with the most readable paper in the volume, by Butler, devoted to explaining the growth of human tooth germs and the developmental sequence of cusps. He concludes that tooth growth is additive, not exponential as had been assumed earlier, even by himself in 1967. Tooth growth and calcification seem to be independent processes and growth between cusps continues until their calcified caps unite. One very interesting feature from a phylogenetic viewpoint is that in man the entoconid remains separate later than other lower tooth cusps do, so that talonid width increases by entoconid movement away from the other cusps until calcification ends growth. The captions of figures 3 and 4 of Butler's paper are in the correct sequence, but the drawings are unfortunately switched.

Three of the papers in the ontogeny section deal with dental histology and problems of induction, two of them describing ingenious experimental work. These three papers seem to me to come to somewhat contradictory conclusions, unless I was misled by differences in terminology. I would have preferred that their authors had combined their efforts into a single, integrated essay.

The section on phylogeny contains an instructive introduction to the phylogeny of calcified tissues by D. F. G. Poole, which points out many unsolved problems. A. Boyde shows wonderful scanning electron microscope pictures of mammalian enamel histology, but makes no sense of the peculiar distribution among mammalian orders of the features seen. P. Hershkovitz's paper, "Basic crown patterns and cusp homologies of mammalian teeth," is proclaimed in the anonymously authored introduction to the volume as a classic in its field; certainly I agree that all researchers concerned with dental cusp homologies will have to deal with it in future work. Hershkovitz goes well beyond Vandebroek and Quinet in finding it necessary to replace long-used names of dental features with unfamiliar new ones, and carries serial homology and supposed homology between upper and lower tooth cusps to their logical extremes, assuming certain premises. Readers will want to analyze for themselves whether zalambdodonty (in modern mammals) is primitive, as Hershkovitz would have it, or derived, whether metacones arise in the ways claimed, and whether Hershkovitz has actually demonstrated serial homology in each claimed case. The paper is totally lacking in functional interpretation, but an alphabetical list of 338 generally unfamiliar dental element names is brought together and the terms are defined according to Hershkovitz's interpretations. W. D. Turnbull's contribution consists chiefly of figuring the Field Museum's Trinity (Albian Cretaceous) mammal teeth by means of stereophotos. He also proposes several new and (I think) unnecessary higher taxonomic categories and develops an argument that it is premature to "force the Trinity therians into the metatherian-eutherian dichotomy." A potboiler by W. A. Clemens on Mesozoic mammals and a review by E. L. Simons of Old World anthropoid specimens from the Oligocene and Miocene complete the phylogeny section.

The morphology section contains two papers that I found especially interesting: I. Kovacs on just about anything one would want to know about dental roots, and K. Hiiemae and A. W. Crompton on a cinefluorographic study of feeding in the American opossum. The other papers are primarily about small-scale evolutionary changes within the genus *Homo*.

The book is well illustrated and supplied with both an author and a subject index. Unfortunately, there are a number of typographical errors.

MALCOLM C. MCKENNA
Department of Vertebrate Paleontology, American Museum of Natural History, New York City

Deformation

Microtectonics along the Western Edge of the Blue Ridge, Maryland and Virginia. ERNST CLOOS. Johns Hopkins Press, Baltimore, 1972. xiv, 234 pp., illus., + maps. \$12.50.

In one way or another the origin of deformed rocks is the subject matter of the long-standing field of structural geology, so it is perhaps remarkable that the state of strain of rocks is, with few exceptions, not well established. Though some workers have studied deformed fossils, the most straightforward way of determining strain has been to measure the orientation and shape of originally spherical or nearly spherical particles which were transformed into ellipsoids during deformation. Cloos did just this in his now-classic 1947 paper on the South Mountain fold between the Susquehanna and Potomac rivers, in which he described the deformation of originally nearly spherical calcium carbonate sand grains (ooids) within limestone beds of this 10-to-20-kilometer-wide fold.

The present monograph is an elaborate sequel in which the study has been extended far south along the Blue Ridge to Lexington, Virginia, and has been expanded to include a number of other deformation features. The careful reader who has the patience for the difficult and exasperating style, which would only warm the heart of Gertrude Stein, will find numerous subtle and rewarding insights into the systematic regional deformation of this 15,000-square-kilometer region of the Appalachian fold belt as well as into the variety and complexity of the operative strain mechanisms. The 85 high-quality photographs of deformation features are worth studying.

It is unusual in present-day earth science that a paper retains considerable importance after a quarter of a century. The continued influence of Cloos's works is due in part to the unpopular nature of this type of research. An enormous amount of labor is required to make the quantitative measurements that lead to qualitative insights. Since Cloos's original publication only a handful of workers, mostly German, have pursued this course. So a quarter of a century later Cloos has produced another careful study of Blue Ridge deformation which is destined to become a classic if for no other reason than that it is not likely to be repeated in the near future in other regions: 42,585 ellipsoid axial ratios were measured on samples in the lab and over 25,000 field measurements were made.

JOHN SUPPE
Department of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey

Clean Metal Surfaces

Chemisorption and Reactions on Metallic Films. J. R. ANDERSON, Ed. Academic Press, New York, 1971. In two volumes. Vol. 1, xii, 556 pp., illus. \$32. Vol. 2, xii, 324 pp., illus. \$21.

Studies of clean metal surfaces principally involve use of evaporated films, sections cut from single crystals, or the single crystal points of emission microscopy. Typical total surface areas of the samples employed are 100 cm^2, 1 cm^2, and 10^{-10} cm^2 respectively. The use of evaporated metal films suffers from the disadvantage that the films are texturally complex and their surfaces are ill defined. In some cases, this defect can be partially reduced by working with films grown epitaxially on suitable supports. Other disadvantages are that the films cannot usually be heated to high temperatures and, since they cannot be cleaned, they can be used but once. On the other hand, they offer two important advantages. A clean evaporated film of almost any metal can be prepared whereas because of the need for cleaning the literature of the other two methods can give the impression that tungsten is the only known metal. The larger sample area of the evaporated film is often an advantage. The gettering capacity of the film offsets the effect of contaminants and the larger area considerably facilitates determination of the amount of chemisorption and the study of heterogeneous catalytic processes.

This treatise is aimed at chemical reactions (adsorption, heterogeneous catalysis, conversion to compounds) at clean metal surfaces. Primarily it treats work on evaporated, thin films, but correlations with metal surfaces of other origins are extensively introduced. Although the treatise is aimed finally at chemical reactions, the structure and growth of thin films are treated extensively and in three chapters from differing points of view. The chapter by J. W. Geus which deals with this is particularly thorough and penetrating.

Several chapters deal with adsorption phenomena. That by D. O. Hayward contains considerable theoretical background on theories of bonding as a background to a survey of the adsorption of diatomic molecules. It serves to update *Chemisorption*, second edition, 1964, by Hayward and B. M. W. Trapnell. The chapter by J. R. Anderson and B. R. Baker considers adsorption equilibria and rates of adsorption with rather heavy reliance upon the conventional formal methods of Langmuir adsorption. The treatment of surface heterogeneity is rather more interesting and useful. Geus provides another penetrating chapter on the electrical resistance of evaporated films and the effects thereon of chemisorption. L. H. Little has a critical survey of the use of infrared spectroscopy for the study of chemisorbed species.

In the sections dealing with chemical reactions, I. M. Ritchie considers the processes involved in the oxidation of metals and Anderson and Baker have a long chapter which well surveys the use of evaporated metal films for study of heterogeneous catalysis. Twenty years ago a Gordon Research Conference on Catalysis was apt to degenerate into sloganeering in which the evaporated metal film adepts disdainfully alluded to the "dirty, contaminated" surfaces of the workers with conventional catalysts and the latter referred disparagingly to the "impracticality" of thin metal films. In reading Anderson and Baker's chapter it is interesting to note how this debate has faded and how well the results with metal films and with supported Group VIII metals accord. The considerable sections of the chapter on mechanism are primarily from the point of view of Anderson's own theories—but that is fair enough.

There are also chapters by D. F. Klemperer and D. R. Rossington on experimental techniques and alloy films, respectively.

This treatise does a good job in attaining its objectives.

ROBERT L. BURWELL, JR.
Department of Chemistry, Northwestern University, Evanston, Illinois

Amorphous Matter

Electronic Processes in Non-Crystalline Materials. N. F. MOTT and E. A. DAVIS. Oxford University Press, New York, 1971. xiv, 438 pp., illus. $24. International Series of Monographs on Physics.

Until very recently solid state physics has been concerned almost exclusively with crystalline materials. Although most of the solid state physicist's time is spent studying deviations from perfect periodicity of the crystalline lattice, such as lattice vibrations, impurities, point defects, and dislocations, because these are essential for understanding the properties of crystals, this disorder is sufficiently small that it does not invalidate the fundamental concepts which are based on the translational symmetry of the crystal lattice. These concepts find their expression in the band theory, Brillouin zones, and the dynamics of the electronic crystal momentum. It is curious that modern textbooks of solids do not even mention semiconducting glasses or, indeed, amorphous substances in general. Why have noncrystalline materials been ignored for such a long time? The answer is probably that noncrystalline materials cannot be simply described as extremely disordered crystalline materials. The whole conceptual framework appears to be useless. Complete absence of long-range order demands that we find and invent new concepts with which the general laws governing the electronic processes in noncrystalline materials can be described. This is precisely the reason why this new field of solid state physics is exciting and challenging.

The field has received much impetus recently from the use of amorphous semiconductors in electrophotography, electronic and optical memory devices, and electronic switching and as infrared optical elements. Despite significant progress in characterizing and understanding noncrystalline materials during the past ten years the field is still in a pioneering stage similar to that of crystalline solid state physics in the early 1950's.

It was therefore a great surprise to find that this new book by Mott and Davis goes far beyond summarizing the present state of knowledge. Mott and Davis analyze the conceptual foundation of the field, develop a theoretical framework for transport processes in disordered materials, and propose simple physical models which are based on physical intuition and a thorough familiarity with the experimental results. The authors present a large quantity of well-selected experimental data on a variety of disordered systems. These include liquid metals, semimetals and semiconductors, impurity bands in crystalline semiconductors, amorphous films of metals and semiconductors, and semiconducting glasses. The experimental evidence is analyzed, interrelated, and interpreted within the theoretical framework developed.

This book demonstrates a symbiotic interdependence of theory and experiment so fruitful for a developing field of research. It therefore should be of great interest to students of physics in general and, in particular, to scientists who wish to investigate systems of even higher complexity, such as organic and biological matter. For students and researchers of noncrystalline materials this book will be, of course, an indispensable source and guide for many years to come.

How remarkable this book is can be appreciated only after recognizing that it is perhaps the most interesting of a long series of similar achievements of the senior author spanning a career of over 40 years.

H. FRITZSCHE
Department of Physics, University of Chicago, Chicago, Illinois