special interest. Such a strategy has the disadvantage of emphasizing the ideas of those with recognized views and encouraging the inclusion of data and conclusions that have already been published. It is successful in several sections of these volumes, however, notably those dealing with the evolution of bipedalism and the evolution of the brain and language in the primate studies volume and the very long section of the paleoanthropology volume devoted to the status of *Ramapithecus* and other Miocene hominoids.

The section of the paleoanthropology volume that concerns *Ramapithecus* includes papers by Conroy and Pilbeam, Aguirre, and Eckhardt. Their major conclusions have appeared elsewhere, yet the section as a whole is very useful, demonstrating the difficulties of evaluating the rather meager collection of scraps identified as *Ramapithecus*. The articles emphasize different aspects of the morphology and point up the equivocal nature of the bones themselves: some attributes clearly support a hominid status for this sample, whereas others suggest a short-faced pongid. The selection of papers also reflects the lack of agreement about whether all the fossils currently placed in *Ramapithecus* are in fact the same animal; some authors suggest that all the fossils ought to be considered hominid, whereas others eliminate the East African or the South Asian samples from consideration as earliest hominid. Finally, this section provides an excellent example of the disagreement about the identification of specific morphological attributes that has caused serious problems of interpretation in paleoanthropology. The first lower premolar (P_3) of the East African *Ramapithecus wickeri* is variously described as "semisectoral and bicuspid," "unicuspidate," and ape-like, and one paper denies that a P_3 from *Ramapithecus* has been reported.

In general, the papers are about evenly divided among reviews or overviews on particular subjects and presentations of original research, especially descriptions of recently discovered fossil specimens.

Among the latter, I found Sartono's description in the paleoanthropology volume of the newly uncovered *Homo erectus* skull from Java (called by Sartono *Pithecanthropus* VIII and by Jacob in the same volume Sangiran 17) particularly illuminating. His discussion of the relative stratigraphy of the Java specimens and their differing morphology clearly reveals hominid morphological change during the period from about 1.5 to about 0.5 million years ago. Sartono places the *Pithecanthropus* VIII specimen somewhat later in time than other *Homo erectus* fossils from Java, yet earlier than the Upper Pleistocene hominid sample from Ngandong (the "Solo" specimens). Sartono demonstrates that *Pithecanthropus* VIII shares morphological affinities with both the earlier *Homo erectus* fossils and the later-in-time Ngandong sample, emphasizing the temporal continuity of this Java sample.

Another article I found especially useful is Brain's succinct discussion of the South African Kromdraai australopithecine site. After summarizing the geology and the hominid and other vertebrate paleontology of this least known of the South African early hominid sites, Brain offers an interpretation of the accumulated bones from Kromdraai based on the extreme fragmentation of the individual pieces and a reconstruction of the en-

vironmental setting when the cave filling was deposited. Brain concludes that the majority of the Kromdraai bone fragments represent the food remains of hominid hunters.

Also of interest are the final papers of the paleoanthropology volume, by Vlček describing a burial from the Crimean site of Kiik-Koba of a Neandertal infant, which at the estimated age of death of five to seven months is perhaps the youngest fossil hominid to be excavated, and by Kolossov, Kharitonov, and Yakimov describing the Neandertal remains from another Crimean site, Zaskalnaya VI.

In the primate studies volume, particular mention should be made of the paper by Walker and Murray on the differences between colobine and cercopithecine monkey bilophodont molars. The paper stresses the relationship of these differences to the ability of colobine molars to cut leafy food materials more efficiently into smaller pieces, as measured primarily by an examination of stomach contents of shot wild specimens. The authors offer convincing evidence that purely metrical analyses of the dentition of fossil primates may not be sufficient to identify adaptive differences in otherwise similar forms.

It is unfortunate that at approximately the same time this congress was convening in Chicago another meeting was being held in Nairobi that drew many paleoanthropologists who might otherwise have gone to Chicago, for there is virtually nothing in these volumes about the evolution of Pliocene–early Pleistocene hominids in East Africa.

Some of the papers could have been improved if more reference were made to other presentations in the volumes. For example, Eckhardt's paper, a well-reasoned argument for regarding *Gigantopithecus*, instead of *Ramapithecus*, as the earliest hominid, deals with the Indian *Gigantopithecus bilaspurensis* as dated from the Dhok Pathan zone in northern India, some 5 to 9 million years old. This dating represents a major problem in his presentation. In an earlier paper, Khatri reports that the mandible was not found in situ, but had been discovered by a peasant who kept it in his house until he sold it. Khatri wonders "how anyone can be sure of its geological horizon."

Finally, it would have been very helpful if the times for the Miocene, Pliocene, and Pleistocene in the papers in both volumes had been modified to reflect recent changes in the definitions of these epochs. Papers in both volumes mention these changes, and a detailed and comprehensive chart is provided at the end of Delson's paper in the primate studies volume, but there is little consistency in the use of these terms from paper to paper.

In summary, although new discoveries and reinterpretations of older finds and dates have caused much of what is said in these books to be outdated, the books do focus on current problems in primate anatomy and evolution and paleoanthropology, offering the considered views of many of the major researchers in these fields. They will be a worthwhile investment for readers who have professional interest in the subjects they deal with.

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Fossil Plant Assemblages

Paleoecology of Terrestrial Plants. Basic Principles and Techniques. V. A. KRASILOV. Translated from the Russian edition (Vladivostok, 1972) by Hilary Hardin. Halsted (Wiley), New York, and Israel Program for Scientific Translations, Jerusalem, 1975. viii, 284 pp., illus. $24.50.

Paleoecology, according to Krasilov, involves not only a systematic study of past life forms in combination with relevant geophysical and geochemical data, but also the development of paleoecological models consistent with information available from extant ecosystems. Krasilov presents a well-researched text that provides numerous examples of the usefulness of fossil plant assemblages (phytotaphocenoses) in paleoecological interpretations. Other books that have been published recently on the principles of paleoecology deal primarily with animals. Krasilov's is the first and only book devoted to principles and techniques of terrestrial plant paleoecology. It will have an important impact on this field in the Western world now that it is available in English.

It is important for students of evolution and sedimentology to be conversant with the principles of paleoecology. Krasilov's book supplies them with a detailed analysis of plant organs as sediments. Numerous depositional models and situations are described, though sometimes with little synthesis of the data presented.

Krasilov recognizes that in any aspect of paleoecology many factors influence the final conclusions drawn; sections of the three major parts of the book, Burial, Life Forms, and Vegetation, are carefully cross-referenced to illuminate the relationships among such factors. The portions of the book dealing with burial and vegetation will be the most useful to biostratigraphers and paleobotanists. Several examples of stratigraphic horizons bearing fossil plants are discussed in relation to the nature of burial, fossilization, and possible reworking of sediments. Descriptions of techniques for extracting information from fossil plant assemblages regarding paleosuccessions, paleoclimate, paleorelief, and the structure of past vegetation are provided and should be useful to students of paleoecology. In the section on life forms interesting aspects of the evolution of specific forms and functions of various plant organs are discussed in relation to the environmental pressures that may have influenced their development. The ecological settings for such major evolutionary events as the origin of land plants, the development of the seed habit, and the origins of major plant groups are discussed, though with the data available at present the role environments played in such events cannot be firmly established.

The broad survey this book provides of pertinent literature from all areas of the world (over 40 pages of references), naturally including work by many Russian authors, should be welcomed by English-reading scholars. It supplies important background information for an understanding of the various techniques for applying information from extant ecosystems to life forms and vegetational assemblages in the rock record. Because of the breadth of techniques covered, only selected techniques are discussed in detail.

Krasilov uses a variety of specialized ecological, botanical, and geological terms, and a glossary would have been helpful to many North American readers. The translation is well done and readable for the most part, though some of the idiomatic expressions used ("peter out," "fit the bill," "under the badge," and so forth) may cause a non-English-speaking reader problems. In correspondence and papers published in English the author transcribes his name Krassilov rather than Krasilov, as in this book. It is hoped that the difference in spelling will not be confusing to anyone. The half-tone illustrations are few and generally of poor quality; the line diagrams are better, but some graphs could be improved with more complete labeling.

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