tractive to us still. Charles Darwin was not without literary sensitivity, despite his complaints about his own stylistic awkwardness and despite his sprawling, leaping, cryptic condensations when the creative ferment was working in him too rapidly for him to control his sentences.

The expurgated material is not startling by modern standards, but it does help to round out our picture of the man and his time. His original theism apparently ebbed with the years, until he became a total agnostic. His lingering Lamarckian conceptions of inheritance led him to comment that the inculcation of religious beliefs in children might cause them to inherit a belief in God. As a sensitive and considerate man, it is evident that the struggle and suffering observable in the natural world offended Darwin's moral sensibilities and led him ever further along the pathway of doubt. It is obvious that he suffered, as did many intelligent Victorians, including Wallace and Lyell, from the great and painful reorientation in human thinking to which he was, at the same time, a leading contributor.

Nevertheless, what was in some ways a sad life intellectually is illumined by Darwin's deep affection for his family, his winning whimsicality, and his genuine devotion to science. There is something a little wistful, a little fey, about his devotion to the lower organisms—almost as though he would have liked to start the whole evolutionary process over again down a different path. "It has always pleased me to exalt plants in the scale of organised beings," he wrote of his botanical experiments, just as he sometimes dwelt upon the intelligence of his earthworms. Yet if men and human cruelty sometimes offended him, no man ever left a more moving tribute to his wife. Written at the end of a letter of hers which he had obviously treasured, is the following: "When I am dead, know that many times I have kissed and cryed over this. C.D."

Into the modern world of doubt and atoms, into the world which has slain its millions in two great, fanatic wars and which now hovers on the brink of a third —a world which has devoted itself to the principles of struggle and made this tired, disillusioned man the spokesman of its philosophy, come these words out of the past. Do they ring strangely in our ears? If so, it will be a measure of how far out of humanity we have grown, and of why Charles Darwin turned to the observation of plants and earthworms in his last years, and of why it pleased him, in his own words, "to exalt plants."

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Biological Sciences

Living Resources of the Sea. Opportunities for research and expansion. A Conservation Foundation study. Lionel A. Walford. Ronald Press, New York, 1958. xv + 321 pp. Illus. $6.

Marine science until recently was a rather academic discipline, regarded with some tolerance as a sort of hobby with no particular application, pursued by zealots—often bearded. Among the marine sciences, biology was considered perhaps the least practical.

Yet, rather suddenly, the exploding world population and the much less rapid expansion of food supplies have caused people to look to the sea as a possible source of food. In recent years there has been a spate of articles and books on the general theme that the sea is an inexhaustible supply of material and food. The approach of many has been starry-eyed—feed the starving millions with plankton, or raise *Chlorella* to relieve famine in India. "Let 'em eat plankton" might serve as a paraphrase of the general theme.

In contrast, Walford's book takes a hard look, appraising the state of marine science today, particularly marine biology. He raises many questions and answers them to the best of modern knowledge. What do we actually know about the sea, about its plants and animals? How are the resources of the sea now used? How can use be expanded? What do we need for further expansion? What lines should further research and development take? Yet, along with the sometimes brutally frank exposé of current ignorance, there is also the plan of a practical man who knows what has been done and what needs to be done.

Walford is eminently qualified to handle such problems. For many years he was head of all marine biological research for the U.S. Fish and Wildlife Service. He serves on many commissions and committees of international scope for evaluation and study of marine problems and has been chairman of the research committee of the International Commission for the Northwest Atlantic Fisheries.

The book details the strength of our knowledge of marine resources where there is strength but does not hesitate to reveal the weaknesses. The two great shortages—of money and of trained manpower—are mentioned again and again. The sea is no less mysterious in some of its aspects than is outer space, but the amount of time and money going into study of the sea is a minute fraction of that spent on space research.

Although Walford himself is a biologist, he does not neglect the technological and even sociological aspects of the problem. Proper development of a new fishery involves biological research on the animals to be exploited. It also involves engineering research into sorts of gear to be used for their capture, design of new boats or adaptations of old ones, economics of financing the fishery, problems of distribution, and—not least—the sociological problem of convincing people that they should eat an unfamiliar food. Here the strength of this book becomes evident, for each of these problems is taken realistically in turn, and the approach is neither optimistic nor pessimistic. Manpower, money, and time are the ingredients which can solve these problems.

The construction of the book is logical. There are two major sections—one, the definition of the problem; the other, a survey of the known resources. The many maps with descriptive captions actually written into the chapters as an integral part of the text are a unique feature.

One might wish that some of the maps were not so detailed and that more consideration had been given to the problems of printing, but in general they make their points. This is not a textbook and does not need full documentation, but the documentation is unfortunately uneven and often difficult to follow. The index leaves much to be desired.

Nonetheless, here are the facts presented—that the sea is grossly underexploited; that expansion of utilization of marine products along the lines we are presently following can probably only double production; that great areas of the sea and significant numbers of its animals are relatively unknown. Current work is directed toward learning more about known factors rather than exploring the unknown. Unless we redirect the research forces we now employ and create vast new ones, man may discover, when he is actually driven to the sea for a major part of his food, that he will be unable to find it.

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Electronic Apparatus for Biological Research. P. E. K. Donaldson and others. Academic Press, New York; Butterworths, London, 1958. xii + 718 pp. Illus. $20.

Biophysicists are frequently asked to name a single textbook or monograph from which a biologist not familiar with advanced electronics and having only rudimentary physics and mathematics at his disposal can learn enough electronics

and instrumentation theory and practice to enable him to build, operate, and understand such electronic instrumentation as is necessary for his research. This book is probably the best single answer available to the demand for a do-it-yourself guide to biophysical instrumentation. In addition, it is, for the expert, a fine compendium of know-how and references, and it contains succinct résumés of specialized techniques and mathematical developments of basic electrical and electronic theory at a level just sophisticated enough to take care of most needs without requiring the use of advanced mathematics.

The American reader will find three substantial shortcomings in the book, only one of which could possibly be charged against the author: it is written in British, not in American, English; it is too expensive for use as a textbook or as a book to be bought by the neophyte researcher for his personal bookshelf; and it stops 3 to 5 years back in several areas where electronic technology has been dashing forward.

The language problem is not trivial, for electronic jargon *is* substantially different in England and the United States, and a term often has very different meanings in the two countries. Both "static" and "dynamic" transducers, for example, are special types of "active" or "passive" transducers in our usage. Components and circuits have different names, for example, "tagboards" for "tiestrips," "concertina phase splitter" for "split-load phase inverter," "brimistors" for "surgistors," and so forth. These differences seem merely amusing when we understand them, but they are highly confusing when we do not. In addition, examples taken from commercial components are not always applicable to American products, nor is there always an equivalent product.

The neglected, recently-developed areas are particularly those having to do with solid-state devices and the logical circuitry and control-system devices which have arisen out of electronic computer advances and military-industrial control instrumentation. There is a last-minute chapter on transistors which is sound and pertinent, but it stops substantially behind the present state of the art. Masers, nuclear resonance and molecular resonance equipment, magnetic amplifiers, precision function potentiometers, core memories, storage tubes, modulation codes—none of these is more than barely mentioned. Printed circuits and modular construction have been severely neglected. Workhorse computer elements that are entering most up-to-date biological laboratories are conspicuously scarce. Hybrid vibrator-stabilized amplifiers, precision integrators and differentiators, adders, multipliers, rooters, curve tracers, digital-analog converters, direct digital read-outs, and print-outs should at least be mentioned.

Pointing out these shortcomings is, however, in effect praising the book with faint damns. The 280-page section on "Theory" is a splendid introduction or refresher on electronic theory. The 50-page section devoted to "Practice" (components and laboratory procedure) is good but differs substantially from American standards. The 252-page section on "Transducers, electrodes and indicators" covers its chosen material well but falls short of ideal choice of subject matter. Its treatment of microelectrode techniques is outstanding. The material on light sources, temperature and humidity control, and strain-gage transducers includes much material not readily available elsewhere. A final 126-page section on "Complete apparatus" discusses power supplies, bioamplifiers, some recording and timing devices, and it has an unusually appropriate section on interference control. The short chapters on trouble shooting and instrument design are too abbreviated to be of much use.

Over-all the book is undoubtedly the best and most complete source of information on electrical instrumentation currently available to the experimental biologist.

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Encyclopaedia Zoologica Illustrated in Colours. vol. 2. "Pisces" by Ichiro Tomiyama and Tokiharu Abe. "Prochordata" by Takashi Tokioka. Hokuryukan, Tokyo, Japan, 1958. 478 pp. Illus. $25.

The first volume of this popular series includes the mammals, birds, amphibians, and reptiles of Japan. Volume 2 illustrates the fishes and prochordates. Volume 2 is divided into three sections, of which the first two were written by Tomiyama and Abe. The first section covers 912 species of marine fishes, illustrated in color; for each, the common and scientific names, a brief description, maximum size, and distribution, are given; for fish of economic value, the texture of the flesh is given also. The second section, on aquarium fishes, covers 108 species, illustrated in color, and gives information of importance to an aquariist. The section on the Prochordata, by Tokioka, contains illustrations, in color and in black and white, of 135 species, and for each one the scientific and common names, a brief description, and size and distribution are given.

The fishes are carefully illustrated by the following artists: Yoshikichi Makino, Ketsunori Tateishi, Mitsuo Shirao, Tadanao Hayabuse, and Masaru Goto. The colored photographs were taken under the supervision of Tadashi Tomura.

This gorgeously illustrated volume was intended to be a popular account of the fishes and "prochordates" of Japan, and without doubt the authors have succeeded in fulfilling this intention. In general, this is a basically accurate work, with only a few instances of careless spelling of scientific names. We disagree, for only a small number of the species, with the scientific nomenclature used for the marine and aquarium fishes. The authors should be proud of this book.

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Heredity and Evolution in Human Populations. L. C. Dunn. Harvard University Press, Cambridge, Mass., 1959. 157 pp. $3.50.

This, the first of the "Harvard Books in Biology," sets a nice tone for a series of books designed for laymen. In his interesting preface, Dunn acknowledges that his writing is not colorful, saying that this is as it should be, that he prefers an accurate statement to a fine phrase. Having set the stage thus, the author proceeds to the essentials of genetics and evolutionary principles. The implications of the sickle-cell trait are well presented. The variation in the distribution of the blood-group genes is posed as a problem in selection that is yet to be solved. Dunn's study of the Jewish community in Rome is retold. Restraint marks the discussion of methods of consciously altering human gene frequencies. The only objectionable statement made is the one at the bottom of page 88 that implies that *gene* frequencies can be altered by prohibiting the marriage of cousins; in truth, only genotype (and phenotype) frequencies are affected by the mating system used.

Since this is the first of a new series, a suggestion may be in order regarding style. Dunn's book contains no bibliographic citations whatever. The thinking behind this is obvious. But is it not possible that the publishers have underestimated "the layman"? At this moment, grocery stores all over the country have on sale cartons of Coca-Cola in which there is a little leaflet discussing nutritional matters: the effect of sugar on teeth, the nutritional identity of "natural" and artificial sugar, and so forth.