about proposed mechanisms of the creation of F and V centers by x-rays, will be disappointed. Rather, the optical absorption, luminescent emission, photoconductivity, and magnetic properties of F centers are covered in detail. The theory is treated in two parts: the calculation of wave functions, and the electron-phonon interactions.

The theory of F centers is still evolving. Markham points out that although most methods give acceptable values for the energy of maximum optical absorption, no method has been particularly successful for calculating other observable properties of the F center. He begins by describing the method of Slater for treating imperfections; this method cannot, however, be rigorously applied to F centers. Of the methods for calculating the absorption-band location, that of Simpson is considered in quantitative detail. A brief comparison with the methods of Gourary and Adrian and of Kojima is given. Questions of recent interest, such as the lifetime of the excited state, and transitions to higher states (to produce the K or L bands perhaps) are not treated.

The book suffers from two drawbacks. First, as with all books dealing with lively research matters, the early cutoff date for new material (mid-1963) creates a feeling that parts of the book are out-of-date. Markham's preoccupation with the prewar work at Göttingen, important though this work is, and his omission of some significant developments in the period 1957–1963, contribute to this feeling. Second, there are many inelegancies in writing and some mistakes that detract from the pleasure of the reader. A careful editor could have been of assistance here.

In spite of these shortcomings, the wealth of information in this book should make it of value to anyone interested in the behavior of electrons in insulators.

ALLEN B. SCOTT
Department of Chemistry,
Oregon State University, Corvallis

On Information on Information

Annual Review of Information Science and Technology. Vol. 1. CARLOS A. CUADRA, Ed. Interscience (Wiley), New York, 1966. 401 pp. $12.50.

Through the combined efforts of a federal agency, a professional society, a nonprofit corporation, a publishing house, and a number of dedicated individuals, a first sample of a much-needed review series has come into existence. Although the editor admits that "at the present time there is no clearly defined and well-understood field of information science and technology," this book nevertheless provides a quite reasonable mapping of that field onto a dozen carefully written review chapters. These chapters, in turn, provide a total of more than a thousand references to the current literature.

Prior to this book, the best tour guide to the field had been the National Science Foundation's series *Current Research and Development in Scientific Documentation.* Unlike such a compilation, this book attempts the difficult task of reviewing in a critical fashion both a technical field and a body of literature. I found the result strongest as a coherent descriptive survey of recent work in the field. Most chapters also provide credible discussions about current status and trends. However, actual criticism of specific endeavors or specific references is rather infrequent and usually gentle; it would have been refreshing to find an occasional admonition to burn a book or to skip a particular field of endeavor, but in this respect the reader will be disappointed.

Three key chapters address, respectively, content analysis, file structures, and the related issues of natural language research. It is interesting to observe that all three chapter authors visualize considerable human participation in the computer handling of information. In the chapter on content analysis, Phyllis Baxendale concludes that "It is entirely predictable, for example, that computer-aided human indexing and interrogation will be qualitatively and economically superior to fully automatic methods." Still later in the book, Jordan Baruch, talking about information system applications in fields such as medicine, similarly concludes that "man has gradually crept back into the interpretation and control loop."

Although extensive citation of the literature leads to occasional slow reading, the excitement of a burgeoning field and the intensity of national interest is clearly transmitted. This review volume should be a useful reference for the expert and an excellent appetizer for the serious novice.

FRANK E. HEART
Bolt Beranek and Newman Inc.,
Cambridge, Massachusetts

Radioactivity in the Sea

Radioecology of Aquatic Organisms. G. G. POLIKARPOV. Translated, with revisions by the author, from the Russian edition (Moscow, 1964), by Scripta Technica. Vincent Schultz and Alfred W. Klement, Jr., Translation Eds. Reinhold, New York, 1966. 342 pp., illus. $16.50.

The Russian edition of this work was reviewed in *Science* **154**, 995 (1966). The volume has much to recommend its translation. It is the first short summary of a very large field, and it provides an extensive introduction to Soviet work in radioecology, which Polikarpov defines broadly as being concerned with the interaction between a radioactive medium and living organisms.

The present revised and updated volume, prepared with the author's active cooperation, is expanded about 20 percent over the Russian edition and has recast tables and a more detailed mode of citation of the literature. There is still no index. The previously criticized "accumulation factors" are still based on the table (except for cesium) for elemental composition of sea water as given by Krumholz, Goldberg, and Boroughs, which is largely derived from older data and is badly out of date. One of the authors of the table (Goldberg) has published several revised estimates since the first compilation appeared in 1957. The translation is accurate and clear, with the exception of a few blue notes (for example, p. 53, "Complexing agents, which are also known as complexons and addenda. . . ."; p. 60, "The total exchange fund of calcium, strontium and some other elements in marine algae is made up of a large number of microfunds"). The price, though stiff, does not approach the exorbitant levels of some translated volumes which have appeared in recent years.

Readers will appreciate that aspects of radioecology lie close to sensitive areas of national nuclear policy and international politics. With due allowance for this and an understandable national orientation, Polikarpov's treatment seems fair and often agreeably candid. Only on one main question does one detect the possible intrusion of dogma: this is the repeatedly stressed view, coinciding with the official Soviet government position, that further addition of any kind of radioactive product to the oceans is inadmissable.

FRANK T. MANHEIM
U.S. Geological Survey,
Woods Hole, Massachusetts