force, the nature of electricity, light, the atom, quanta, the nucleus, wave mechanics, complementarity, the chemical bond, mesons, and fields; next, he works up to the molecules of living systems, proteins, nucleic acids, DNA, RNA, and the origin of life and terminates with evolution and the emergence of man. A vast expanse of man's recent achievements is briefly scanned here, but the concepts are so clearly stated and so logically tied together that even the reader who is fully enlightened in these fields will enjoy the perspective and integration which the author achieves. Besides, one not familiar with these topics will probably derive little benefit from them. The book can only add, one may venture to say, insight and pleasure for students of science who need an inspiring overview of the terrain covered thus far on the shining frontiers of science, more or less in our own life span. The clarity with which well-known modern concepts are laid bare and related, with each other and with their historical antecedents, and the span of horizon covered, render the book worthwhile to any student of science, regardless of his specialization.

Its appearance as a paperback in the PSSC Science Series renders it possible for every student of science to add the book to his library; this he should quickly do, for it is a grand vision that he will gain, even if many of the facets are already known to him.

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Sigma Xi-RESA Lectures

Science in Progress. vol. 12. Wallace R. Brode, Ed. Yale University Press, New Haven, Conn., 1962. xii + 331 pp. Illus. $7.50.

For a quarter of a century it has been the privilege of scientists and of those interested in science to have available, at two-year intervals, excellent summary accounts of the progress of science. The Sigma Xi National Lectures, and more recently the Sigma Xi-RESA National Lectures, have appeared in the successive volumes of *Science in Progress*. Volume 12 in the series is edited by Wallace Brode and contains the lectures presented in 1959 and 1960. It maintains the high standards achieved by the previous volumes.

George C. Kennedy discusses the origin of continents, mountains, and oceans, and he concludes that older theories must be discarded in favor of the view of phase transition. A chemical contrast at the Mohorovicic discontinuity is considered unnecessary.

William J. Luyten outlines stellar evolution and presents evidence that white dwarfs are nearing the end of the line to obscurity and oblivion. The end of the road is the black dwarf, small and degenerate and no longer giving off light. It may well be that our own sun will some day follow this path.

John Verhoogen describes temperatures within the earth; he outlines earth's thermal history and supports Ringwood's theory of formation of the metallic core by chemical reduction of the original meteoritic matter.

Paul Delahay builds his lecture around the cultural aspects of science and discusses such areas as intellectual curiosity versus utilitarian ends, the ways of scientific research, and the evaluation of scientific achievement.

Harold G. Cassidy diagnoses the problem of ineffective communication between scientists and humanists and gives concrete examples. Cassidy then proceeds to offer a prescription for treating the underlying causes. Members of university communities may well take his prescription to heart.

R. F. Dawson discusses the technical problems of the biosynthesis of alkaloids, especially nicotine, from the universal metabolites nicotinic acid and ornithine, and points out their potential importance in elucidating unresolved areas of general biochemistry.

J. Herbert Taylor presents an excellent account of chromosome reproduction and discusses the possibilities of breaking the genetic code. The code has, of course, been broken since the lecture was delivered, but the lecture itself furnishes a fine groundwork for understanding the subsequent developments.

Emil Witschi reviews the extensive researches, including his own important contributions, on sex reversal in man and other animals.

Robert C. Elderfield presents an interesting account of the alkaloids of certain Australian trees and of their effects on blood pressure.

Ralph H. Wetmore provides a new approach to morphogenesis in plants; Wetmore recognizes that embryonic development does not proceed by a single rigid pattern, but that alternative orderly patterns may occur side by side within the same genetic milieu.

Harry F. Harlow reviews in considerable detail the development of learning in the rhesus monkey and concludes that the monkey possesses capacities far in excess of those of any animal below the level of primates.

The volume concludes with a discussion by Barnett F. Dodge of the problem of applied versus basic research. Dodge uses as his vehicle of discussion the production of fresh water from saline waters.

The volume as a whole is a most worthy addition to a set of excellent summaries of progress in scientific research.

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On Writing About Science

The Genetic Code. Isaac Asimov. Orion Press, New York, 1962. xiv + 173 pp. Illus. $3.95; New American Library, New York, 1963. 187 pp. Paper, 60¢.

The Human Body. Its structure and operation. Isaac Asimov. Houghton Mifflin, Boston, 1963. xii + 340 pp. Illus. $5.95.

Isaac Asimov is the Lenny Bernstein of scientists who write. Bernstein conducts, composes, amuses, and teaches. Asimov writes, both fact and fiction, and he has written for scientists, students, adults, and children, in nearly 50 books to date. And only heaven knows how he does it.

But however he does it, he does it beautifully. Both of these new books are popular science of a high caliber for intelligent nonscientists. For one important thing, Asimov writes a good sentence—a simple sentence. This goes a long way toward keeping the eye and mind of any good reader.

For another, both books are extremely well constructed and organized. They go from a start to a finish, without needless side trips or see-sawing. Many a noble effort fails mainly for lack of organization, which is hard work.

To the critic, *The Genetic Code* is the more interesting of these books, for the job of telling the citizen about molecular biology is one of the hardest that has faced science reporters. To the average person, the cell is even a greater mystery than the atom. With his simplicity and discipline, Asimov is at his best in expounding this subject's

chemistry, and in fitting one part of the story to another.

The book is not everything, however. It is short; sometimes it teases rather than satisfies. There is little mention in it of the people who have done the molecular unraveling; Asimov chooses brevity and the plain facts instead. Its last chapter, on the future and social implications, is just hurried.

Two lesser quibbles. Its typography is unfortunately poor: small type in narrow columns. Its illustration is undistinguished; and one would like to see each explanatory drawing fitted into the text where it belongs, rather than having to seek "Figure 23."

In attractive typography and in beauty and clarity of illustration, *The Human Body* is everything that—pity—*The Genetic Code* is not. It is a popular physiology at a simpler level than *The Genetic Code*; any intelligent reader might enjoy it; a junior high school student could understand it. It omits the nervous system;—this will be covered in a companion volume on the human brain.

As a science writer and a nonscientist, I hope more and more young scientists will soon join the Asimovs. John Fischer of *Harper's* recently quoted Loren Eiseley—who, according to Fischer, "wrote in secret, almost as a vice, for nearly 15 years"—as saying: "If I had let any of my colleagues know that I wrote for a general audience, or what they called a popular audience, it would have ruined me academically, and I would never have gotten ahead in my chosen profession." In these days!

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BIOLOGICAL AND MEDICAL SCIENCES

Toward a Modern Synthesis of Evolutionary Thought

Can the result of biochemical investigation provide significant insight into evolutionary processes?

Lynn H. Throckmorton and John L. Hubby

More than 20 years ago the largely independent investigations of systematists, mathematical biologists, and geneticists combined to produce the dynamic, synthetic approach to evolution. The power of this modern synthesis rested primarily upon the fact that it was founded broadly on many of the basic scientific disciplines. During the years since its inception, the Modern Synthesis and its sibling, the New Systematics, have made profound contributions to biological thought. Here, as has happened so often in the history of biology, conceptualization in one area has reached a culmination at almost precisely the time that new approaches, new methods, and new concepts were developing in other, apparently unrelated, areas. The study of evolution is again at a stage for transition. Recent advances in physiological genetics, comparative biochemistry, and developmental biology are providing wider insights and powerful tools which may potentially allow studies of evolutionary processes to be carried to even deeper levels. The modern synthesis of the early 1940's is no longer a truly modern synthesis in these formative years of the 60's. One of biology's fundamental disciplines, biochemistry, is missing. Two recent contributions to biological literature, Ernst Mayr's **Animal Species and Evolution** (Harvard University Press, Cambridge, Mass., 1963. 813 pp. Illus. $11.95) and Vernon Ingram's **The Hemoglobins in Genetics and Evolution** (Columbia University Press, New York, 1963. 192 pp. Illus. $6), lead us to hope that this deficiency will not persist indefinitely.

Major advances are often heralded by the appearance of a lucid, thorough, and authoritative summation of the current status of a field of study. This should be particularly true in a field as complex as the study of evolution, and we are indeed fortunate that Mayr's superb resynthesis appears at such an opportune time. As a leading spokesman, both for the Modern Synthesis and for the New Systematics, Ernst Mayr is uniquely suited for the task of documenting and evaluating our progress toward an understanding of evolutionary processes. Realizing that evolutionary biology has become too vast a field to be covered in a single volume, he has restricted his discussion to only those aspects that involve the species. Basically, he has taken concepts from developmental and population genetics and utilized these theoretical considerations to evaluate and interpret a massive amount of data from a wide variety of disciplines. Quite rightly, he does not develop the mathematical bases for population genetic theory or document the experimental evidence from developmental genetics. These areas are well covered in the recent literature. However, and this is one of the outstanding features of his work, he does document and discuss the pertinent information available from the areas of systematics, ecology, evolutionary genetics, and behavior. The coverage, while encyclopedic, is far from a mere catalog of existing data. A presentation of new concepts is combined with a discussion of those replaced, new ideas are defended as older ones are refuted, and the needed exploitation of current avenues of approach is emphasized while future potentialities are suggested. The documentation required to substantiate or support each assertion, conclusion, or argument is smoothly interwoven with the discussion, and the result is an eminently readable and thoroughly absorbing description of one of the most fascinating areas of biological investigation.

It is virtually impossible to do justice to a work of this scope and detail in

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