Japanese communications about as fast as the Japanese themselves could. Although circumstances made it impossible to prevent or even attenuate the raid on Pearl Harbor, communications intelligence played a major role throughout the Pacific war. Admiral Chester Nimitz has described the battle of Midway Island as "essentially a victory of intelligence."

A long chapter is devoted to the National Security Agency and the current status of American cryptology. Kahn states that his manuscript was submitted to the Department of Defense before publication. I imagine that many people will be surprised at the amount of information he has been able to amass about this supersecret and hypersensitive branch of government. Much of it undoubtedly comes from the 90-minute press conference held in Moscow by W. H. Martin and B. F. Mitchell, NSA employees who defected to Russia in 1960. But much information is of a more recent vintage, and it is an interesting speculation how he came by it. Kahn also discusses the morality of cryptanalysis and the need for congressional surveillance of even the most secret government activities.

Only within the last 50 years could cryptology properly be called a science. The large number of distinguished mathematicians, here and abroad, who have made significant contributions in recent years to cryptology in general and cryptanalysis in particular attests to the changing nature of the subject. With the advent of large computers and delicate statistical tests to find hidden patterns submerged in a seemingly formless sea of cipher text, the need for intuition and inspiration has diminished, though not completely disappeared. In at least one college in the United States a course in cryptanalysis has been offered within the regular curriculum of the mathematics department.

But in no sense is this book a text. The weaknesses and strengths of numerous cryptological systems (including one that when properly used cannot be broken—the so-called one-time key) are fully described, and some cryptanalytic methods are mentioned though only sketchily illustrated. The reader who overcomes the temptation to skim over the more technical pages in favor of the abundant anecdotal material will certainly gain an understanding of the basic laws of cryptography. However, it is much more difficult to appreciate the subtleties (as either an art or a science) of cryptanalysis without actually doing some. And the author does not provide the reader with an opportunity to get his hands dirty. He does, however, mention several elementary texts on cryptanalysis which are currently in print, including at least one in English (Helen F. Gaines, *Elementary Cryptanalysis*, 1939, reprinted as *Cryptanalysis,* Dover, 1956). For someone whose interest in cryptology is of a more passive nature, this book will provide many hours of pleasant reading.

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Practical Lore for Biologists

Methods in Developmental Biology. FRED H. WILT and NORMAN K. WESSELLS, Eds. Crowell, New York, 1967. xvi + 813 pp., illus. $18.

The Materials and Methods section of the ordinary biological paper skims over the surface of a vast submerged mass of practical knowledge (not to mention belief, fashion, ritual, and magic) which is transmitted between practitioners mainly by apprenticeship, demonstration, and conversation. It can be troublesome for the outsider to break into such a predominantly oral tradition, and the publication of this volume of the practical lore of developmental biology comes at an opportune time. So many scientists from outside the subject are becoming attracted by its outstanding intellectual problems, and so many already at work in one of its branches are feeling the need to diversify their techniques. The 51 chapters of the book will give them a panorama of what can be done, and often in full detail exactly how to do it.

Many years ago a worried physicist, setting out to revolutionize biology (which he soon did), asked me to join his group as resident biologist with the anguished cry: "We've just got to have someone who can go out and catch the frogs." The role accorded the biologist lacked adequate dignity, but the problem expressed, how to choose, obtain, nurture, and prepare suitable living material so that the experiment may actually begin, can be formidable to the uninitiated. Nearly half the present volume is rightly given to the husbandry of the organisms, both plants and animals, that are known to be convenient for developmental studies.

Developmental biology is concerned with systems that are interacting intensely at the cellular level, and, since so much analysis of this remains to be done, techniques of isolating and transposing cells and populations of cells by dissociation, culture, or grafting are of fundamental importance. A major section of the book covers such methods. In addition, plant growth substances (over a quarter of the book is devoted to plants), cell marking, nuclear transplantation, and miniaturized surgery have one or more chapters each. There are also important articles on the solution of the special problems posed by small size, by yolkiness, and by other peculiarities of embryonic material, when one applies such standard procedures as the separation of cell organelles from homogenates, chemical determinations, or electron microscopy. But it is of course impossible to indicate the wealth of topics treated systematically or incidentally. The index, so important for a work of this kind, is efficient, averaging about 50 entries per article.

The editors have drawn from their contributors, many of whom are known as fastidious technicians, a rich output of experience, and they have tied it together with a valuable amount of cross-referencing between articles. They have taken the editorial task seriously. The practice of developmental biology will for a long time be in their debt.

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Biological Phenomenon

The Contractile Process. Proceedings of a symposium sponsored by the New York Heart Association. Little, Brown, Boston, 1967. xii + 299 pp., illus. $7. Also published as a supplement to the *Journal of General Physiology*, Vol. 50, No. 6, Part 2, 1967.

This symposium was organized into four sessions dealing in turn with the contractile process in macromolecules (two papers), the contractile process in striated muscle (three papers), comparative aspects of muscular contraction (five papers), and contractile processes in nonmuscular systems (three papers). The value of the published proceedings is greatly enhanced by the well-edited discussions following the papers and by a carefully prepared index.

The papers fall into two classes: one consists of reports of research unpublished at the time of, but largely pub-

lished since, the symposium; the other comprises broader reviews of some important topics in the field of contractility. In the papers of the first type the results are presented against a background sketched in sufficient detail to enable newcomers to the field to get a quick orientation. In fact, the introductions to some of the papers reporting new findings—for example, that by P. Dreizen, L. C. Gershman, P. S. Trotta, and A. Stracher on myosin subunits—would qualify as concise reviews. H. E. Huxley's excellent discussion of recent x-ray work on living muscle focuses on the role of cross bridges in the contractile process. G. F. Elliot's paper raises some important questions, particularly with regard to the role of electric charges in the interaction of cross bridges with actin. T. Hayashi describes some experiments and offers some speculations on the role of the nucleotide bound to actin and explores possible changes in the actin filaments during contraction. B. M. Twarog deals with the role of Ca^{++} in the catch mechanism, and M. Barany presents evidence concerning the quantitative relationship of the speed of muscle contraction and the adenosine triphosphatase activity of myosin.

Those interested in contractility in general, as well as specialists in some narrower aspect, will find the broader reviews of interest. Particularly stimulating are the two papers (by H. A. Scheraga and L. Mandelkern) dealing with conformational changes and molecular mechanisms that may cause contraction. The discussion following these papers brought out the need of considering general principles in the light of the specific structures found in muscle. S. V. Perry's introduction to the session on striated muscle amounts to an excellent introduction to the myofibrillar proteins, whose known number is, it seems, rapidly increasing. It is to be regretted that no paper deals in detail with the interaction among actomyosin, tropomyosin, and troponin, which is subject to regulation by Ca ions and seems to play a key role in the process of excitation-contraction coupling. J. W. S. Pringle's analysis of the rather specialized system of insect flight muscle may be applicable in general to the currently accepted sliding-filament theory of muscle contraction.

The papers reviewing nonmuscular contractile processes are a welcome addition to the volume, since they cover material not well known to those interested in the more conventional processes of muscular contraction. The reversible fibral formation involved in the formation of the mitotic apparatus, discussed by S. Inoue and H. Sato, may have a relevance to the formation of actin filaments; and the mechanism of ciliary and saltatory movement, discussed by P. Satir and L. I. Rebhun, respectively, may bring to light processes that have been overlooked in thinking about possible ways in which the cross bridges between myosin and actin filaments move.

This sampling of the contents of this book shows that it may be profitably used by both novice and veteran investigators in the field of contractility, as well as by those whose chief interest lies elsewhere but who would like to find out what some of the current problems in contractility are.

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Morphology at a Turning Point

The Interpretation of Animal Form. Essays by Jeffries Wyman, Carl Gegenbaur, E. Ray Lankester, Henri Lacaze Duthiers, Wilhelm His and H. Newell Martin, 1868–1888. Translations and introduction by WILLIAM COLEMAN. Johnson Reprint Corp., New York, 1967. xxx + 191 pp., illus. $10. Sources of Science, No. 15.

It has recently become a popular practice to combine within the covers of a single book articles and essays originally published in periodicals or in other books; the advantages to students (and librarians) are evident. Coleman's collection of six essays goes beyond the prevalent custom of republishing articles which professors hope every student in a particular field will read; he has chosen instead to present provocative essays a number of which in the normal course of events may have escaped the notice of scholars as well as of beginning students.

The first essay in the book, by Jeffries Wyman, on symmetry and homology of limbs (1868), used to be called to the attention of graduate students at Yale by Ross Harrison, but one is permitted to wonder how many of them assign it to their students for the benefit of its substance. One other essay in Coleman's book, E. Ray Lankester's "Degeneration" (1880), is, like Wyman's, an interpretation of specific biological data. The remaining four essays concentrate not only on morphological facts but on attitudes for their study. These are by Carl Gegenbaur on "The condition and significance of morphology" (1876); by Henri Lacaze Duthiers on "The study of zoology" (1872); by Wilhelm His "On the principles of animal morphology" (1888); and by H. Newell Martin on "The study and teaching of biology" (1877).

Each of the essays except that of Lacaze Duthiers is presented in its entirety. Coleman has himself translated into English the portion of this essay included in the collection, and he has also translated the article by Gegenbaur. The translations are excellent. The remaining four essays (including the one by His, which was originally published in English) are reproduced in facsimile, or in reduced facsimile. The volume is attractive in appearance; careful bibliographical notes further enhance its value.

Some editors of collected articles have presented without comment the essays they have selected to reprint; others have written introductory notes discussing the separate essays or groups of them. Coleman has instead incorporated his comments on the articles he has chosen in a single coherent introduction which not only points up their significance but which in itself is a brilliant and original essay on morphological thought in the 1800's and its movement into physiology and experimentation toward the turn into the new century. Thus there are seven excellent reasons for owning this book, and, as in the case of the phenomenon of biological organization, which Coleman names as one of the foremost problems of biology, the whole is more than the sum of its parts.

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Modes of Action

Wirkungsmechanismen von Fungiziden und Antibiotika. Mechanisms of Action of Fungicides and Antibiotics. An international symposium, Gotha, May 1966. M. GIRBARDT, Ed. Akademie-Verlag, Berlin, 1967. xii + 443 pp., illus. Paper, DM 29.50.

The book is a report of proceedings of a symposium sponsored jointly by the Biological Society of the German