# ADVANCED BIOLOGY

WHEAT
AND
FITZPATRICK

*(Frontispiece)* *American Museum of Natural History*

The entire world is the laboratory of the biologist. Field excursions are made both to the jungles and to the deserts. Roy Chapman Andrews, shown in the center of the picture, is an eminent scientist interested in the biology of yesterday. He has gone to the Gobi desert of Mongolia and unearthed the remains of some of the giant reptiles and mammals that lived there millions of years ago. The reptile eggs shown on page **306** and the restorations shown on pages **378**–**379** are material and data gathered by this field worker.

# ADVANCED BIOLOGY

BY

FRANK M. WHEAT

Chairman, Department of Biology,
George Washington High School, New York
Instructor in Biology, New York University

AND

ELIZABETH T. FITZPATRICK

Chairman, Department of Health Education,
George Washington High School, New York

AMERICAN BOOK COMPANY

NEW YORK CINCINNATI CHICAGO
BOSTON ATLANTA

AD. BIO. WH. AND FITZ.

W.P. 3

MADE IN U.S.A

DEDICATED TO TWO SUCCESSFUL PIONEERS
IN BIOLOGY TEXTBOOK MAKING

GEORGE W. HUNTER
AND
JAMES E. PEABODY

FROM WHOM THE AUTHORS OF THIS BOOK
RECEIVED THEIR EARLY TRAINING
AND INSPIRATION

# PREFACE

Most adolescent boys and girls are more interested in themselves than in abstract problems. Although colleges emphasize mathematics and languages in their entrance requirements and say little about science, there has been a rapid growth in the number of sciences elected in the high schools. This is primarily due to the realization that science is more a part of the lives of pupils than other school subjects and an answer to more of their questions. Youth is more interested in making direct observations and reasoning from them than in abstract thinking. There is a concerted effort to ascertain the truth about phenomena and to find out how and why things happen. Science teaches a valid method of interpreting evidence and helps one to arrive at logical conclusions.

In most secondary schools throughout the country elementary biology or general science is taught in the first or second year. There has been a growing demand for an advanced course in general biology to follow the elementary science course. This text has been written primarily to fill this need. The emphasis of the book is on problems relating to human welfare. The origin and principles of the development, structure, and functions of plants and lower animals are introduced mainly as a background for the proper understanding of human problems.

An interesting and novel feature of the text is the historical treatment of many of the subjects, which gives the pupil a bird's-eye view of the entire subject without overwhelming him with unrelated facts. Teaching material is given at the end of each chapter, designed to help the pupil in organizing, in his own mind, the important principles discussed. The list of supplementary readings offers the pupil sources of information other than the text. All the laboratory problems necessary for a thorough

understanding and mastery of the subject are included. These problems are usually given at the beginning of the chapters, so that the pupil may find out for himself many of the facts given later in the text. The pupil can exercise here the true scientific method: examination, observation, and confirmation of his findings.

The plan of presenting the subject matter is based on the prac tical experience in teaching this course for several years to high school pupils by means of mimeographed lesson sheets prepared by various members of the Biology Department of the George Washington High School, New York, N. Y. Changes in these sheets have been made, but much of the material has been elaborated into the present text. The enthusiasm of the Biology Department in the George Washington High School is due largely to the inspiration and support of Harold S. Campbell, Associate Superintendent of the New York high schools. In his annual report of 1928 he included the report of the District Superintendent of High Schools, Dr. John L. Tildsley. In this report, Dr. Tildsley summarized the objectives of science teaching and said:

"These objectives call for the creation of a more magnificent self. They call for the expanding of the element of appreciation, the kindling of imagination, the arousing of the sense of admiration and wonder, the excitation of the emotions, the development of the power of accurate observation, the desire for truth, courage to follow the truth, and above all, the setting forth of science as a 'way of life.'"

The authors hope this text will open this broader "way of life" and inspire pupils to think and to act magnificently.

Thanks are due the Biological Supply Co., New York, for the use of photomicrographs prepared by Mr. Roy M. Allen, and also to Miss Marjorie Fitzpatrick, Mr. Charles Inman, and Mr. Paul B. Mann of New York city high schools, Prof. Ralph Cheney of Long Island University, and Miss Ada Weckel of Oak Park, Illinois, high school, for their critical reading of the manuscript.

# CONTENTS

*Underwood and Underwood*

**Col. Charles Lindbergh.**

# CHAPTER I

# THE BIOLOGY OF TO-MORROW

*Underwood and Underwood*

**Guglielmo Marconi.**

At no time in the history of the world have the layman and the scholar turned to the field of science for inspiration and help as in the present age. We are all becoming more scientific-minded. Man is leaving behind him the era of superstition and romanticism and is seeking the truth in the light of science. Almost daily a miracle happens — a discovery that thrills the world with its tremendous import. Newspapers and periodicals devote column after column to scientific matters, and even the writers of drama and fiction go to science for plots. People discuss present-day science as they once discussed literature.

**The age of science.** Do you recall how interested and excited you were over the proposed New York to Paris flight of Charles Lindbergh? The entire nation followed the preparations and the performance of the fearless and skillful lone pilot. All marveled at the tiny monoplane with its speedy Wright whirlwind motor. Nations rejoiced in the success of the experiment, and almost overnight practically all people developed an interest in aviation. They became air-minded. Since that time great progress has been made in aviation, and travel by air over certain routes has become so safe that few hesitate to sponsor this method of transportation.

Not only in aviation, but in radio, color photography, and

television, experiments have been made and are followed with intelligence and eagerness by great numbers of people. The radio

*Ewing Galloway*

Many of the problems of science are solved in the laboratory.

has brought the people of our nation together again and again. In our own homes, by a turn of the dial, we take part in great public gatherings miles away, enjoy a symphony, or listen to the World Series baseball games. The transmission of the human voice and of instrumental music through miles of space is now accomplished, with very little distortion. The reception of light waves, bringing movies into every home, is a development of to-morrow.

There is as wide an interest in the subject matter of biology as in other fields. The history of many scientific experiments and investigations has been so wide spread that there is hardly a school boy or girl who does not know the story of the control of malaria and smallpox. The dramatic death of Hideyo Noguchi, of the Rockefeller Institute, occurred at the culmination of years

of work on yellow fever. Through his experiments, he revealed to the entire world the painstaking methods characteristic of a true scientist as well as the fearless persistence of a martyr.

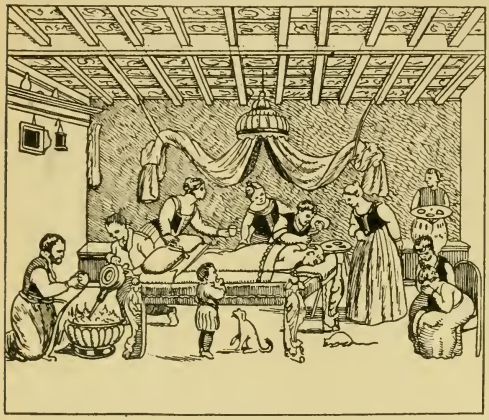
Noguchi had solved the problem of yellow fever in South America, but the facts he found in that country did not seem to hold true for the African type of the disease. He, therefore, journeyed to Africa to make further studies. He contracted the disease and died before completing his work. He is one of the heroes of to-day.

**What of yesterday?** Consider the strides surgery has made since the early days of this science. For generations the chief medical and surgical treatments were sweating, bleeding, and amputations. In the Lewis and Clark expedition in 1804, one of the men became ill. Captain Clark described the treatment given him. A big hole was dug in the ground and a fire was built in it, in order to make the ground hot. Then the fire was removed and the man was laid on the hot earth and securely covered so that he would sweat. After this treatment he was bled. Not having any other knife, Captain Clark used his pocket penknife to open the blood vessel. Needless to say, the man died. Among primitive people of to-day similar methods are still in vogue. The medicine man in a certain primitive tribe still places people in holes heated to high temperatures, to sweat them. If a member of the tribe suffers from chronic headaches, the medicine man cuts a piece out of the sufferer's skull.

Physicians of yesterday practiced bleeding for many ailments.

In civilized communities, surgery, as a scientific study, began with the hypothesis of Louis Pasteur, about 1860, that disease was usually due to the presence of microörganisms. Realizing that most of the surgical cases died from infections rather than the actual

operation, Sir Joseph Lister (1827–1912) studied the work of Pasteur. Up to this time pus was always considered the necessary accompaniment of all wounds. Lister decided that germs must enter the wound from the air, from surgical instruments, or from other outside agencies. Thereafter, when operating, he used what he called antiseptics to kill the germs. He attempted to destroy the germs in the air by spraying the air of the operating room with a carbolic acid solution. He then protected the wound as much as possible from contact with the air. All his instruments were subjected to the most careful antiseptic treatments. He taught his principles of antiseptic surgery to the surgeons of France. The Franco-German War broke out in 1870. It occurred to no one in France, in the first battles, to apply the new method of antiseptic surgery. In consequence, hundreds and thousands of wounded soldiers succumbed to gangrene and septicaemia, types of blood poisoning. Then doctors all over the world adopted antiseptic surgery. Infections which formerly followed many operations practically disappeared. Before Lister's time 70 per cent of all compound fractures resulted in death, and about 50 per cent of all major operations were fatal. After Lister's antiseptic methods were introduced these percentages were greatly reduced.



An old print shows that headache was treated by removing a portion of the skull.

**What of to-day?** The most modern method of surgery is aseptic surgery. Germs are controlled by killing them with dry heat

rather than antiseptics. It is now known that the entrance of germs into wounds is due to contaminated instruments or hands rather than to air. If the hands of the doctor and the body of the patient are washed with antiseptics and the instruments are thoroughly sterilized, there is very little chance of contamination from the air. The spraying of antiseptics in the air is no longer done. To-day, less than one per cent of the patients subjected to operation for compound fractures die.

Many of the mistakes of yesterday prevail even to-day. Along with pure science come the pseudo-sciences. For example, people were taught that definite areas of the brain controlled definite mental activities like motor control, vision, and judgment. Immediately the pseudo-science, phrenology, came into being. Phrenologists examined the various bumps on the head and claimed that these were related to the development of areas of the brain. They argued that success in selling, teaching, or executive ability could be predicted if the proper irregularities were present on the person's skull. But, through many years of observation and experimentation, it has been conclusively proved that the irregularities in the skull do not necessarily follow brain irregularities. With the invention of the radio and television came a revival in the belief in telepathy and spiritualism.

*Underwood and Underwood*

**Nurses who use antiseptic measures save as many lives as do doctors.**

Interest in diets has led to fads in foods. People were told raw foods supplied vitamins. Some people began to eat nothing but raw foods such as nuts, fruits, and vegetables. Yeast was found beneficial in supplying a certain vitamin, and was at once accepted, by some, as panacea for all ills.