The cellular components of the germarium are described in detail and interpreted in terms of the division of stem cell oogonia into daughter stem cells and cystoblasts at each division. Each cystoblast then undergoes four synchronous divisions to become the ring-canal-interconnected 16-cell cyst, made up of an oocyte and its 15 nurse cells.

The author uncritically assumes each germarium to have two stem cells. The progression of stages in the germarium must be more or less in step, new cystoblasts being added by stem cell division at a rate matching the loss of 16-cell cysts by incorporation into the vitellarium, since the germaria remain relatively uniform in cellular content. Finding one too many single cells in the germarium thus creates the ad hoc requirement that some cell type divide at half the cystocyte rate and therefore have two representatives. This cell type could as well be the cystoblast as the stem cell. The two models have quite different consequences, for example, with respect to mutagenesis.

Preadult ovarian development is treated inadequately. The origin, migration, and incorporation of pole cells into the developing ovary are described in three paragraphs. The initiation of division of primordial germ cells is not mentioned, nor are data on growth of the larval ovary. Differentiation of the pupal ovary is described, on the basis of the author's own work, but reference is not made to the major contributions of Aboim and of Bucher, which are pertinent to the theme of the book. It is not recognized that early germ cell proliferation may not follow the linear pattern found in the adult germarium and differences may exist that are significant, for example, for the nature of mutant clusters and for "age" effects on crossing over.

In general, the survey of the literature has been too selective. The works of Bucher and of Aboim are not isolated instances of earlier, significant papers that are neglected. Additional examples include the studies of Guyenot and Naville on the cytology of the pupal ovary and of Painter and Reindorp on the cytology of nurse cell development.

The author has speculated too freely, to the detriment of his worthwhile efforts. Thus, the account of the behavior of the oocyte chromosomes serves primarily to support the author's speculations—inappropriate to a work of this nature—on genetic recombination. There is even a new function for that marvelous stuff, heterochromatin. (Incidentally, only the most peripheral justification is evident for the inclusion of salivary chromosome maps in this—or any—connection.)

Discussions of female-sterile mutants are scattered throughout the book on the basis of the nature of the developmental failure. The idea is sound that the analysis of mutant development should give insight into the genetic control of oogenesis, but the insight actually gained is more than offset by the discontinuity introduced. The descriptions would better have been placed in a separate chapter toward the end of the work.

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Biological Spectrochemistry

Atomic Absorption Spectroscopy. Applications in Agriculture, Biology, and Medicine. GARY D. CHRISTIAN and FREDERIC J. FELDMAN. Wiley-Interscience, New York, 1970. xxii, 490 pp., illus. $16.50.

The last 230 pages of this book are recommended to scientists interested in elemental analysis of biological materials by atomic absorption spectrometry (AAS). The occurrence, biological role, and determination of about half the chemical elements are described. Some of the methods are summarized in tables—so that material up to mid-1969 can be included in a text written in early 1968—and none are described in detail. References are given to original publications, however, and the analyst can easily obtain details of the methods. The writing in this part is descriptive, rather than critical, it being left to the reader to evaluate the reliability of analytical methods. This requires knowledge of the chemical and physical principles of the method, and unfortunately these topics are treated quite poorly in the text.

Atomic absorption spectrometry has been used for a century to analyze stellar atmospheres, and flame emission has been used in the laboratory for even longer. The theory of flame AAS as a laboratory method has been built on these foundations and is well established. Unfortunately, the treatment of theory in this book is brief and, more seriously, it is shot through with errors. A knowledgeable practitioner of AAS may enjoy picking out the errors, but I suggest that the neophyte turn to other sources for information.

Some examples of errors can be chosen from page 11. Equation 2.9 purports to describe the Saha equilibrium, but two numbers are wrong (if you have the book, write in 5040 for 5050 in the first term and 3/2 for 5/2 in the second term, and be sure to express T in °K and E_i in eV) and there is an unfortunate use of P as the symbol for statistical weight (the usual symbol is g, and P is used in the preceding equation for partial pressure). Further down the page we read, "When the dissociation energy for a metal atom approaches the ionization potential, a difficulty in the absorption or emission emerges." I think I know what the authors mean, but as it stands the sentence makes no sense because the only dissociation (other than nuclear) for an atom is ionization. A purist may also object to the lumping together of potential and energy.

The following chapters, on instruments and procedures, are better but to my mind less satisfactory than the similar chapters in the books on AAS by Slavin and Ramirez-Munoz. The last chapter in part 1 is a fairly well balanced comparison of AAS with flame emission and atomic fluorescence. Unfortunately, the authors spoil it by gratuitously stating at the end that recent studies "should help to establish the importance of atomic emission. . . ." Really! Flame emission was used by Lundegardh to analyze agricultural, biological, and medical materials before the authors of this book or I were born. A serious problem in AAS has been that practitioners have ignored the flame emission work and have had to rediscover a vast amount of information.

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Investigating Glaciers

International Symposium on Antarctic Glaciological Exploration (ISAGE). Hanover, N.H., Sept. 1968. A. J. Gow, C. KEELER, C. C. LANGWAY, and W. F. WEEKS, Eds. Scientific Committee on Antarctic Research of the International Council of Scientific Unions, Cambridge, England, 1970. xviii, 544 pp., illus. Paper, $10. Publication No. 86, International Association of Scientific Hydrology and Scientific Committee on Antarctic Research.

In early September 1968, 125 glaciologists from 15 countries converged on the Dartmouth campus to participate in a symposium devoted to Antarctic glaciological exploration. The 55 papers

presented at the symposium are the basis for this volume. Although glaciology is a field of inquiry in which major scientific advances have been made only since the International Geophysical Year of 1957–58, the papers demonstrate that glaciologists employ highly sophisticated techniques in their field and laboratory investigations.

The papers are grouped into nine categories: glaciochemistry, deep soundings, thermodynamics, dynamics, glacial meteorology, mass budgets, fringe regions, ice shelves, and sea ice. Reference to only a few of these sections will be made in this review.

The geochemistry of glacier ice is a relatively new aspect of glaciology that was stimulated by the retrieval of long ice cores from Camp Century in Greenland. Because seasonal variations in the physical characteristics of glacier ice diminish with depth, glaciologists sought other means of dating the deep ice layers. These include studies of insoluble aerosols, ionic content, and stable and unstable isotopes.

The vertical dimension of an ice cap can be attacked by direct penetration with a core drill, by the use of a thermal probe, by traditional seismic soundings, or by radio echo exploration. Core drilling provides the most information because actual samples are returned to the surface for laboratory study. Thermal probes are in their early stages of development and may have value as an inexpensive means of making remote measurements of *in situ* temperature and stress conditions deep in the ice. The record of radio echos from an ice sheet shows the base of the ice, the ice surface, and internal reflecting horizons of unknown origin. The airborne radio echo sounding technique has made thousands of kilometers of ice thickness profiles available for analysis and study, but one constraint on the interpretation of these data is the poor quality of navigational control of the flight lines.

Papers on the thermodynamic behavior of ice sheets are concerned with the meaning of vertical temperature profiles in terms of the past climatic history of the ice sheets. The general idea is that past changes in the surface temperature of an ice sheet will be reflected in the temperature profile. Problems arise in isolating this effect, however, because other parameters such as the accumulation rate, strain rate, ice velocity, surface slope, ice thickness, and the geothermal heat flux all have some effect on the temperature profile. Work with theoretical models indicates that there is considerable merit in continuing this line of investigation.

A paper in the section on dynamics deals with glacial modeling in an attempt to study the interplay between glaciers and climate. This approach involves a consideration of how changes in accumulation will be reflected in the behavior of a glacier.

The papers on ice shelves include movement studies and other aspects of ice shelf regimes with special attention to the question of bottom melting or freezing. This question is not yet resolved.

The international aspects of Antarctic glaciology are clearly in evidence by the fact that almost all of the member nations of the Scientific Committee for Antarctic Research (SCAR) are represented by authors of papers in this volume. While there is no general theme to this collection of papers, it is still a useful volume for scientists who are working in one or more aspects of Antarctic glaciology.

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