conclusions, one may raise quite serious objections as to the validity of the instruments chosen to establish these results. For instance, many science teachers conceive of the laboratory as a quite appropriate place to teach scientific method, more appropriate in fact than the classroom lecture. Yet the author relies almost entirely on many aspects of teaching *except* the laboratory to discover his data. Stated purposes of teachers as to their important motives in attending AYI programs are probably given in the light of what they believe to be the purpose of AYI—usually given as subject matter. It is an interesting report, meticulous in detail and care, but, in this reviewer's opinion, laboring under invalid assumptions.

P. K.

BIOLOGICAL EDUCATION IN AMERICAN SECONDARY SCHOOLS 1890-1960, Paul DeHart Hurd, 263 pp., $4.75, Biological Sciences Curriculum Study Bulletin No. 1. American Institute of Biological Sciences, Washington, 1961.

In this book Professor Hurd has carefully summarized the history of biology teaching in the United States from the period 1890-1960. By collecting references and studies and synthesizing them into one concise volume, Hurd has provided a reference useful to educational historians, science curriculum workers, textbook writers and publishers, and the teacher who seeks a broad background on the history and current status of his profession. All of these will be indebted to Professor Hurd for this publication.

The first section deals with reports of curriculum committees and other groups interested in science teaching. Some of the early committee recommendations are cited, and it is alarming to note the similarity of these recommendations to the extant curricula in many high schools and colleges. It is alarming in that most biologists would agree that very substantive and significant advances have been made in biology in the past few decades which were not included in the 1890 curriculum! The curriculum of the 1890's was focused on the structure and taxonomy of plants and animals almost exclusively. While "modern" biology textbooks contain topics on heredity (usually with little reference to chromosomal structure or the nature of "gene" action) and some general physiology, the preoccupation in most popular books remains on the structure and taxonomy of plants and animals. If we define biology as that science in which biologists are engaged, the current textbooks resemble more closely the activities o fthe biology of 1890 than that of 1920 or 1940 to say nothing of the activities which characterize biology today! Since the textbook *defines* the curriculum in most biology classes, the aroused concern of practicing biologists as to what is taught in secondary schools (albeit, in colleges, too!) is not without foundation.

In Part II, Professor Hurd reports some of the more significant research studies in the area of biological education. Unfortunately, such shortcomings of these studies as poor sampling technique, lack of appropriate "controls" in "experiments," poor or inappropriate tests, and interpretive transgressions of the "research workers" were not pointed out. Admittedly, some of the "research workers" have been so naive that it is impossible to identify what the specific design, sample, or test was. In summary, as Hurd suggests, we have a vast frontier of research in biological education which is virtually untouched.

Many readers of *ABT* have been or will be engaged in curriculum planning, textbook selection, school plant and laboratory planning, and related activities. I would strongly recommend that this book be obtained and carefully read with "markers" in the many appropriate sections.

Joseph D. Novak
*Department of Biological Sciences*
*Purdue University*

THE PROCESS OF EDUCATION, Jerome S. Bruner, 97 pp., $2.75, Harvard University Press, Cambridge, 1961.

This book reports on a conference of scientists, scholars, and educators that was conducted under the sponsorship of the National Academy of Sciences at Woods Hole, Massachusetts, for the purpose of examining fundamental issues in the teaching of science and mathematics.

The central idea of *The Process of Education* is that teaching at all levels should be primarily concerned with what is termed the structure of a subject. This structure, as seen by Bruner, consists of the basic principles and concepts that tie together and relate various ideas, facts, and techniques. Bruner believes that the structure or foundations of a subject may be taught in some form to children at any age. He claims "that any idea can be represented honestly and usefully in the thought forms of children of school age, and that these first representations can later be made more powerful and precise the more easily by virtue of this early learning." For example, fourth-grade children can become absorbed in games governed by principles of topology and set theory, even discovering new "moves" or theorems.

Teaching the structure and foundations of science and mathematics as a central purpose of education suggests many things. For one, it would appear that it is of special importance for the teacher to have a thorough understanding of the structure of his subject as well as a knowledge of factual specifics. Ideally, the science and mathe-

matics teacher should be aware of cause and effect relationships, should be able to identify the basic principles and concepts of his subject, and should be thoroughly familiar with the knd of thinking that is involved in the discovery and use of knowledge.

Bruner's ideas suggest that science teachers must devote more time to teaching the nature of scientific thought. Also, he suggests that science and mathematics teaching should include more truly experimental laboratory work and should emphasize the inductive approach to learning. The author strongly implies that the teaching process must be directed away from the present emphasis on short-cuts, devices, recipes, and computational skills towards a more thorough, creative, and imaginative teaching of basic principles and concepts.

Bruner's report on the Woods Hole conference is a welcome and significant contribution to the teaching of science and mathematics. As stated in the preface of this book, science education is embarking on a new era of creative development. Basic to the process is an exposition of and commitment to a clear statement of the aims and purposes of school instruction. *The Process of Education* makes a thoughtful and worthy contribution towards this end.

Charles H. Heimler and
Elmer Eason
*San Fernando State College*
*Northridge, California*

## General

I Can Learn About Calculators and Computers, Raymond G. Kenyon, 112 pp., $2.95, Harper and Brothers, New York, 1961.

Written in a clear style, with large type, this book attempts to trace the history of the number system to modern calculator devices in an easy to understand way. Almost half the book is devoted to instructions for the construction of calculating devices, including the abacus and Napier's "bones." Since biology is rapidly becoming quantified, such elementary treatments will be valuable for both teacher and student.

Editor

Model Rockets for Beginners, H. H. Gilmore, 117 p., $2.50, Harper and Brothers, Publishers, New York, 1961.

There are enough diagrams to fill quite a few science fairs in this book. Written for the elementary and junior high school pupil, it is a compilation of diagrams and information concerning rockets with an eye to pupils constructing models —not working ones however.

P. K.