The articles indicate that macromolecular metabolism, function, and organization constitute a major focus of the series. "Organelle biosynthesis: chloroplasts" is an example of perhaps the best of this genre of survey article. The subject is of considerable interest and probably unfamiliar to many workers in "molecular biology" inasmuch as plants have not yet become highly fashionable. This fascinating organelle provides an excellent example of semiautonomous genetic information used to form and maintain a highly differentiated structure within the cell cytoplasm. Its formation can be conveniently triggered, and specific inhibitors of many of its macromolecular synthetic processes are known. The subject is reviewed clearly and competently.

The article by Mandel on the incorporation of 5-fluorouracil into RNA and its molecular consequences is an extensive review of a large and disparate literature which would constitute practically mandatory reading for anyone considering the use of this or other analogs that are incorporated into RNA.

"Errors in translation" summarizes what is known about the fidelity of amino acid incorporation and especially the drug-induced ambiguities.

"The biological significance of the genetic code" by Woese contains a concise account of the history of the breaking of the code. The "biological significance" actually means the author's speculations about the evolution of the protein synthesis apparatus. This reviewer's personal prejudice has never permitted enthusiasm for this type of reasoning, and I am skeptical of the idea that RNA-DNA hybridization data really indicate much about a primitive ribosome; others may find such speculation more to their taste.

Finally, a brief article by Agranoff on "Macromolecules and brain function" states clearly that this is a field of inquiry that is in, to say the least, a primitive state. A number of interesting and mystifying phenomena are described, as well as the author's own studies on the effect of metabolic inhibitors on memory, from which very modest conclusions are drawn. The article serves a useful function in indicating the complexities and difficulties awaiting those who, perhaps with youthful exuberance, might decide to launch into the problem of "brain function."

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New Findings from Antarctica

Antarctic Ecology. Based on a symposium, Cambridge, England, 1968. M. W. HOLDGATE, Ed. Published for the Scientific Committee on Antarctic Research by Academic Press, New York, 1970. 2 vols. Vol. 1, xx, 604 pp., illus., $18.50; vol. 2, xx, 394 pp., illus., $14.

This is the report of the second symposium on antarctic biology, held at the Scott Polar Research Institute at Cambridge, England, in 1968. Both that symposium and the first one, held in Paris in 1962, were arranged by the Scientific Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions. The results of the first symposium were published under the title *Biologie Antarctique* by Hermann & Cie. in 1964. That volume consisted of largely preliminary outlines of knowledge of systematics and ecology of antarctic biota, partly based on short periods of study. The new two-volume work is another landmark, representing a great advance over the former.

The large number of contributions to this remarkable collection is such that merely to list authors and titles would occupy most of the space allotted for this review. A total of 101 authors and co-authors appear; there are 81 articles, arranged in 14 sections each of which includes an editor's introduction and a discussion. The subjects of the sections are: vol. 1—Past Environments, Marine Ecosystems, Plankton and Its Pelagic Consumers, The Pelagic Resources of the Southern Ocean, Marine Benthos, Fishes, The Biology of Seals, Adaptation in Seals, Ecology of Antarctic Birds; vol. 2—Freshwater Ecosystems, Soils, Vegetation, Terrestrial Fauna, Conservation.

This collection presents a remarkable assemblage of information on antarctic ecology and its ramifications, including the more pertinent aspects of the nature and history of the physical environment. Much of the information is new. There is great emphasis on the marine environment, productivity, and potentials of utilization in a context of wise conservation.

Adie indicates that the eastern, Gondwana, portion of the continent is Paleozoic and the western, Andean, portion much younger—Mesozoic and Tertiary—and that many fundamental factors, such as multiple glaciation, sea-level fluctuation, paleomagnetism, climatic variation, and paleogeography, are significant in affecting the present occurrence of life on the continent. In the Pleistocene the ice sheet was larger than at present (Hollin). Sea-bottom deposits present much history of ice erosion and also show two periods of rapid cooling, 2.5 million and 0.7 million years ago, respectively (Hays).

The dry valleys near McMurdo Sound constitute unique environments. They partly form one of the driest spots known on earth, but also contain some lakes over 60,000 years old, with frozen upper layers, warm bottom layers with great concentrations of various salts, and no circulation (Wilson).

The climate warmed 10,000 years ago, but the Antarctic Convergence (where cold antarctic waters sink beneath the temperate waters) may have been 5 degrees farther north at antarctic glacial maximum, when land biota would have been lost or restricted (van Zinderen Bakker).

Much attention is devoted to the marine environment in all aspects. The potential importance of krill as a world food is stressed. Knox shows that the marine environment varies only between +3° and −2°C, that productivity is surprising, that there are more species at greater depths, that many are very large, that sessile species are dominant, and that the standing crop is much richer than that of the Arctic. Hedgpeth reports that bipolar species are very few, that biomass may be 5 to 10 times that of the Arctic, that group compositions differ, and that the Arctic Sea may have been a frozen lake when the seas were colder. Dunbar shows that animals can adapt to low temperatures, that growth rates may be slow but there is compensation in large body size and extensive egg production. El Sayed indicates that the Pacific is poorer than the Atlantic in phytoplankton, and that the antarctic coastal waters, 70° to 75°S, are the most productive. Zermova shows that most phytoplankton are diatoms and there is a bloom between January and April. Balech indicates that dinoflagellates and tintinnids are highly endemic and radiolarians are more abundant than in other seas. Kozlova shows that diatoms decrease from surface downwards. Belyaeva states that Foraminifera are denser near the continent and especially south of New Zealand. Voronina stresses seasonal cycles and shows that copepods make up 73 percent of biomass of mesoplankton. Makarov *et al.* show that krill feed upon phytoplankton. Several authors discuss krill predation by fish, whales, and others and discuss possibilities of whale

extinction or rehabilitation and numerous important related matters.

Many other interesting points are discussed, such as the near lack of intertidal life because of ice scouring, the different bottom biotas with different substrate and depth, the great depth to which the Weddell seal dives (600 meters; for 45 or even 60 minutes). Many new data are presented on filling in the food webs, on physiology under low temperature, and on the many adaptations to this and other factors of the environment. Some of the fish have supercooled blood and do not freeze even when resting on ice platelets on the bottom. In some, blood circulation may be restricted during cold stress and metabolic heat apparently has survival value. Solar radiation is of significance to some. Seals apparently have tolerance to sustained hypoxia, and have high O_2 capacity of hemoglobin. Pregnant females make longer dives.

The section on birds is likewise of great interest, recounting the feats of the albatrosses and giant petrel (some breeding in South Georgia and feeding in off-season near Australia), and the penguins (the emperor incubating in winter on sea ice with egg between feet; the Adélie making fantastic journeys and returning to birthplace). The relations of skua and Adélie are complex and vary with season, environment, and individuals.

The freshwater ecosystems, though limited, are unusual. As with land fauna, the South Victoria Land area is rich in endemics, which suggests survival through the maximum glaciation of the Pleistocene. Some ponds thaw much less often than annually, and there are some unusual phenomena such as "ice explosions."

Ugolini and others describe the primitive nature of soils and stress the importance of moisture to biota. The microbiology of the soils and ponds presents great contrasts and many interesting problems.

The land vegetation is rich and diverse compared with the land fauna, with perhaps a thousand species, even though only two are flowering plants. Lichens are best represented, and most conspicuous. Lamb, Greene, and others elucidate the fundamental ecological roles and the great significance of climate. Rudolph discusses dissemination. Jenkin and Ashton show that productivity is high on Macquarie Island, comparable to the alpine zone in New Guinea and twice as high as coastal southern Australia.

Space allotted to terrestrial fauna is rather meager. Janetschek points out that the ice sheet supports no fauna and that arthropods are better represented in mountains (possible refugia) than at sea level in South Victoria Land. The situation is the reverse in North Victoria Land and in the Antarctic Peninsula area. Tilbrook presents excellent data for the latter region. Holdgate concludes the second volume with an excellent treatment of conservation.

As editor Holdgate has done a superb job of organizing the contributions and discussion. His brief introductions to the 14 sections present succinct background data and useful short summaries. In general, this work is a remarkable contribution to modern ecology and in no sense concerns the Antarctic alone. There is much discussion of bipolar problems, and some comparative articles or parallel ones concerning the Arctic. As is indicated, much significant research remains to be done. The production of the volumes is good, including the numerous graphs, diagrams, tables, and other useful material. Typographic errors are reasonably few.

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Optics and Methodology in the 17th Century

Theories of Light. From Descartes to Newton. A. I. SABRA. Oldbourne, London, 1970 (U.S. distributor, Elsevier, New York). 364 pp., illus. $12.75. Oldbourne History of Science Library.

Acknowledging an intellectual debt both to the late Alexandre Koyré and to Karl Popper, Sabra has undertaken in this impressive study of 17th-century optics to wed the history of that science to the history of methodology. It is his belief and, indeed, the basis of *Theories of Light* that actual scientific practice and metatheoretical convictions are dynamically related. The claim is immediately plausible and will certainly engage assent when the discussion is about an age in which the nature and scope of knowledge itself were as much a matter of debate as the nature of the natural world. Beginning with Descartes's considerations on method and his optical studies, including the derivations of the laws of reflection and refraction, and then turning to the controversy with Fermat over the proper demonstration of these laws, Sabra substantiates the view that a deeper understanding of the optical theories can be gained by a careful look at the related "methodological" teachings. After an analysis of Huygens's "Cartesianism" and his successful elaboration of a pulse theory of light, the ground has been prepared for a thorough treatment of Newtonian optics and the criticisms it provoked among the "wave theorists." Declining to write the usual survey, Sabra has not only treated "problems and controversies which have appeared to [him] to be particularly important in the development of seventeenth-century theories about the nature of light and its properties," he has in following that program engaged himself with the century's most influential methodologists.

While there are some grounds for seeing in this twofold enterprise the successful articulation of a new historiography of science, I must confess that I have found the union somewhat debilitating to both partners. In pursuing this "method" of confronting actual research in optics with the "attendant evaluations and theories of method" enunciated by the practitioners, Sabra has been unable, as I see it, effectively to focus his concern either on the development of optics in the 17th century or on the difficult and increasingly sophisticated methodological issues. The paradoxical result is that, while the discussions of method do not come fully to grips historically or philosophically with the questions they naturally raise, they occupy far more space than their "payoff" in understanding the optical theories seems to justify, and the concern with method distracts attention from the inner dynamics of the optical researches themselves. We should applaud Sabra's decision not to write a survey, but it does not relieve the book of the obligation to consider whether the period in question constitutes a meaningful or coherent "era" from the point of view of some problems or set of problems in optics *or* in scientific methodology. One should consider the interaction of researches toward a theory of light not so much with second-order speculations about the legitimacy of particular accounts as with the obviously related theorizing about the physical-chemical