historians of physics (including Hermann) began as physicists, it is especially interesting to read his account of Haas, who is probably the only one to have made the inverse transformation.

Despite its merits Hermann's book is not adequate as history. It does not begin to reconstruct the science of the early 20th century in the kind of depth and detail that we need in order to understand what happened in the crucial first decade of the quantum revolution.

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Archeometry

Dating Techniques for the Archaeologist. HENRY N. MICHAEL and ELIZABETH K. RALPH, Eds. M.I.T. Press, Cambridge, Mass., 1971. xii, 228 pp., illus. $12.50.

This collection of papers, which inaugurates a series of handbooks to be produced under the auspices of the University of Pennsylvania Museum Applied Science Center for Archaeology, joins a collection of volumes that have appeared over the last three years dealing with the various technical and analytical specialties that can be grouped together under the heading archeometry. The other recent works include *Radiocarbon Variations and Absolute Chronology*, edited by Olsson; *Science and Archaeology*, edited by Brill; *The Impact of the Natural Sciences on Archaeology*, edited by Allibone; *Scientific Methods in Medieval Archaeology*, edited by Berger; and the second edition of *Science in Archaeology*, edited by Brothwell and Higgs. With the appearance of these works, archeometry can be said to have come of age, although the actual number of people engaged in it is relatively small. It has been, and presumably will continue to be, a contributory factor in nudging archeological research in the direction of more rigorously built strategies and methodologies modeled on those of the physical sciences. Although the so-called "new archeology" has a number of tangled roots, certainly the advent and increasing precision and accuracy of chronometric—"dating"—methods now in use must not be overlooked in any explanation of its origins.

The volume under review brings together contributions by eight authors, with four of the seven chapters—on dating by means of radiocarbon (Ralph), archeomagnetics (Bucha), thermoluminescence (Winter), and obsidian hydration (Michels and Bebrich)—providing extended discussions that include outlines of laboratory procedures. The other chapters—on dendrochronology (Michael), fission-track dating (Faul and Wagner), and potassium-argon dating (Faul)—although brief and selective, are valuable for those who wish to understand or review the basic elements of these techniques. The chapters on the two techniques with which most archeologists have had the most contact—radiocarbon and obsidian hydration—should be commented on specifically.

The chapter on radiocarbon is one of the most complete summaries of the technique available. Especially pertinent is the discussion of sample types suitable for radiocarbon work and of problems connected with their utilization. Very valuable also is a concise outline of the laboratory procedures, including the specific basis of statistical manipulations of counting data and the significance of $^{13}C/^{12}C$ ratios in fractionation determinations. Some, however, may be puzzled to find that a discussion of the basic assumptions of radiocarbon dating has been alloted only about twice the space of a section devoted to the McBee edge-punched retrieval cards for radiocarbon dates, especially in view of the fact that a project to provide a computer-based data-retrieval system is now well under way. Ralph's discussion of the relation of radiocarbon years to calendar or "true" years, in other words the secular variation or De Vries effect, apparently does not completely utilize the data published by Suess, and Ralph specifically notes some concern about the use of some radiocarbon data in magnetic intensity studies in Bucha's chapter in the volume. Ralph accepts the validity, *on the average*, of the long-term cycles identified by Suess, but does not agree on the existence of short-term oscillations. The occurrence of at least some of these short-term perturbations has been supported by carbon-14 data from European medieval samples (see the Berger volume). Those concerned with the problem of correcting carbon-14 data for secular variation may wish to use the "MASCA Correction Factors" in conjunction with the Suess values published in *Radiocarbon Variations and Absolute Chronology*.

The chapter on obsidian hydration provides a complete historical survey of the development of the technique, noting the lack of immediate acceptance of it as a time-placement method. Although the grounds are not specifically stated, the reluctance to accept the technique can be attributed to the simple fact that, on the average, 60 to 70 percent of the early obsidian hydration "dates" did not agree with the age of the obsidian sample as determined by other criteria. It was not until about five years ago that other workers began to investigate the chemical and physical nature of the hydration phenomena and the effect of compositional variability on hydration rates. Although the chapter notes the chemical problems in obsidian hydration work, it does not bring into clear focus the trends of the current research, in particular the realization that all hydration rates cannot be assumed to follow a simple diffusion formula. Evidence available by 1968 called into question, at least for one area, the use of a simple diffusion formula, and subsequent geochemical evidence confirms the extremely complex nature of obsidian hydration chemistry.

One trusts that, as the editors intend, this handbook will be regularly updated.

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Metropolitan Expansion

Suburban Land Conversion in the United States. An Economic and Governmental Process. MARION CLAWSON. Published for Resources for the Future by Johns Hopkins Press, Baltimore, 1971. xviii, 406 pp., illus. $12.50.

This comprehensive and careful study characterizes the broad results of America's century-long process of urbanization and illuminates the subtle and complex mechanisms that produce those results. Although the primary focus is on the land conversion process as it operates at the growing suburban fringe of our cities, its scope reaches into the slums and city halls of the metropolitan centers and the vast remaining rural areas of the nation. Based primarily on the last two decades, this study tells as much about our future as an urban nation as it does about our past.

The principal contribution of Clawson's book, in my view, is provided by the well-documented, analytic overview of the process of urban expansion in the United States in the period since World