questions on stock material, and antiquated methods of teaching that promote memorization rather than discovery and problem solving.

A qualitative issue raised in all three volumes is the desirable relationship, at various educational levels, between general education and technical and vocational training. Should the formal school system train youngsters for specific jobs in industry, or should the schools produce trainable people, with specific training made the responsibility, wherever possible, of employing organizations? What should be the content of education in rural areas? Should it be basically the same as in urban areas, or strongly aimed towards agriculture as a vocation and towards distinctively rural problems?

In discussion at the conference sponsored by the International Economic Association, J. Miner of UNESCO warned against overemphasizing the manpower element when considering the effects of education on economic growth. There are other ways by which education influences economic growth besides its contribution to the output of a more highly skilled labor force. Education promotes technological change and the shift of people into more productive economic sectors; it has effects on aggregate demand; there are social-cultural effects, including the creation of modern literate societies in which economies of scale become significant; and education has important effects on political stability. The most significant aspect of education's relation to economic growth in the developing countries, he concluded, is not its production of qualified manpower but rather its role in transforming the character of society. Vital, though hard to pin down and measure!

Teachers' Mathematics Reference Series

In this book, **Explorations in Elementary Mathematics** (Prentice-Hall, Englewood Cliffs, N.J., 1966. 288 pp., $5.95), Seaton E. Smith, Jr., presents an intuitive discussion of the real number system, beginning with the natural numbers and working up to a brief discussion of the irrationals. Sets, systems of numeration, and some nonmetric geometry are also included. As stated in the preface, the text is designed primarily as an introductory course in modern mathematics for elementary teachers (preservice and in-service).

In general, the exposition is clear, and there is an adequate number of examples and exercises. Concepts are developed intuitively through specific examples, number lines and tables, and no formal deductive reasoning is required (only one proof—that $\sqrt{2}$ is irrational—appears in the book). This approach makes it palatable reading for the mathematically unsophisticated; whether it is sufficient for the elementary teacher (especially the preservice teacher) is another question.

In my opinion, some effort should have been made to at least occasionally *supplement* the intuitive approach with a small taste of formal deductive reasoning. For example, the reader is led to the product $-2 \cdot 3 = -6$ by observing a pattern in a table and assuming that the "patterns are reliable" (p. 107). It would seem equally reasonable to assume distributivity for integers (as on p. 108), along with the additive inverse property (p. 70) to present the following argument:

$$\begin{aligned} 0 &= 0 \cdot 3 \\ &= (2 + -2) \cdot 3 \\ &= 2 \cdot 3 + -2 \cdot 3 \\ &= 6 + -2 \cdot 3 \\ &= 6 + -6 \end{aligned}$$

Similarly, the author sidesteps distributivity of division over addition, when this could have been easily demonstrated in chapter 6, using the definition of addition for rational numbers and $a/b = a \div b$.

In general, the author's attempt to communicate with the unsophisticated reader without a loss of mathematical precision is commendable. I noted only a few exceptions. In defining an infinite set, some confusion exists as to what is really meant by a one-to-one correspondence (p. 12). On pages 76 and 108 needless restrictions are placed on a, b, and c. Why should $a \neq b$ and $b \neq c$? The phrase "numbers represented by the denominators" (p. 123) implies denominators are numerals. In discussing separations, for example, one says that a line separates a plane into *three* sets: two half-planes and the boundary line. If the plane is divided into two sets, where does the line belong? Irrational number is incorrectly defined in the glossary.

These errors can be easily corrected and should not deter those who wish to use the book. The omission of deductive reasoning may be appropriate for a *first* in-service course for elementary teachers. However, in view of the continual improvement in our public school mathematics curriculum, today's elementary education majors may find this text somewhat elementary.

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Regeneration in Animals

More than three dozen distinguished investigators gathered in Athens, Greece, in the spring of 1964 to assess progress in the study of regeneration and to present, often in a historical fashion, progress made in their individual laboratories. Their presentations, creditably edited and indexed by V. Kiortsis and H. A. L. Trampusch, appear in this lengthy volume, **Regeneration in Animals and Related Problems** (North-Holland, Amsterdam, 1965. 592 pp.).

This publication will be valuable because of its comparative approach. After a discussion of some general problems in the field, the reader systematically embarks on a phylogenetic trek through the major invertebrate phyla and then enters the vertebrate kingdom, related in a less systematic but engaging fashion. First, there is a discussion of regeneration in vertebrates (mainly amphibian), followed by a section entitled "Related problems" in which regeneration is discussed in light of tumors, hyperplasia, cell migrations, and the like.

What impressed me most, after the initial reading, was the enormous lack of progress during this century in this vital area of development. The questions asked by T. H. Morgan more than 50 years ago are the questions being asked today. This is not in itself detrimental except that, in general, the approach to the problems has not significantly altered either.

Repeatedly, the reader finds himself presented with an idea, implied by its author to be catastrophically original, when it is nothing more than a restatement of a concept that was in vogue several decades ago. The importance of the nervous system in regeneration, for example, is timeworn. Still no one has concentrated or characterized the topic material, nor has anyone developed a hypothesis concerning the mechanism of action of such a mate-

rial. Many of the studies presented here simply add to a growing list more organisms that enjoy a nerve-dependent regeneration. More than 100 pages of the text are devoted to regeneration in flatworms. Here, the text seems to lapse into a combat of personalities rather than a search for crucial experiments to determine once and for all the origin and nature of the cells constituting the blastema. The French authors who work with these organisms should have had their ofttime repetitious discussions before the conference and then, at the conference, they should have presented suggestions for critical experiments. One is continually aware of the need in this field for constructive models, a breaking of the rigid "set" of ideas that we have carried for 50 years; in short, a *rejuvenation.*

Certain papers written in a more theoretical vein are exciting—for example, Goss's analysis of regeneration from the evolutionary-adaptive point of view and Clark's ideas on cell adhesion in blastemal cells. Tardent's breakthrough in invertebrate tissue culture, Singer's quantitative approach to nerve-dependent phenomena, and Simpson's demonstration of cartilege induction in lizards by ependymal cells are highlights. The careful work of Trampusch and Abeloos, plus their general contribution to discussions, and the reviews of Herlant-Meewis, on asexual reproduction, and Needham, on hormonal control of regeneration in arthropods, are extremely informative.

This text is excellent reading for the aspiring, young developmental biologist. It will provide him with a great backlog of valuable information and convince him that he is at the frontier of development the first day he begins a regeneration experiment.

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Biochemistry of Animal Development

The Biochemistry of Animal Development is a two-volume treatise (volume 2 has not yet appeared) which, according to the fly leaf, is intended to provide an "introduction to the biochemical study of animal development," with emphasis on "current research as well as on those investigations in which a promising contact between experimental embryology and biochemical inquiry has been established." Volume 1, **Descriptive Biochemistry of Animal Development** (Academic Press, New York, 1965. 662 pp., $23), edited by Rudolf Weber, contains three major headings—(i) Biochemistry of Germ Cells and Fertilization, made up of two chapters: "Chemical constitution and metabolic activities of animal eggs" (by J. Williams) and "Biochemical aspects of fertilization" (by A. Monroy); (ii) Biochemical Patterns in Embryos, made up of three chapters: "Morphogenetic significance of biochemical patterns in sea urchin embryos" (by T. Gustafson), "Morphogenetic significance of biochemical patterns in mosaic embryos" (by J. R. Collier), and "Biochemical patterns in early developmental stages of vertebrates" (by E. M. Deuchar); (iii) General Biochemistry of Development, made up of four chapters: "Enzyme development in relation to functional differentation (by F. Moog), "Development of nonenzymatic proteins in relation to functional differentiation" (by J. B. Solomon), "Biochemical mechanism of information transfer" (by M. Staehelin)," and "Informational molecules and embryonic development" (by P. Grant). "The history of chemical embryology," an introductory chapter by J. Brachet, effectively brings into perspective the "pre-Needhamian" era and the developments since the appearance of Needham's monumental three-volume opus *Chemical Embryology* (1931).

In addition to a separate author and subject index, an index to genus and species names is provided.

It is no longer possible for an individual scientist to review and deal critically with the developments in a broad and rapidly developing area such as chemical embryology. As a matter of fact, the effectiveness of an editor, in the case of a multi-authored volume such as the one under review, in insuring clearly defined areas of review, critical selection, and evaluation of the subject matter to be discussed with minimal redundancy, is limited. Thus, as with most current review volumes of this type, the chapters vary greatly in their scope, emphasis, and usefulness to the individual reader. In the present volume, the scope varies from a chapter that reflects a strong author-oriented view (chapt. 3) to a synopsis of a course on introductory molecular biology (chapt. 8). The discussion in chapter 5 includes a series of *caveats* to warn the classical embryologist that biochemical procedures have to be carried out with appropriate and modern techniques and interpreted with great care, and to warn the biochemist that embryology is very complex. The reader profits from such a discussion (if the obvious isn't belabored), but a reviewer is burdened by the necessity of making certain that the most up-to-date and reliable biochemical methods are presented. Unfortunately, this was not always done in this volume. Thus, for amino acid analysis by microbiological assay and paper chromatography, references are given to papers published in 1943 and 1944 and to a review paper published in 1955. The chapter on enzyme development attempts to come to grips with such questions as what significance (biologically) one can attach to an increase or decrease in enzyme activity; is an increase in enzyme activity evidence of activation of an inactive precursor, or is it the result of *de novo* synthesis, for example.

The quality of the reproduction of figures and photographs varies greatly. The lettering and numbers of some figures are barely legible (compare Fig. 11, (*a*) and (*b*), p. 158); the electron micrographs reproduced on pages 219 to 221 are very poor and lack information on magnification; they contrast sharply with those on pages 450 to 453.

As one would expect in a relatively recent review on development, the invocation of the operon theory in terms of the genetic code, messenger RNA, regulation by induction and repression, and the like, is prominent throughout Chapter 8, "Biochemical mechanism of information transfer," and chapter 9, "Informational molecules and embryonic development" overlap to a large degree.

The difficulty of keeping the literature references up-to-date in the face of the considerable delay in publishing a volume such as this is again revealed in this book. Only a few references more recent than 1963 are cited. (Addenda are provided for chapts. 6 and 8 with references as recent as 1965.)

The volume will undoubtedly prove useful to a wide variety of readers, if for no other reason than that it provides a useful bibliography (up to 1963!) and identifies research efforts in a field which is attracting biochemically trained biologists and yielding exploitable biochemical concepts. Although the complexity of the challenge is made