weigh and sift their separate conclusions.

Despite—or possibly even because of—these difficulties, the book is an excellent compendium of our current knowledge about the solar system. Among other insights, it shows how our increasing knowledge about the separate members of the solar family illuminates our understanding of the whole system. One cannot help but endorse the stated wish of many of the authors that spacecraft will continue to be sent out on their missions of exploration. The riches in this book give eloquent testimony to the power of such machines to gather wonderful information about our solar system.

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Ancient Mining

Prehistoric Mining and Allied Industries. R. SHEPHERD. Academic Press, New York, 1980. xii, 272 pp., illus. $37. Studies in Archaeological Science.

During the last decade renewed interest in prehistoric technology has generated numerous studies of the processes by which both stone and metal artifacts were made. In lithic analysis, studies of the mechanical aspects of production and of microwear predominate, whereas archeometallurgical investigations comprise elemental and metallographic analyses of copper, bronze, and iron artifacts. End products—that is, finished artifacts—generally have been the focus of research, and little attention has been given to the initial process in their production, in which raw materials are extracted from the earth's crust.

Shepherd aims to fill the need for a survey of prehistoric mining directed especially to archeologists. He devotes approximately half his book (four chapters) to European flint mining, which started perhaps as early as the fourth millennium B.C. In these discussions the author's expertise as a mining engineer is best demonstrated. Through description of the two largest excavated flint-mining areas (Grimes Graves, Norfolk, England, and Spiennes, Belgium) and of other flint mines in Europe, one sees the extent and sophistication of this early mining. The mining of flint is perhaps better understood in archeological terms than the mining of metals, and levels of preservation not only of the mines themselves but of artifacts found in them make it clear that reconstruction of not only the technological but also the social aspects of this activity warrants more attention from scholars. In chapter 6 the author does turn to brief overviews of the cultural background of the flint-mining sites to try to place them in proper context.

Shepherd's treatment of prehistoric ore mining and related issues in archeometallurgy, to which he devotes two chapters, is not as thorough as the evidence permits. For example, the Bronze and Iron Age mining center at Timna in the Wadi Arabah in the Negev desert, Israel, receives little attention although it is one of the most extensively investigated of all mining sites. Also, the site of Laurion in Attica, Greece, which is perhaps the most important source of lead and silver for the entire eastern Mediterranean world and undoubtedly was exploited in prehistory, is not discussed.

The attempt by the author to review basic concepts in archeometallurgy that concern the development of the technology runs into difficulty. Archeometallurgical research has become sharply focused in a number of areas of Europe and elsewhere in the Old World, and one can no longer easily describe a developmental sequence that is applicable to all areas. Though the archeology of mining is adequately surveyed, the bibliography on archeometallurgy is neither current nor sufficient. Glaring omissions such as the more recent articles of Theodore A. Wertime (*Science* **159**, 927 [1968] and **182**, 875 [1973]) and James D. Muhly's *Copper and Tin* (1973) reflect on the nature of the research. In addition, the book is marred by the acceptance of several hypotheses that have been vitiated by more recent research or that represent only one of several possible explanations. None of these dicta can be considered as accepted fact: that the collapse of the Hittite Empire around 1200 B.C. allowed the dissemination of iron-working technology (p. 203), that the increased use of iron that marks the Iron Age occurred as a result of the disruption in the tin trade (p. 203), and that in prehistory arsenical copper artifacts were produced by mixing arsenic with copper (p. 240). All are currently the subject of considerable speculation and debate.

A pervasive problem is caused by the uncritical presentation of the ideas of a wide variety of scholars, both past and present, which makes the text rather erratic and disjointed; this book could have been the vehicle for the synthesis of current and relevant data into a useful, comprehensive body of information. In addition, editing should have ensured consistency in style, spelling, and content, and here the fault lies partly with the publisher.

This volume stands, nonetheless, as the only modern survey of prehistoric mining. Future users may find that flaws in the reporting of certain basic information as well as in format and style render it less valuable as a reference volume than one might have hoped.

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Biological Records

Skeletal Growth of Aquatic Organisms. Biological Records of Environmental Change. DONALD C. RHOADS and RICHARD A. LUTZ, Eds. Plenum, New York, 1980. xiv, 750 pp., illus. $47.50. Topics in Geobiology, vol. 1.

This book reviews current understanding of the sorts of information stored in animal skeletons, how it is stored, and how it can be recovered. Examples given in the book show that such information can be used not only to reconstruct aspects of the environments in which skeletons grew but also to determine population features such as growth rate, recruitment, and survivorship.

Analysis of past environments from the structure and morphology of skeletal materials was given a new twist by J. W. Wells in the early 1960's. Wells brought together the annual banding long recognized in the morphology of rugose corals and the tiny surface ridges that give this fossil group its name. He suggested that the ridges in these fossil corals (and in their modern relatives) represent daily growth increments. Since there are about 400 ridges to an annual band in Devonian fossils, the length of the Devonian day must have been about 22 hours. A geophysicist, S. K. Runcorn, saw the potential of this information. He stimulated further research and was rewarded with an estimate of 30.6 days for the length of the Devonian lunar month. This was obtained from repeated patterns of daily growth ridges within each annual band. These values were used with Kepler's second and third laws to calculate the loss of angular momentum from the earth to the moon. The transfer of energy occurs because tides raised by the moon