tribution to our arsenal of ideas to help explain orientation behavior.

Kenneth S. Norris discusses migration and orientation in seals and whales. Both groups certainly display lengthy migrations, as demonstrated both by observation and by recovery of tagged animals. But no direct evidence is available concerning the sensory basis of their orientation. The migration of the California gray whales is largely coastal from the Arctic Ocean to the Gulf of California, and hence is known in greater detail than those of other species. While there is considerable evidence that these whales use both bottom topography and visual landmarks from the coastline, most other whales migrate long distances through the open ocean. Norris discusses the possibility that sounds may be important cues, not only those of fish or other marine animals that may well be characteristic of a given locality, but also echolocation or active sonar, which is known to exist in most if not all species of whales. He is forced to conclude that much remains to be learned about the orientation behavior of these fascinating creatures.

Frank C. Bellrose discusses "Orientation in waterfowl migration," bringing together many lines of evidence. He and his colleagues have observed many flocks of migrating ducks and geese from a light airplane. These extensive first-hand observations of large and readily visible birds in the course of actual migration have been supplemented by experimental releases of ducks captured during migration and displaced by hundreds of miles to areas almost certainly outside their experience. After such releases, both with and without displacement over long distances, many waterfowl have been observed from the ground, visually and by radar, by day and by night, and under both clear and overcast skies. Some results of radio tracking of ducks are also reported. These extensive and varied studies show that conspicuous features of the landscape such as rivers and lakes are sometimes used as local landmarks or as "guidelines" during seasonal migration. But ducks also use the sun and stars for directional orientation under clear skies. The initial orientation of mallards after release in strange surroundings is likely to be northward, regardless of season, in what Bellrose calls "goalless" and Matthews "nonsense" orientation. This orientation does not necessarily last for more than a few miles, but it is apparently one of a large number of cases in a wide variety of animals of sun- or star-compass orientation.

Most exciting is substantial evidence from radar observation that waterfowl, and other birds as well, sometimes migrate at night under thick layers of cloud when astral cues cannot possibly be used. Bellrose concludes that when neither landmarks nor the sun or stars are available as directional cues, waterfowl use the wind as a source of directional information. This conclusion is based in part on evidence that migrating birds appear to compensate for the wind and maintain approximately the appropriate direction of flight even in cross winds. Sometimes this occurs even in the apparent absence of visual reference points in the sky or on the ground below. Bellrose believes that patterns of turbulent air currents correlated with wind direction provide this sort of directional information. Some will remain unconvinced that correct orientation of migrating birds over long distances really occurs in the absence of visual cues, or that turbulent air currents have sufficiently predictable patterns to provide useful guidance. But the evidence marshalled by Bellrose in this chapter and in several papers cited in its bibliography clearly deserves thoughtful consideration. It is important that this work be followed up by further observations, and perhaps even experiments, to explore its evident implications and ramifications.

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Melanin and Melanocytes

Advances in Biology of the Skin. Vol. 8, The Pigmentary System. Proceedings of a symposium, Portland, Ore., 1966. WILLIAM MONTAGNA and FUNAN HU, Eds. Pergamon, New York, 1967. xxii + 659 pp., illus. $27. Oregon Regional Primate Research Center Publication No. 183.

Twenty-eight of the chapters in this volume represent work reported at a symposium held at the University of Oregon Medical School in 1966. Seven more papers were included in the book for completeness. During the last 20 years several collections from symposia on pigment cell biology have been published. Perhaps for this reason, not much new information stands out. Nevertheless, this book is useful for people interested in different aspects of melanin pigmentation.

The most exciting chapters are Mason's review on the structure of melanin and the papers that follow expressing different opinions. Mason strongly supports the concept that melanin is a homopolymer resulting from the polymerization of subunits of a single type, indole 5,6-quinone, held together by identical linkages. Nicolaus and Hempel present separate papers which support a theory of random polymerization according to which both the subunits and linkages vary throughout the polymer. Blois offers a good compromise. The lively controversy brings the reader up to date on the structural problems of melanin.

A second interesting subject is described separately by McGuire and by Hadley and Quevedo: epidermal melanocytes in frogs. In the past most work on amphibian pigment cells has concerned dermal melanocytes. But the different responses of dermal and epidermal melanocytes to a variety of agents are important. For example, both types of cells darken in the presence of melanocyte-stimulating hormone; and both will lighten when the hormone is removed. However, only the dermal cells, when darkened by melanocyte-stimulating hormone, will lighten in the presence of melatonin and noradrenaline. Controversy exists about whether or not acetylcholine lightens epidermal melanocytes as well as those in the dermis. In some ways epidermal melanocytes of frogs behave more like pigment cells in mammalian skin than do the dermal melanocytes of frogs. Epidermal melanocytes in both frog and mammal share the property of being able to transfer melanin to surrounding epidermal cells.

Among the reports updating research on the enzymic process of melanin formation and the fine structure of pigment cells is a lucid review by Fitzpatrick.

Montagna's paper on melanocytes of subhuman primates is intriguing. For example, in the rhesus monkey, melanogenic activity increases upon exposure of skin to ultraviolet light and reaches a peak after one month of irradiation. Yet with continued treatment there is a steady drop in active cells. Montagna also introduces the problem of different populations of epidermal melanocytes in the chest and the thigh of primates.

Hormonal control of pigmentation is

considered in only one chapter. Unfortunately, neural control of pigment cell activity is hardly mentioned. Immunologic features of pigment cells are not discussed. Despite the omission of some essentials of melanocyte biology, the book is good for the information contained and for bringing the reader up to date.

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Fish Populations

Fisheries Biology. A Study in Population Dynamics. D. H. CUSHING. University of Wisconsin Press, Madison, 1968. xii + 200 pp., illus. $7.50.

The fishery biologist has to deal with a rather complex system of processes of living organisms interacting with those of the aquatic environment. This book describes the past attempts, primarily of the author and his colleagues at the Lowestoft Fishery Laboratory, to define and quantify the more essential processes of the system and to apply this information to the management of commercially exploited marine fish stocks.

Cushing presents the processes of movement, feeding and growth, birth, and death primarily by reviewing the extensive studies on Atlantic eels, North Sea herring and plaice, and the arctic cod. These studies serve well to illustrate some of the behavioral patterns of fish populations which are the result of the physiological drive interacting with the marine environment, and which the fishery biologist must comprehend to describe the system adequately. A great deal of methodology is interwoven in these examples, notably the use of acoustic surveys for detecting fish concentrations.

The most important problems facing fishery biologists today are the measurement of fish abundance, which includes the subject of statistical distribution functions, and the mathematical modeling of the system, which includes the subject of dependence of the processes on population density. The author deals with these problems primarily by reviewing the theory developed by Beverton and Holt in their well-known 1957 publication "On the Dynamics of Exploited Fish Populations" (*Gt. Brit. Min. Agr. Food Fisheries, Fishery Invest.* ser. 2, vol. 19). The work of W. E. Ricker [*J. Fisheries Res. Board Can.* **11**, No. 5, 559–623 (1954)], which is the best formulation of the stock-recruitment problem to date, is also discussed. Beverton and Holt's theory, however, does not deal at all with the important statistical aspects of estimating fish abundance and distribution, nor does it treat adequately the stock-recruitment aspect. The author's opinion that recruitment of young fish to the fishable stock bears no relation to the numbers of spawning adults over quite wide ranges of the latter is based on the lack of direct correlation of the reported observations. Other factors which are not accounted for are quite probably the reason for the lack of correlation.

Management of renewable resources to provide the maximum benefits to man is a subject of both scientific and political interest. The book outlines Beverton and Holt's contribution, which has had wide application in the control of minimum size of fish caught through regulation of minimum mesh size in trawl nets. Contrary to what the author states, mesh regulations in the North Atlantic groundfish fisheries have not ensured that catches are well controlled. In fact, catches are not controlled at all. This is primarily because the total yield depends on the numbers of fish entering the fishable population, that is, the recruits, which can be regulated only through direct control of the numbers of fish caught, if at all. Mesh regulation is intended to maximize the yield per recruit, and it has never been shown that even this goal has in fact been obtained.

The author's exposition of these subjects reflects the lack of development of adequate theory, but the parochial view, which is confessed in the last paragraph, leads to the omission of some good beginnings published by American scientists.

The author concludes that "conceptually the dynamics of fish populations are not very difficult or complicated." I know he is not that naive, and his book, in spite of its limitation, belies this conclusion. The future of fisheries research depends more on improved conceptual models, which accommodate the statistical, or probabilistic, nature of events, than on obtaining larger quantities of data.

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Reactions, Agents, and Products

Microbial Transformations of Steroids. A Handbook. WILLIAM CHARNEY and HERSHEL L. HERZOG. Academic Press, New York, 1967. xiv + 728 pp., illus. $21.

Microbial Transformation of Steroids and Alkaloids. HIROSHI IIZUKA and ATSUSHI NAITO. University of Tokyo Press, Tokyo; University Park Press, State College, Pa., 1967. xii + 294 pp., illus. $16.50.

Microbial Transformations of Steroids by Charney and Herzog represents a remarkably successful fulfillment of a most challenging and difficult assignment. These authors have compiled, in a highly useful and interesting format, a very comprehensive treatment of their subject.

The introductory chapter includes a brief, informative history of the field and a discussion of new trends. The second chapter presents a chemical classification of the various microbial transformations, and includes brief discussions of the discovery of each one, as well as discussions of the enzymology, mechanisms, practical significance, and other pertinent aspects of the various reactions.

Chapter 3 describes and then presents table 1, a 139-page listing of microbial transformations arranged according to the empirical formula of the *product* of the reaction. Included for each listing is the name of the product, the type of transformation, the yield (where known), the name of the transforming organism, physical constants (melting point and specific rotation) of the product, and a literature reference.

Chapter 4 contains a taxonomic treatment of the subject. It includes the 411-page table 2, arranged alphabetically according to the genus of the transforming organism. The source of the organism, the substrate, the type of reaction, and a reference are presented for each entry. It is not often that one is confronted with a table of this length and finds it an occasion for pleasurable and informative browsing. The reader is struck both by the almost unbelievable versatility of the microorganisms and by the persistence of their human exploiters as he leafs through, for example, the 18 pages listing transformations by *Corynebacterium simplex,* the 14 pages