lacking entirely in theory or any broad intellectual goals.

All of this is not criticism of *Science in Archaeology* which makes no pretense (except on the dust-jacket and that can be ignored) of being a complete treatise on methods and techniques. Concentrated as it is on the laboratory approach, the book is far from complete, even with respect to the natural science part of archeology, although its summary articles include excellent up-to-date statements about most of the problems of current interest. One can, however, more clearly appreciate the accomplishments of the authors through understanding the place of their essays within the framework of scholarship in archeology.

It is not particularly useful to comment on which of the 54 articles are the best. The individual reader will find that his interest varies widely from article to article, depending on his background and specific interests. Some of the articles are well done, but their content will be familiar and hence perhaps less exciting than material of greater novelty. Some of the more interesting articles are those by E. H. Willis on radiocarbon dating (a most informative compact summary of the current problems), Charles Reed on osteoarcheology (the analysis of faunal remains), and Nils-Gustaf Gejvall on cremations (the determination of age and sex from small fragments of cremated human bone). Other readers will find their own interests most drawn to different parts of this extensive and varied series of essays.

It is a truism that large collections of essays are uneven in scope and quality, and in works like this one the variability is inevitably intensified because the contributors are from different countries and different disciplines. A few of these articles are brief pontifications without bibliographies. Others, while not lengthy in pages, are crammed with information and have such exhaustive bibliographies that some of the more obscure and inconsequential articles (namely my own) are cited. Many of the articles cite only "local" literature, mainly European. Some articles cite no archeological writing and are confined to specialized literature dealing with a particular type of analysis. Other articles make the analysis more explicitly relevant to archeological conclusions.

Despite the inevitable shortcomings of collected essays, however, the volume profits greatly from the built-in advantages of this kind of treatment—primarily the assemblage between two covers of many kinds of compact summary articles. Although much of the material is available elsewhere, to uncover what is presented here would require broad reading in many technical journals. The selection of essays is good and the editorial grouping is sensible, so there is a coherent pattern for the book as a whole. As a result of the broad coverage, every reader will find something of interest in and will learn quite a bit from *Science in Archaeology*.

CLEMENT W. MEIGHAN
Department of Anthropology,
University of California, Los Angeles

Crystalline Polymers

Polymer Single Crystals. Philip H. Geil. Interscience (Wiley), New York, 1963. xii + 560 pp. Illus. $16.

In 1957 Keller showed that the single crystals produced by precipitating polyethylene from dilute solution were formed by repeated folding back on themselves of the long polymer molecules, a process that results in thin, platelike, single crystals whose large upper and lower surfaces consist of chain folds. This discovery initiated a revolution in polymer crystal physics, which, when expanded to include the case of other polymers and crystallization from the melt, forms the basis of Geil's timely book. Geil treats the experimental aspects with admirable clarity and without serious omissions. Theoretical aspects of chain folding and related phenomena are discussed, but they do not constitute his central theme.

The chapters on the experimental aspects of single crystals from bulk and dilute solution, and on hedrites and spherulites formed in the bulk phase, are excellent. Convincing experimental evidence of chain folding is given in detail. The chapters on the annealing of polymers and on the relationship of morphology and properties are perhaps somewhat less satisfying because both the experimental and the theoretical background of these aspects are more confused or less complete, than those of other parts of the topic. Certainly Geil's presentation and organization of the facts in these areas, as they are now known, will not be easily surpassed until new evidence comes to light. The chapter on orientation effects is particularly worthy of praise.

Most of the theoretical side of chain folding is discussed in one chapter, and in the discussion of the experimental aspects no persistent attempt is made to weave theory and experiment together, although the expert reader can often sense what Geil thinks about the origin of various phenomena. Doubtless his reluctance to assume a firm stance with respect to the theoretical intrepretation is partially justified by the fact that two very different and somewhat complex theories of chain folding have been proposed. At the time the book was written there was no clearly decisive test of which, if either, theory was correct. Geil gives a sound and fair presentation of both theories.

My evaluation of this book can be summarized in a prediction: In a relatively short time, well-worn copies of Geil's book will be found in the laboratories of practically every worker interested in the physical properties of crystalline polymers, regardless of whether his main interest is fundamental research or technological application.

JOHN D. HOFFMAN
Polymers Division,
National Bureau of Standards

Russian-English Dictionary

Russian-English Physics Dictionary. Irving Emin and others. Wiley, New York, 1963. xxx + 564 pp. $14.

This Russian-English dictionary of physics is a welcome addition to our technical literature, for it fills a great need in that it facilitates our access to a highly important segment of the world's scientific literature. Indeed, the Emin dictionary is too much of a good thing. An adequate physics dictionary need not be burdened with geology, mineralogy, and meteorology. We do need good polytechnical dictionaries, but the Emin dictionary does not claim to be one. Why then burden a physics dictionary with пулемет [machine gun], партийный [party] разве [perhaps; unless; really], извините (меня) [I beg your pardon], шпион [spy], and many others. Although the English rendition of Russian technical terms is generally good, there are mistakes. Thus, чад is never smoke but fumes, and обзоливать is not calcine but ash

(the latter is also given). Кидание, киданный is not abandoning, abandoned. It acquires this meaning only with the prefix по, that is, покидание, покинутый. Небесполезный is preferably rendered as "not without use" rather than "of some use." Some of the alloys are capitalized while others are not. True, compared to the value of the dictionary, these are minor points. However, the use of "press" for издательство is inadmissible. John Wiley and Sons, Inc. is not a "press" but a publishing house or publisher, and they are likely to take strong exception when referred to as a "press."

The physical make-up of the dictionary—the font, printing, edge index, appendix, and introductory matter—is very good. But why the inaccurate rendition of the Library of Congress transliteration scheme on page xix? And what is meant by "standard letters" (line 4, p. xix)? Does it mean roman? I sincerely hope these irritants will be eliminated in future editions.

M. Hoseh
Biomedical Directory, Fordham University Project, Washington, D.C.

Lichen Anatomy

Encyclopedia of Plant Anatomy. vol. 6, pt. 9, *Lichens*. P. Ozenda. Borntraeger, Berlin, 1963. 199 pp. Illus.

Ozenda's *Lichens* is the first revision of volume 6 of the *Handbuch der Pflanzenanatomie*. Wilhelm Nienburg's *Anatomie der Flechten* (1926) was published as volume 6 of the first edition of the *Handbuch*.

Ozenda has attempted to provide an up-to-date treatise with respect to contemporary lichenological research on anatomy, morphology, cytology, and related topics. The author's aims are essentially fulfilled, and according to the preface, these aims included that of providing new chapters on the reproductive structures of lichens, on parasitism, and on growth. The volume fills the need for a thorough reference source on lichen structure; for this reason, it should be useful to all botanists and should also serve as a manual for instruction in lichenology.

Ozenda's publication is primarily a text on lichen anatomy, a fact that may be overlooked by those who see in its all-inclusive title, *Lichens*, a more general work. Nienburg's more specific title, *Anatomie der Flechten*, leaves no doubt in this respect. Lichenology includes a large number of works entitled "Lichens," and of these there are a few old but still authoritative publications that give more comprehensive descriptions of lichens, among them Annie L. Smith's *Lichens* and Zahlbruckner's *Lichenes*. Questions on lichen phylogeny, nomenclature, ecology, and economic uses, as well as details on lichen anatomy may be found in these earlier studies. Consequently, Ozenda's treatise does not displace the earlier and more general works in lichenology, although it does bring together contemporary research on lichen anatomy into one very useful volume, and thus it supplements the older references. This may be noted by examining its table of contents.

In a well-prepared introduction, Ozenda refers to the work of his predecessor and to that of his contemporaries. However, there is no formal reference to Nienburg's *Anatomie der Flechten* in either the text or the bibliography. Although Ozenda's monograph is some 40 pages longer than the earlier volume, the 177 pages of text includes 128 figures. The book has an appendix (3 pages) and indexes to subjects, Latin plant names, and authors. Asterisks are used in the indexes to identify materials that are illustrated. Illustrations have been used generously and to good effect to support the text, and the selection includes the excellent drawings from Galloe's *Natural History of the Danish Lichens*. The nomenclature used throughout conforms to either Rabenhorst's *Kryptogamen-Flora* or Zahlbruckner's *Catalogus Universalis Lichenum*.

Lichens is a conservative, straightforward exposition on lichen anatomy. The text, which is written in French, consists of three principal sections, in which are considered the constituents of lichens, the anatomy of the thallus, and the reproductive structures. The discussion on the algal and fungal constituents includes systematics and is followed by a brief review of the growth of lichen constituents in pure culture. The second and lengthiest part of the text gives considerable details of the lichen unit, the thallus. The material is arranged according to thallus type, beginning with the least developed, the granulose, through all intermediate types to the most advanced, the fruticulose. Ozenda brings to this discussion pertinent studies and theories, including some phylogenetic and ecological notes, which add considerably to the treatment. Under each type of thallus, brief summaries have been prepared of the appropriate families or genera. In this section soredia and isidia and their relationships to vegetative reproduction are also described, and data on the development and growth of thalli of both sexual and asexual origins are reviewed; the chapter closes with a description of thallus deformations caused by lichen parasites.

This final part contains an excellent description, including nomenclatural and systematic data, of the plant parasites of lichens. The third and last section of the text is on reproductive organs, apothecia and pycnidia, and on their products, spores and pycnids. This material is also well presented, in considerable detail, with many illustrations that provide a fairly comprehensive review of the sexual reproductive structures of lichens.

One would expect contemporary research to be reflected in the documentation of the text by a relatively large number of recently published works. Yet it appears that more than three quarters of the references in the bibliography were published between 1850 and 1925, the greatest peak about the turn of the century, a time of considerable activity and development of which Nienburg was very much a part. As I noted earlier, the title of Nienburg's treatise is not cited in the bibliography; a number of other lichenologists are referred to by name in the text but are not identified by their works. For example, although Frey's systematics in *Umbilicaria* may be preferred to Llano's the reader should be given references to the works of both authors. How else can the student or researcher evaluate the facts or find the pertinent literature? The description of lichen culture research is incomplete without reference to the work of British workers or without information on experimentation in the field of lichen antibiotics. Lichen acids are mentioned, but almost in passing and, unfortunately, are poorly illustrated. Several aspects of this subject are of increasing significance, and the subject might well have been given more consideration. Lichenology is a branch of the botanical sciences founded on the remarkably stable relationship between two dis-