One may question whether many biologists will be convinced that the "two specific categories of vital factors, the organizatory and the mental" (p. 394), which the author believes must be recognized, are real in the sense in which he conceives them, can be helpful in researches of the kind they carry on. What help, for example, could any working botanist or anatomist or biochemist get from entelechies (the Drieschian form which Eldridge adopts after subjecting them to rather radical revision) when they are presented to him in this way: "Must not our entelechies, like the chemists, have been limited in the beginning by the incompleteness of their knowledge, a knowledge, however, which has been extended through their efforts to utilize matter?" (p. 426).

This almost sounds as though an embryologist or psychologist, when in the course of a research he comes upon a particular knotty point, might go to his telephone and call in the entelechy that is a specialist in the field where his trouble lies.

But I reiterate that despite the meager value to biology of the positive results reached by Eldridge in this book, he has yet performed an important service to the science if only students in this realm of natural knowledge will take it for what it is essentially, namely, a critical study of certain of the logical processes and philosophical implications necessarily involved in some of the main subdivisions of that realm. For while this is an aspect of biology which can not be escaped finally by biologists themselves, they have so long tried either to ignore it or have treated it so skimpily or lightly that the science is now suffering grievously thereby.

It is good to note that Professor H. S. Jennings, who writes a brief introduction to the book, appraised it in much the same way that we do. So it may be hoped that the work will contribute substantially to putting biology on a broader and more intelligently critical basis than it is now on or ever has been on.

WILLIAM E. RITTER

SCIENCE SERVICE,
WASHINGTON, D. C.

SPECIAL ARTICLES

SOME PROBLEMS WHICH MAY BE STUDIED BY OXYGENATION

DURING my studies on the effect of oxygen under pressure on protozoa, bacteria, molds and yeasts, I have thought of many problems which might be attacked by means of oxygenation, and, since it is impossible for me to investigate most of them, I have decided to list them, together with brief comments, and pass them on to others for whatever they may be worth. No doubt many of the problems and suggestions when investigated will prove to be of no value whatever, but, I believe, some of them will.

A. PROBLEMS OF IMMEDIATE ECONOMIC IMPORTANCE

(1) *Protozoan parasites of the silkworm and other insects:* It is an important and difficult problem to keep silkworms free of protozoa of the genus *Nosema.* It is quite possible that by confining either eggs or cocoons of the silkworm in oxygen under pressure that this protozoan menace to the silk industry may be entirely got rid of. Similar protozoa occur in other insects; for instance, the honey-bee. They may be killed by oxygenation and without injury to their hosts.

(2) *Protozoan parasites of fishes:* More than three hundred species of microsporidia, one or more species of the flagellate genus *Hexamitus,* species of two ciliate genera, *Ichthyopthirius* and *Chilodon,* and other protozoa, are known to be parasitic on fishes. Some of these protozoa are pathogenic and do damage to fish, causing great losses to the fish industry, and *Ichthyopthirius* produces a disease which makes it a menace to fancy fish dealers and owners. It is known that *Hexamitus* may be killed by oxygenation and without the slightest injury to its hosts. Perhaps the other protozoan parasites of fishes will be killed in the same way.

(3) *Other parasites of fishes:* Trematodes and molds do considerable harm to fish. The ectoparasitic trematode *Gyrodactylus* and the mold *Saprolegnia* would be good examples to begin with in a study of the effect of oxygenation on the trematodes and molds of fishes.

(4) *Protozoa of plants:* Milkweeds harbor many flagellate protozoa of the genus *Herpetomonas,* but the means by which these protozoa are transferred from one plant to another is unknown. Protozoa morphologically identical to those in the milkweeds are found in abundance in the gut of insects (*Oncopeltus*) living on and near the infected plants. It has been impossible so far to determine whether the protozoa in insects and milkweeds are the same organisms or not. The insects may or may not transmit the protozoa from plant to plant. It has been impossible to get suitably uninfected plants and insects with which to carry out experiments.

Of course uninfected plants can be found easily, but such plants may not be susceptible to infection. There are also other difficulties, but by oxygenating plants and insects, thus freeing both hosts of protozoa (as oxygenation will probably do), it seems to me that many if not all difficulties of the problem—Are the protozoa transferred from plant to plant by means of these insects?—would be greatly if not entirely removed; for clean and undoubtedly susceptible plant and animal hosts could thus be obtained.

It has been reported that flagellates producing a disease in plants may, after passage through an invertebrate (insect) and a vertebrate host (lizard), acquire pathogenic properties for a mammal. Oxygenation will perhaps give us uninfected but susceptible hosts to work with, which will enable us to determine beyond question the possible method or methods of infection in nature.

(5) *Insect-transmission of protozoa:* The rôle which many insects are able to play in the transmission of protozoa may very probably be worked out beyond question by confining the insect hosts in oxygen under pressure, because the oxygen, according to many experiments already completed, is much more toxic for protozoa in insects than for the insects themselves. There are a large number of problems which may be attacked by any method which will give us protozoa-free insects to experiment with.

(6) *Virus diseases of plants:* A number of bodies, some of which simulate protozoa in appearance, have been found associated with various plant diseases. The nature of most of these bodies is unknown. If they are protozoa, they should be removed by oxygenating the plants in which they occur. If they can be removed without injury to the plants, it will be possible to determine whether or not they are disease-producing agents. The method of transmission of the disease-producing agent might also be determined.

(7) *Immunity:* Protozoa, and perhaps other organisms, when killed by subjecting them to oxygen under pressure, may be used in the immunization of animals in a manner similar to that in which heat-killed bacteria are used.

(8) *Infested nuts and grain:* By confining insect-infested nuts and grains in oxygen under pressure it is possible to destroy the insects without injury to the nuts and grains. Can this be carried out profitably on a large scale? Can fungus-infested grains be treated in the same manner?

(9) *Sterilization of culture media:* It may be possible by oxygenation to sterilize culture media containing ingredients which can not be sterilized by heat without being greatly changed; if so, certain microorganisms which have not been cultivated on artificial media may be cultivated, and some that have been cultivated with great difficulty may be cultivated more easily.

By oxygenation it may also be possible to sterilize many liquids without changing them greatly, if at all. It may be possible without sterilization to store and preserve liquids under oxygen pressure.

B. PROBLEMS OF GENERAL BIOLOGICAL IMPORTANCE

(1) *The specificity of protozoan parasites:* It is practically certain that all intestinal flagellates and ciliates may be removed by oxygenation from all invertebrates and cold-blooded vertebrates without injury to these animals, and it is possible that other protozoa may be removed from these animals in the same way. If so, it will then be possible by cross infection experiments to determine the host specificity of many closely related and often morphologically indistinguishable protozoa, which hitherto has been impossible because of the lack of a reliable method of obtaining protozoa-free animals to experiment with.

(2) *Partial protozoal defaunation:* The fact that different protozoa in the same host are almost invariably affected differently by oxygenation, that is, have differential death points with a fairly large margin between each point, makes it possible to remove certain kinds of protozoa and then note how this affects those remaining. It will now be possible not only to work out the relation of protozoa to their hosts, but also the relation of the protozoa to each other. How does the presence of one protozoon inhibit the multiplication of another beyond a certain point? There is an inhibition of some kind going on, for, when the inhibiting protozoon is removed, the inhibited protozoon multiplies out of all proportion to what it formerly did.

(3) *The relation of protozoa and other microorganisms to their animal and plant hosts:* The interrelation of host and parasite is an important problem both from the biological and medical standpoint, but it has been little investigated, owing chiefly perhaps to the number of difficulties encountered. For instance, many insects are said to be aided in the digestion of their food by many different kinds of microorganisms, but in most cases we do not know how if at all the microorganisms aid their insect hosts or partners. Many of the so-called examples of symbiosis should be reinvestigated: for instance, zoochlorella and fresh-water animals and zooxanthella and many marine animals (protozoa, sponges, coelenterates, ctenophores, rotifers, bryozoa, turbellaria, annelids, molluscs), insects and intestinal yeasts, insects (Blattidae, Lecaniinae, Coccinae, Aphids, Icerya, Cicada, Aphrophora, Orthezia, Pediculidae, and others) and intracellular yeasts and bacteria, Mycorhiza and various plants, root-nodules and leguminous plants, and, finally, lichens.

Such structures as mycetocytes, bacteriocytes and mycetomes of insects may be the survival of profound pathological changes. If we can learn the origin, function and relation of these structures and the organisms in them to insects, a great deal will be added to our much too meager information concerning the origin of commensalism, symbiosis and immunity. Here is a relatively virgin field of investigation, bristling with hundreds of different problems. Will oxygenation help in solving some of them?

L. R. CLEVELAND
DEPARTMENT OF TROPICAL MEDICINE,
HARVARD UNIVERSITY MEDICAL SCHOOL

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF AMERICA

THE thirty-eighth annual meeting of the Geological Society of America was held at Yale University, New Haven, Connecticut, December 28 to 30, 1925. One hundred and forty-eight fellows of the society, and one hundred and ninety-five members of affiliated societies and visitors were in attendance. Sixty-five papers were presented covering all the major branches of the science.

The following officers were elected for the year 1926:

President: Andrew C. Lawson, University of California.
Vice-Presidents: Heinrich Ries, Cornell University; Lewis G. Westgate, Ohio Wesleyan University; Stuart Weller, University of Chicago; Waldemar T. Schaller, U. S. Geological Survey.
Secretary: Charles P. Berkey, Columbia University.
Treasurer: Edward B. Mathews, Johns Hopkins University.
Editor: Joseph Stanley-Brown, New York City.
Councilors (1926–1928): Nelson H. Darton, U. S. Geological Survey; George H. Ashley, Pennsylvania State Geological Survey.

The following two representatives to the National Research Council were elected to serve from July 1, 1926, to June 30, 1928:

K. C. Heald, Pittsburgh, Pa.
Frank F. Grout, University of Minnesota.

Thirteen new fellows were elected, and three foreign correspondents.

THE MINERALOGICAL SOCIETY OF AMERICA

THE sixth annual meeting of the Mineralogical Society of America was held at Yale University, New Haven, Connecticut, on December 28, 29, 30, 1925, in conjunction with the Geological Society of America. Thirty papers were presented. The following officers were elected:

Honorary President: Edward S. Dana, Yale University, New Haven, Connecticut.
President: Waldemar T. Schaller, U. S. Geological Survey, Washington, D. C.
Vice-President: George Vaux, Jr., Bryn Mawr, Pennsylvania.
Secretary: Frank R. Van Horn, Case School of Applied Science, Cleveland, Ohio.
Treasurer: Alexander H. Phillips, Princeton University, Princeton, New Jersey.
Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.
Councilor (1925–1929): W. A. Tarr, University of Missouri, Columbia, Missouri.

THE INDIANA ACADEMY OF SCIENCE

THE Indiana Academy of Science held its forty-first annual meeting at the Indiana State Normal School and Rose Polytechnic Institute, Terre Haute, Indiana, on December 3, 4 and 5, 1925. The officers of this meeting were as follows: E. R. Cumings, Indiana University, *president;* Charles Stoltz, South Bend, *vice-president;* Flora Anderson, Indiana University, *secretary;* J. B. Dutcher, Indiana University, *assistant secretary;* William M. Blanchard, DePauw University, *treasurer,* and J. J. Davis, Purdue University, *editor.*

At the general and sectional meetings more than eighty papers were read.

After the academy dinner in honor of the charter members the annual public lecture was given in Normal Hall by Dr. H. C. Cowles, professor of botany, University of Chicago. The title of Dr. Cowles's illustrated address was "Some Features of the Indiana Flora." This lecture was well attended by the citizens of Terre Haute.

The most important action taken by the academy at its business meetings was the affiliation with the American Association for the Advancement of Science. Dr. H. E. Enders, of Purdue University, was chosen to represent the academy at the Kansas City meetings.

The officers elected for the year 1926 were; William M. Blanchard, DePauw University, Greencastle, *president;* L. J. Rettger, Indiana State Normal School, Terre Haute, *vice-president;* Ray C. Friesner, Butler College, Indianapolis, *secretary;* W. P. Morgan, Indiana Central College, Indianapolis, *assistant secretary;* C. M. Smith, Purdue University, West Lafayette, *treasurer,* and J. J. Davis, Purdue University, *editor.*

On the day preceding the regular meetings of the academy, those interested in entomology held their annual informal meeting and discussed the scientific and economic phases of the subject on which each was working.

HARRY F. DIETZ,
Press Secretary