er into a book. It is evident that all three authors are basically radio astronomers; the discussion of optical and x-ray observations would no doubt have been different in emphasis had they been written by specialists from these fields. The few mistakes in these discussions are unimportant to the main concepts.

The books will be used by advanced astronomy students and by astronomers and physicists whose specializations are in other areas. The "small band of pulsar specialists" (a phrase from Smith's preface) already know this material, although the books may serve them as useful compilations. Nonphysicists will have trouble because much knowledge of physics is assumed (of electrodynamics and the physics of nuclear matter, for example). But those who want to read most of what is known about pulsars should read one or both of these volumes.

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Outbreeding Mechanism

Incompatibility in Angiosperms. D. DE NETTANCOURT. Springer-Verlag, New York, 1977. xiv, 232 pp., illus. $24.70. Monographs on Theoretical and Applied Genetics, 3.

Self-incompatibility in flowering plants is the inability of a fertile hermaphroditic plant to produce zygotes after self-pollination. Self-incompatibility is genetically controlled by one or more loci, with from two to hundreds of different alleles, depending on the particular system. Fundamentally, it is a cellular recognition phenomenon in which self is rejected and nonself accepted.

Self-incompatibility is common in angiosperms and is a major mechanism for enforcing outbreeding in plant populations. It is therefore instrumental in determining the genetic structure of populations and is of considerable evolutionary significance. It is also of importance in agriculture, particularly in dictating the pollination requirements of certain fruit and seed crops.

Incompatibility in Angiosperms is the first book in English devoted to the subject. De Nettancourt has collected and summarized a large amount of widely scattered literature. The result is comprehensive and up to date, although many aspects of the subject are treated very briefly and the book is written in a rather telegraphic style.

More than ten different systems of genetic control of self-incompatibility are now known. A polygenic system with at least three or four loci has recently been discovered in *Ranunculus* and sugar beets. In this system the loci are complementary; that is, the three or four loci together specify one unique pollen incompatibility phenotype. Such complex systems are difficult to elucidate genetically and may be more common than is now apparent.

The biochemistry of the incompatibility reaction remains largely unknown. The book summarizes the limited data available and the abundance of wild and wonderful hypotheses. The sporophytic incompatibility system of the Cruciferae is the best understood. The evidence suggests that the diploid sporophyte synthesizes recognition proteins in the tapetum of the anther and in the stigmatic papillae. The tapetal proteins are transferred to the exine of the pollen grain and the stigmatic proteins are transferred to the pellicle that covers the surface of the stigma. At pollination the exine bound proteins diffuse out and interact with those of the pellicle. If the proteins are identical, a rejection response occurs in the papillae and pollen tubes do not penetrate the stigma.

The natural evolutionary breakdown of self-incompatibility systems is treated briefly. More coverage is given to the experimental modification of incompatibility, particularly as a tool for the plant breeder. Included are such sexual exotica as electrically aided pollination and mutilation of the stigma with a wire brush.

One-fifth of the book is devoted to interspecific incompatibility, the failure of pollen from alien species to germinate on a stigma—that is, the rejection of nonself pollen. This is a subject about which virtually nothing is known. The author concludes that the self-incompatibility gene is involved in the control of interspecific barriers to fertilization. The evidence is the phenomenon of unilateral incompatibility. Interspecific crosses between a derived self-compatible species and a closely related self-incompatible species often succeed when the self-compatible species is the pistillate parent, but the reciprocal cross usually fails. In this special case the self-incompatibility system may function as one barrier to hybridization, but it seems unlikely that it is the mechanism by which plants as unlike as apples and oranges recognize each other.

The major strength of the book is that it covers almost everything. The major weakness is that the author is usually noncommital and tends to present every conflicting hypothesis and bit of data at face value. One example: in a study of self-incompatibility in *Capsella* in the 1930's, Riley correctly concluded that the incompatibility behavior of the Cruciferae could not be explained by any known system. He proposed a system with two alleles at each of two loci to explain his data. After the elucidation of the one-locus, multiallelic, sporophytically controlled system in the Compositae and Cruciferae in the 1950's, Bateman showed that it could account for Riley's data and that it was extremely unlikely that *Capsella* differed from all other Cruciferae. Nevertheless, de Nettancourt seems to accept Riley's model, as well as a similar, earlier, model by Correns.

In some cases where the author does take a stand, his position seems to be dictated by historical precedent. He accepts the traditional dogma that one-locus gametophytic self-incompatibility is a primitive feature in the angiosperms, despite the fact that the system is found only in relatively specialized families and that self-incompatibility itself has never been conclusively demonstrated in any supposedly primitive angiosperm. He hedges later in the book, however, and admits that the recent discovery of polygenic systems may necessitate a revision of the traditional view.

There are a few mistakes in the book. For example, the segregations given for tristyly in figure 3 on p. 29 are incorrect.

All in all, the author has compiled a concise yet comprehensive summary of the subject, but he leaves it to the reader to recognize which conclusions are compatible and which are incompatible with the facts.

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Intelligent Invertebrates

The Biology of Cephalopods. Proceedings of a symposium, London, April 1975. MARION NIXON and J. B. MESSENGER, Eds. Published for the Zoological Society of London by Academic Press, New York, 1977. xviii, 616 pp., illus. $41. Symposia of the Zoological Society of London, No. 38.

This volume is the published version of a meeting held to honor J. Z. Young on his "retirement" from University College, London. Young in fact continues his research at the Wellcome Institute for the History of Medicine, hence the quotation marks. Most American zoologists educated since 1950 tend to associate Young with his monumental *Life of Vertebrates* and *Life of Mammals* and may not realize that most of his research efforts have been devoted to the behavior and neuroanatomy of the alternative form of intelligent animal: the cephalopods. I was pleased to be asked to review this volume because I participated in the symposium (although I had not contributed to the published volume).

This volume takes a modern multidisciplinary approach to the interpretation of cephalopod biology. It is not a definitive and all-inclusive reference work, however, nor was it intended to be, despite the ambitious title and the real need for such a work.

The book begins with papers on evolution and taxonomy, which emphasize the problems of the incomplete fossil record and taxonomic difficulties. The discussion of systematics by G. L. Voss is more a discussion of problems in dealing with these animals and of taxonomists than a discussion of the animals themselves. This is offset by an appendix of a classification of recent Cephalopoda by Voss. There are papers on sampling techniques and on the mechanisms and significance of bioluminescence. There are several papers on the squid giant axon discussing not only impulse conduction but also the structure of the giant fiber system, described by R. Martin. Unfortunately, the film of the giant nerve shown by J. B. Gilpin-Brown could be represented only by the text of the commentary it included. It is well worth viewing. Papers on other aspects of neurophysiology and neuroanatomy include accounts of work on sensory organs (extraocular photoreceptors, statocysts, pupillary response) and on the biochemistry of the central nervous system and an extensive comparative study of brain evolution and behavior by Young himself. Of course, behavioral studies are well represented, and some of the papers on behavior nicely complement the anatomical and physiological papers. Biochemistry is represented only by discussions of hemocyanin and the central nervous system. Two papers present conflicting views of the endocrine role of the optic glands, but no general discussion of reproductive biology is given. As in any symposium volume, the quality of the papers varies, and in the two copies I have seen the reproduction of photographs is frequently poor.

Several important subjects, such as metabolism and comparative physiology, developmental biology, ecology, and larval dispersal, are not represented. This deficiency is in part offset by the very thorough introduction, which includes references to key papers and reviews in areas otherwise not covered.

This symposium volume is a fitting tribute to Young. It will be useful not only to cephalopod biologists but to biologists in general, for it is the only modern compilation of its kind and as such will serve as an introduction to the field. I suggest that the editors consider preparing a supplemental volume reprinting significant papers from the literature to offer even more complete coverage of this important and interesting group of animals.

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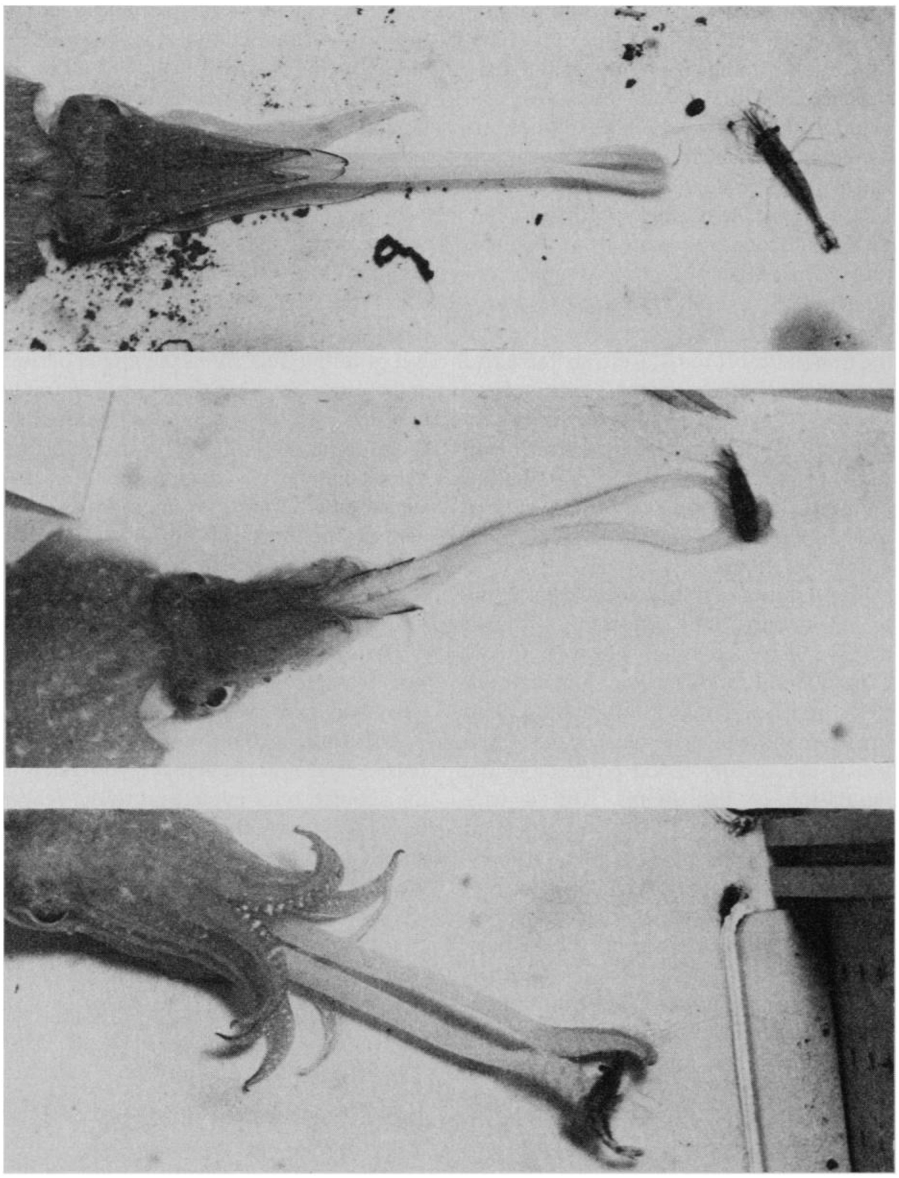

A cuttlefish capturing a prawn. The cuttlefish "lunges forward slightly and the tentacles . . . are thrown out so quickly that high-speed cinematography is necessary to resolve the details. . . . At first each tentacle shaft emerges quite straight. . . . The tentacle clubs [then] open outwards slightly presenting more sucker surfaces to the side of the prawn. The tentacles strike the prawn so strongly that they . . . carry it further away from the body; at this juncture the shafts begin to buckle . . . and it is not until the end of full excursion that they once more straighten out as they are pulled back towards the arms and mouth. The arms meanwhile have opened and spread out ready to deal with the prawn . . ., which they manipulate so that it can be bitten in the mid-dorsal abdomen." At the Naples laboratory about 91 percent of prawns are seized on the first attempt. "The high speed of the strike precludes its control by visual feedback and, as in other fast motor acts in a variety of organisms, it seems that it is under 'open-loop' control; that is, the strike is programmed on the assumption that the prawn will not move. . . . Indeed the prawn's best strategy is to wait until the tentacles have been shot towards it and only then flick its telson; and the laboratory observations suggest that most unsuccessful strikes are the result of a 'last-minute' move by the prawn." [From J. B. Messenger, "Prey-capture and learning in the cuttlefish, *Sepia*," in *The Biology of Cephalopods*]